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SOCLIMPACT

Downscaling climate impacts and decarbonisation pathways in EU islands, and enhancing socioeconomic and non-market evaluation of Climate Change for Europe, for 2050 and beyond

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Work Package 7:

Deliverable 7.3.

Workshop Reports

This is a result of Tasks 7.3 - Engage islands' stakeholders in the design of alternative pathways.

This deliverable will include the agendas, the list of participants, and the workshops outputs including the decisions taken.

Coordinated by FCIENCIAS.ID (Ricardo Coelho; Tiago Capela Lourenço; Hugo P. Costa; Andreia Sousa)

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D7.3 Workshops report_ FINAL	28/12/2020	FC.ID & IFP	Version ready for approval by the Project Officer

According to the quality review:

A summary paragraph/chapter will be developed in D7.4.

Its content and results correspond to the deliverable's description indicated in the Grant Agreement.

1 Introduction

This document presents the results of the **SOCLIMPACT Adaptation Pathways** consultation process for each of the Islands and the description of the used methods and materials which were adjusted and created for this task. This process is included in SOCLIMPACT Task 7.3 - Engage islands' stakeholders in the design of alternative pathways. In accordance with the project Description of Action these workshops used the background material prepared in Task 7.2/D7.2, which includes the main results from previous WPs for each Island.

This report includes in its annexes the **Regional Workshops Reports** for each island which gather the key outputs of the online workshop materials, namely: (1) decisions taken; (2) agendas and (3) list of participants.

2 Methodological framework for SOCLIMPACT Regional Workshops

2.1 Objectives

The methods and materials used are part of a stakeholders' consultation process to design a downscaled participative and evidence-based adaptation policy. For the consultation process, the following **objectives** were set:

1. **Identify and present the characterized packages of adaptation and risk management options** available for each archipelago/island.
2. **Develop detailed archipelago/island integrated adaptation pathways**, in three timeframes: Short term (up to 2030), Mid-century (up to 2050) and End-century (up to 2100).
3. **Evaluate** and rank pathways for Blue Economy sectors.

To achieve these objectives a set of **four milestones** (or steps) were developed (before the Covid-19 pandemic context) to engage stakeholders in a **workshop**. These **milestones** were developed for and communicated to the **IFPs (Island Focal Points)** who would later explore these methods and materials (both developed by Task 7.3) in a workshop with the **LWG (Local Working Groups)**, as follows:

1. **Contextualisation:** Major current and projected climate hazards and sector-associated climate vulnerabilities and risks were to be presented and discussed from the archipelago/islands perspective. Likewise, a predefined set of sector-specific adaptation options/measures were presented and discussed.
2. **Adaptation Pathways design method:** The design of the pathways is based on the concept of Adaptation Policy Trajectories (APTs) (see explanation below). Individual scenario narratives for the archipelago/island, as well as the materials and the general process of pathway design were to be introduced and explained to the participants.
3. **Developing Sector Adaptation Pathways:** Participants were to be given the opportunity to contribute to the design of their island pathways working on break out groups (one per sector) with the assistance of a sector moderator and the IPF team.
4. **Enriching analysis of Sector Adaptation Pathways:** Using a plenary session, each sector (by the moderator or designated participant) was to present its pathway. The pathways were to be collectively discussed to identify cross-sector win-win situations (i.e., actions that would yield positive adaptation across some or all the sectors) and, when possible, a their decarbonization performance (i.e., assess how each pathway will measure to address decarbonisation targets for the region).

Adjustments were made on how these **milestones** are to be met because of the Covid-19 pandemic context which was tackled by T7.3 using the contingency plan developed below.

2.2 Covid-19 contingent Plan

With the health and travel limitations due to **Covid-19** pandemic, changes had to made to the original plan. Partners decided to develop two shorter **online webinars** mixed with an intermediate online survey stage and results processing. The consultation process was therefore split into two online two-hour **webinars** instead of the original plan of holding one presential full day workshop in each archipelago. The rationale was to make it as easier as possible for both **IFPs** and **LWGs** (stakeholders) to carry out the proposed work, without seriously compromising the **scientific quality** of the projects' outcomes. Overall, considering the new state of **confinement** and **future uncertainty,** a set of **robust, approachable, and pragmatic solutions** were put in place. Such was the case with the development of the **online survey tool** based on an Excel file containing links to the findings section of the SOCLIMPACT website for the background material.

A set of 24 adaptation options per sector (96 in total) were developed for each of the 12 classes (chapter 2.4.2) of the APTs. Furthermore, up to six additional adaptation options per island and per sector could be added by the LWG (class of adaptation "Local Knowledge"). All measures were characterized by each of the IFP using the five criteria defined (Table 3, chapter 2.5), with the option of consulting with their stakeholders before the first webinar.

The stakeholder's involvement process was based in the "**Online SOCLIMPACT Regional Workshops:** co-developing Sector Adaptation Pathways" guidance which was shared and validated by the IFP partners during the preparatory procedure restarted in June 2020**.** Nevertheless, each webinar considered the specific requirements of each archipelago/island and the resources available to each IFP partners. Therefore, the **framework** described hereafter was adapted by each IFP (see island report put in chapter 1.3 or Islands Reports) to serve specific interests and needs of their archipelago/island stakeholders and sectors.

The whale watching case study followed the defined methodological framework and the COVID-19 contingency plan proposed for the remaining sectors in the project. However, due to the specificity of the case study, the stakeholders involved, and the tailor-made background material developed for the Macaronesia region results will be presented and discussed in a dedicated workshop. In this workshop, planned for March 2021, the development of adaptation pathways will be carried out.

2.3 Online Workshop framework for IFPs

2.3.1 Steps for the consultation process and pathways design

The Covid-19 contingency plan reset the workshop framework for IFPs where which preparations had started at the start of the pandemic (in the beginning of March 2020). A new IFP preparation procedure restarted in late June 2020 with the presentation of a new online workshop framework using an online survey tool with links to the project's website.

A sequence of four steps was devised for this new Online Workshop framework to pursue T7.3 **objectives** and its original **milestones**, to the best of the partners abilities, as follows bellow:

Step 1 – Presenting SOCLIMPACT and Sector Adaptation Pathways design process.

Step 1a – Select the sectors and choose a date/time for a 2-hours **webinar**.

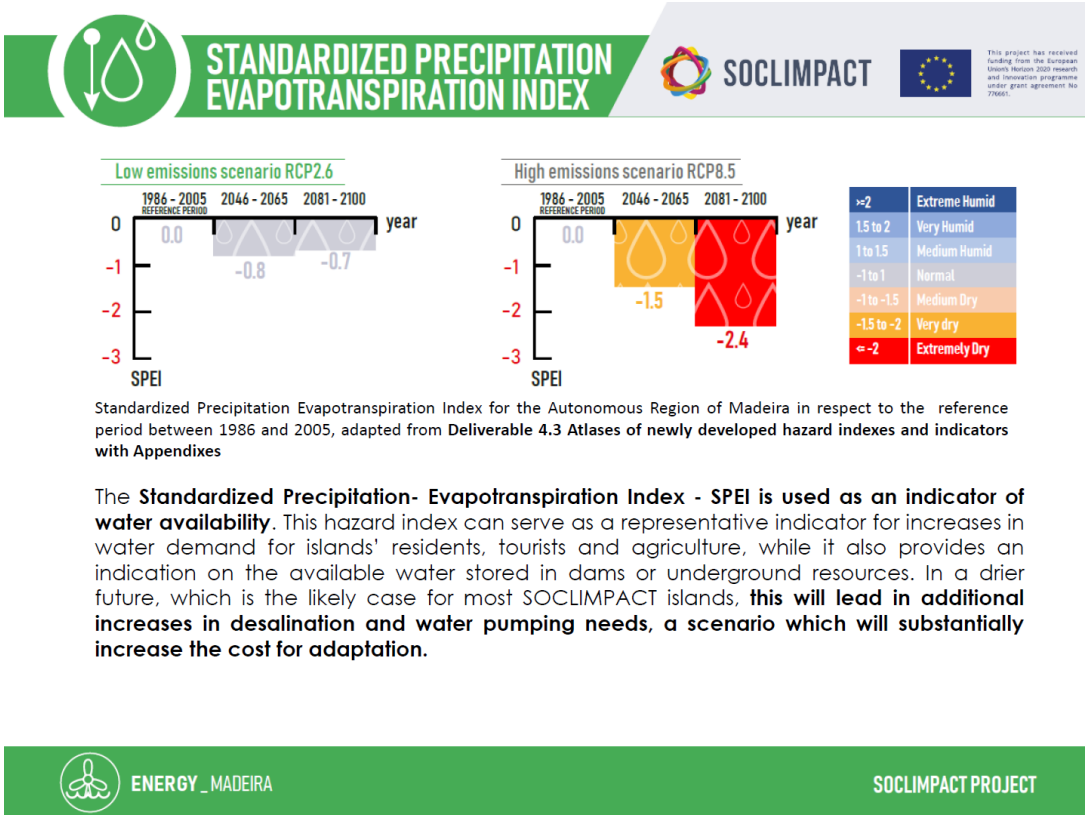
Step 1b – Select stakeholders (of the LWG) and send invitations explaining the **online process** for the **adaptation pathway design** and inviting them to the **first webinar**.

Step 1c – Preparing the '**Sector Adaptation Pathways - Online Survey Tool**':

- Before the first webinar, as a standard **procedure**, complete the **Adaptation Options** sheet for each selected sector, by providing local knowledge measures/options (six additional measures that IFPs can include per island) and making the **characterization** of all measures (giving criteria points that range from one to four, see chapter 0).
- Before the **first webinar,** as an alternative **procedure**, there is the option to include stakeholders in the completion of the Adaptation Options sheet. This is an alternate step managed by each IFP. This means stakeholders will be engaged by IFPs to provide their input regarding local knowledge measures and the evaluation of all sector measures using the **characterization** criteria (in the adaptation options tab). In this alternative, this step should also happen before the **first webinar**. This guarantees that the contribution of a given stakeholder is available to all other stakeholders when they are choosing the **adaptation pathways** in the next step.
- Due to time restrictions, we advise for the standard **procedure** as it is safer and easier to manage by IFPs. However, some IFPs may prefer to use the alternative **procedure** specially if they have resources available, a reduced number of stakeholders or they want to enrich stakeholder input.
- IFPs should also check the background material which was prepared for their island by WP8 and the links to projects website.
- Having this in hand IFP can proceed to the **first webinar** with stakeholders, which is the next Step.

Step 1d – Host a 2-hours webinar (using an online tool selected by IFP) with the following agenda:

- Welcome and housekeeping.
- Introduction to SOCLIMPACT project and their importance for the design of **Sector Adaptation Pathways,** both at the local level and for the outcome of the project defining a **European Adaptation Policy for the islands**
- Overview of key **climate change risks** to the **Blue Economy** of the archipelago/island presenting:
    - What is included in the background material that derived from D7.2 See example in Figure 1.
    - Other sources that IFPs consider relevant for stakeholders to have.
- Introduction to the general process for the **online design of Sector Adaptation Pathways** and associated timeline
- Explain to stakeholders how they will individually use the **Online Survey Tool** for the **Sector Adaptation Pathways**
- Q&A session
- Next steps and closing



Standardized Precipitation Evapotranspiration Index for the Autonomous Region of Madeira in respect to the reference period between 1986 and 2005, adapted from **Deliverable 4.3 Atlases of newly developed hazard indexes and indicators with Appendixes**

The **Standardized Precipitation- Evapotranspiration Index - SPEI is used as an indicator of water availability**. This hazard index can serve as a representative indicator for increases in water demand for islands' residents, tourists and agriculture, while it also provides an indication on the available water stored in dams or underground resources. In a drier future, which is the likely case for most SOCLIMPACT islands, **this will lead in additional increases in desalination and water pumping needs, a scenario which will substantially increase the cost for adaptation.**

Figure 1 - Example of a water scarcity indicator slide presented by Madeira in their first webinar (step 1d) containing an infographic prepared by WP8 from D7.2

Step 2 – Design Sector Adaptation Pathways

Step 2a – After the first webinar, send the island excel file of each sector ('Sector Adaptation Pathways - online survey tool') to each individual stakeholder. This file should contain the characterization of measures prepared in a previous step.

Step 2b – Support stakeholders while responding to the online survey (suggestion: 10 days for filling in the survey).

Step 2c – Send the individual stakeholder files to WP7 leader (FCiências.ID) for an information check and processing of results (results provided before 10 have passed from file receival).

Step2d – Get the survey results and Sector Adaptation Pathways to prepare for the second webinar

Step 3 – Presenting survey results and Sector Adaptation Pathways

Step 3a – Invite stakeholders (LWG) to the **second webinar** (due to happen about 20 days after the first webinar)

Step 3b – Host a 2-hour **second webinar** (about 20 days after the first webinar) with the following agenda:

- Welcome and housekeeping.
- Recall results from **first webinar** and **online survey process.**
- Presentation of archipelago/island **Sector Adaptation Pathways**
- Cross-sectoral discussion on pathways and (when possible) with a decarbonization performance and a Covid-19 discussion [1]

[1] Only presented in the Regional Workshop Reports for some Islands

- Next steps and closing

Step 4 – Analysing data, compiling results, and sending final feedback to stakeholders.

Step 4a – Evaluate and rank final **Sector Adaptation Pathways** for each archipelago/island and for European Islands as a whole, considering the results of the online survey and the second webinar.

Step 4b – Write the Workshop Island Report for the two webinars, the evaluation, and the pathway ranking.

Step 4c - Send back the report to stakeholders along with a process evaluation.

The hole framework process can be encapsulated by the following scheme.

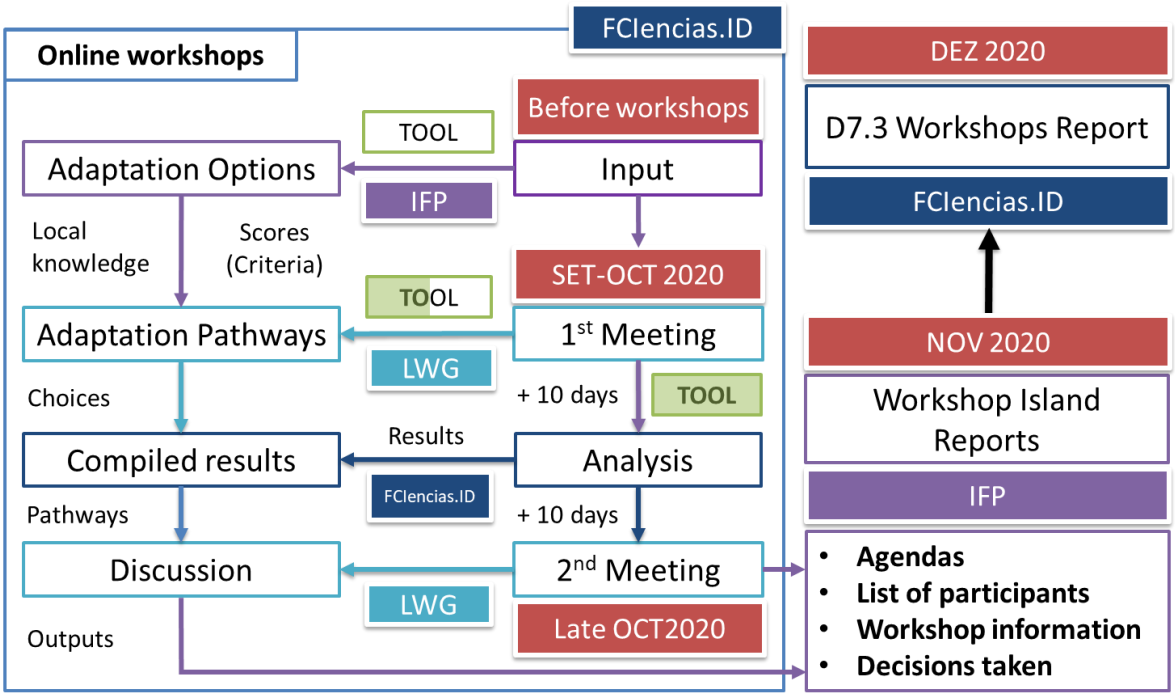


Figure 2 - Online Workshop framework for IFPs scheme

2.3.2 Sectors and stakeholders

The profile of stakeholders invited are highly dependent on the interests and choices made by the IFPs. However, a wide variety of stakeholders were involved in the process to properly capture different perspectives, knowledge, and stakes. The profile of the individuals invited to answer involved policy and decision-makers, practitioners, non-governmental and civil society organisations, science experts, private sector, business operators and sector regulators.

In step 1b, during the **first webinar**, stakeholders are to be given their importance in the **Sector Adaptation Pathways** design process within project SOCLIMPACT, as shown below.

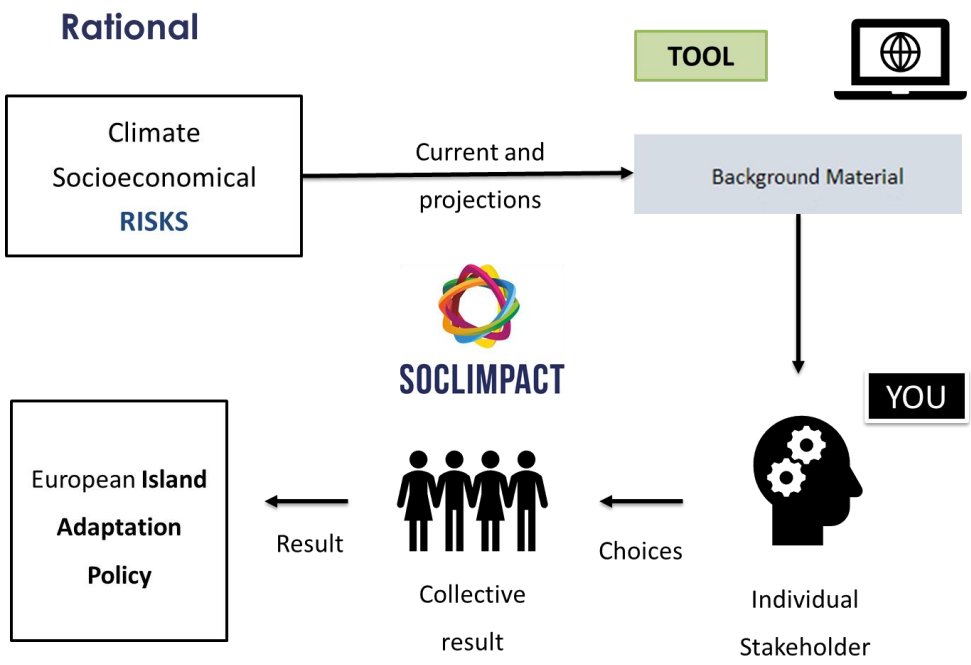


Figure 3 - Example of a presentation slide to explain their part in the Sector Adaptation Pathways design process.

The framework considers the Blue Economy sectors considered in SOCLIMPACT. All four sectors of SOCLIMPACT (Aquaculture, Tourism, Energy and Marine Transport) can be covered in the webinars for the stakeholder's engagement process in all the Islands case studies. However, during the process and following the **recommended number of stakeholders per sector** (between 6 and 8), the inclusion of the sectors was adjusted accordingly. Nevertheless, IFPs had the option to include sectors with less stakeholders available although considering that a decrease in robustness of results could occur. Also, the sector relevancy and strategic importance across the regions was considered as a criterion for the inclusion of sectors.

2.4 Adaptation pathways rational and concept

2.4.1 Sector Adaptation Pathways

Adaptation Pathways describe a sequence of policy actions or investments in institutions and infrastructure over time to achieve a set of pre-specified objectives under uncertain changing conditions. Adaptation pathways provide insight into policy options, the sequencing of actions over time, potential lock-ins effects, and path dependencies. These pathways provide an analytical approach for exploring and sequencing a set of possible actions based on alternative external developments over time (Haasnoot et al., 2013).

The **Adaptation Pathways methodology applied in SOCLIMPACT was based in the framework developed by** Suckall et al. (2018) **and considered the three main objectives for climate resilience: (1) vulnerability reduction -** Five capitals of Sustainable Livelihoods Approach (SLA)**; (2) Disaster Risk Reduction –** developed throughout Hyogo and Sendai Frameworks; **(3) Social-Ecological Resilience** – that emerge from the Millennium Ecosystem Assessment (MEA) and Common International Classification of Ecosystem Services (CICES).

The **Adaptation Pathways methodology** aims to capture the policy preferences in time and the relevancy of the context traduced in investment and commitment (Suckall et al., 2018). These **Adaptation Pathways Trajectories (APTs)** were delineated as a set of adaptation classes each one with two options/measures to choose from. Each individual stakeholder choice will contribute to create a policy pathway together with the other choices made by different stakeholders independently. If the majority of the stakeholders chose

one option, then that measure was incorporated in the island adaptation pathway for that specific class in each APT in that particular. If there is a tie between two options, then they will both be included and become part of the adaptation pathway in each time frame. The result of the series of choices in the three timeframes defines the pathway. Therefore, the options were included in the pathway when they were selected more than or the same as 50% in each time frame, within each APT in each sector. Local Knowledge measures (an additional class of measures in all APTs) were included in the pathways if they were chosen by at least a minimum proportion of times which is given by the inverse number of available measures (for example, if there are 4 different Local knowledge measures available then that minimum proportion is set at 25%)

2.4.2 Classes of adaptation

The method proposed presents a structure for categorising adaptation into 12 different classes, under which the participants decide which are the most relevant options for the Region/Island under consultation. The adaptation classes were used to define future directions for adaptation policy which were expressed in Adaptation Policy Trajectories (APTs).

For **vulnerability reduction** five classes were considered: (1) Financial capital; (2) Human capital; (3) Social capital; (4) Natural capital; and (5) Physical capital. For **Disaster Risk Reduction** four classes were considered: (6) managing long term risk; (7) preparedness; (8) response; (9) post disaster recovery and rehabilitation. For **Social-Ecological Resilience** three classes were considered: (10) Post disaster recovery and rehabilitation; (11) Provisioning services; and (12) Regulating and Maintenance Services (Figure 5). In SOCLIMPACT the Common International Classification of Ecosystem Services (CICES) was used to Regulating and Habitat (originally called Support or Maintenance) have been merged into Regulating and Maintenance Services (biotic and abiotic). The focus of these 12 classes has been slightly revised from the original method to be in line with the sectors and geographical context under study (see table in the project website

Table 1 - Adaptation climate variability/change and related drivers 12 classes of adaptation presented in the projects website and linked from the Online Survey Tool in the Background material tab

BROAD OBJECTIVE	CLASS OF ADAPTATION	DESCRIPTION OF PLAUSIBLE ADAPTATIONS
ADDRESSING DRIVERS OF VULNERABILITY	1. Financial capital	Changes in flows of money and savings that households have available, including loans and insurance
	2. Human Capital	Changes in skills, health and hability to labour of members of a household
	3. Social capital	Changes in networks, relationships and membership of groups that households can use
	4. Natural capital	Changes in land ownership and access to natural resources and storage facilities
	5. Physical capital	Changes in infrastructure and goods such as tools and equipment that households can use to increase productivity and non-productive assets of the households (e.g. house material)
DISASTER RISK REDUCTION	6. Managing long term risk	Efforts to build physical and social infrastructure that mitigate the worst impacts of an event. These can be one off activities, for example, building a sea wall, cyclone shelters, or on-going initiatives, e.g. developing flood risk management plans or relocating communities.
	7. Preparedness	Efforts to ensure communities are ready to respond to an event. These activities take place cyclically, for example, ensuring sea walls are maintained, practicing evacuation drills, or testing early warning systems.
	8. Response	Efforts to ensure affected households, communities, business and services receive appropriate assistance during and immediately following an event, e.g. evacuation support, first aid medical supplies, emergency responders
	9. Post disaster recovery and rehabilitation	Efforts to ensure affected households, communities, business and services are able to rebuild following an event, e.g. rehousing, reconstruction, etc.
LANDSCAPE /ECOSYSTEM RESILIENCE	10. Provisioning services	Changes in ecosystem goods, quality or productivity that can be directly consumed, such as food, water, raw materials (e.g. fibre, biofuel, ornamental items), but also adaptations that enhance these services such as the use of irrigation and fertiliser
	11. Regulating and Maintenance Services	Changes in the services that keep the wider planetary systems (such as the atmosphere, cryosphere, oceans) functioning and include the regulation of climate, air, nutrient cycles and water flows; moderation of extreme events; treatment of waste – including water purification; preventing erosion; maintaining soil fertility; pollination; and treatment of waste – including water purification; preventing erosion; maintaining soil fertility; pollination; and biological controls, such as pests and diseases.
		Changes in the habitats that maintain the life cycles of species or maintain genetic diversity, through quality and quantity of suitable habitats. In turn, these habitats underpin the health of provisioning and regulating services.
	12. Cultural services	Changes in aesthetic, recreational and tourism, inspirational, spiritual, cognitive development and mental health services provided by ecosystems.

2.4.3 Adaptation Policy Trajectories (APTs)

Adaptation Policy Trajectories are distinct visions (scenarios) of future policy adaptation choices (Kebede et al., 2018). When assessing diferent alternative directions for adaptation policy and practice, two key limiting variables, or drivers, direclty influence descion-making: the **level of investment** on adaptation, and the extent to which **commitment to a significant policy change** is required (Suckall et al., 2018)

Therefore, adapting to climate change may range from **minimal to high cost**, and from requiring a **small or incremental** change to a **significant change** from the *status quo* (Suckall et al., 2018).

The figure bellow depicts these two drivers (level of investment x commitment to policy change) and the respective four quadrants created by their intersection.

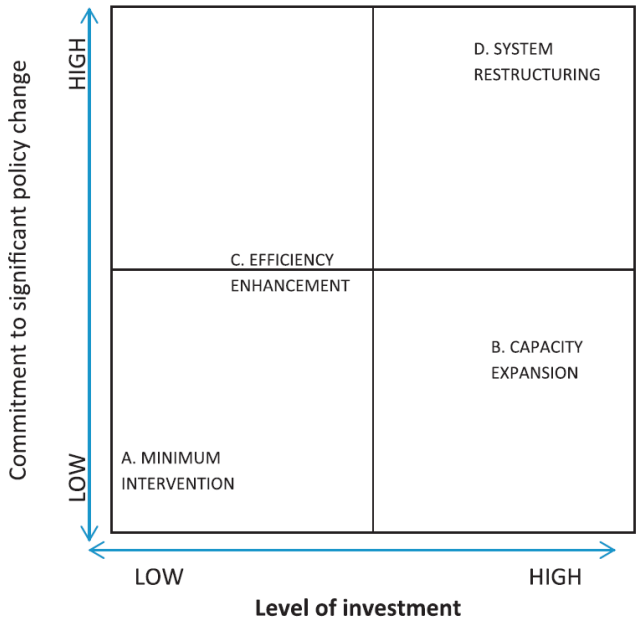


Figure 4 - Drivers of adaptation policy choice. Each letter represents an Adaptation Policy Trajectories (APTs) (Suckall et al., 2018)

Drawing on this four-quadrant categorization, different combinations of level of investment and commitment to policy change were developed for SOCLIMPACT. Each combination represents a distinct **Adaptation Policy Trajectory (APT)** (Kebede et al., 2018):

A. **Minimum intervention (MI)** (low investment/low commitment)
B. **Economic Capacity Expansion (ECE)** (high investment/low commitment)
C. **System Efficiency Enhancement (SEE)** (medium investment/medium commitment)
D. **System Restructuring (SR)** (high investment/high commitment)

Each **Adaptation Policy Trajectory (APT)** has a specific associated narrative. The objective of using narratives is to provide the scenario context against which stakeholders will develop their **Sector Adaptation Pathways** during the workshop and to encourage thinking about different portfolios of adaptation responses. For SOCLIMPACT these narratives were adapted from Kebede et al. (2018), Suckall et al. (2018a) e Hall et al. (2016).

APT Narratives

The four APT narratives considered in the workshop are described in the following pages:

A - Minimum Intervention (MI) (low investment/low commitment to policy change)

This policy trajectory assumes a no-regrets strategy where the lowest cost adaptation policies are pursued to protect citizens from some climate impacts. This APT address those areas where maximum impact can be achieved for the lowest cost. It requires low levels of commitment to policy change and promotes adaptations that require little investment. This APT reflects either a fundamental preference for a non-interventionist local government, or a government lacking ambition or the capacity to act locally. It may also reflect the position of a government that feels that no further action is required locally. In this policy trajectory, there is little planning for climate events, but instead, the government provides basic emergency response when disaster strikes.

The Minimum Intervention APT takes a general approach that reflects historical levels of investment, continue maintenance and incremental change in the performance of the current system.

Key elements

Vulnerability Reduction

Vulnerability is reduced through investing in human capital. There is little or no investment in other forms of capital. Investment in human capital may include basic training on how to increase income at the household level, such as learning new agricultural or fishing techniques.

Disaster Risk Reduction

Disaster Risk Reduction (DRR) is delivered in three ways. First, through simple measures to address long term risk, such as training populations to use future flooded areas for recreational purposes. Second, through disaster response such as temporary evacuation, emergency responders and the secondment of the army or national resources. Third, basic services are provided during post disaster recovery and rehabilitation, such as post disaster mobile water treatment plants and post disaster house construction for the worst affected households.

Social-Ecological Resilience

Ecosystem resilience is delivered through some basic provisioning services, which are partially supported through training services such as potable water management. There is no support for other ecosystem services.

B - Economic Capacity Expansion (ECE) (high investment/low commitment to policy change)

This policy trajectory focuses primarily on encouraging climate-proof economic growth but does not seek to make significant changes to the current structure of the economy. In this APT a high level of investment is required to prepare the economy for future change, but adaptation policy does not aim to reorient the economy or create significant change. Instead, the focus is on climate proofing industry and enhancing ability to adapt to changes. In this policy trajectory the increased financial capacity is used to protect the economic system from climate-induced harms.

The Economic Capacity Expansion APT focuses on planning for the long-term by increasing investment in infrastructure capacity.

Key elements

Vulnerability Reduction

Vulnerability is reduced by focusing on improving financial capital. This is done at the household level, for example training on post-harvest production and storage, governmental and private insurance schemes. Vulnerability reduction is also done at the government level, for example, by encouraging private sector investment in ecotourism. There is also an emphasis on human capital as the government invests in training that in turn will ensure households are able to better address the impacts of extreme events and on physical

capital by ensuring that appropriate infrastructure exists to support economic growth (e.g., roads, storage, rural electricity).

Disaster Risk Reduction

Disaster Risk Reduction (DRR) focuses on easing long term risk through hard and soft measures. For hard DRR, the focus may be on the provision of river/coastal infrastructure to protect economically important areas. For soft DRR, the focus is on preparedness and risk mitigation, for example through agriculture- and fisheries-based insurance schemes. Post disaster recovery efforts focus on getting the economy functioning quickly after disasters and reducing the impact of natural hazards on economic sectors. For example, by rapidly releasing funds to rebuild damaged economic resources such as ports, roads, and key stores.

Social-Ecological Resilience

Ecosystem resilience is delivered through investment in provisioning services. This is to enable income from food and water production under future climate change, for example, by using saline tolerant crops. There is also a focus on regulating services, for example, the use of agrochemicals or creation of private sector incentives for tree planting.

C - Efficiency Enhancement (EE) (medium investment/medium commitment to policy change)

This policy direction is based on an ambitious strategy that promotes adaptation consistent with the most efficient management and exploitation of the current system, looking at ways of distributing labour, balancing livelihood choices, and best utilising ecosystem services to enhance livelihoods and wellbeing under climate change. As this APT is about efficiency, it requires less investment than other interventionist approaches (i.e., capacity enhancement and system restructuring). However, there is a reasonable commitment to significant policy change as the system moves toward supporting people to adapt to long term change.

The Efficiency Enhancement APT focuses on deploying the full range of technological and policy interventions to optimise the performance and efficiency of the current system, targeting both supply and demand.

Key elements

Vulnerability Reduction

Vulnerability is reduced by focusing on human and social capital at the household and community level. In terms of human capital, livelihood diversification in farming is promoted as is the teaching of climate resilient farming and post-harvest production methods. In terms of social capital, local farming and fishing cooperatives ensure maximum production benefits. Finally, by improving access to natural capital, for example through fishing permits, households can make the most efficient use of income generating resources.

Disaster Risk Reduction

Disaster Risk Reduction (DRR) is provided through investments in long term risk management using relatively low-cost interventions such as early warning systems and storm shelters, development of building codes for buildings in risk areas, establishment of no build zones and funds to reduce risks to agriculture, such as government run support schemes. Communities are trained to prepare for events through relatively low-cost initiative, such as DRR education at school, evacuation training and stakeholder engagement in DRR plans. There is little emphasis on response or recovery.

Social-Ecological Resilience

Ecosystem resilience is a priority as it supports efficient management and exploitation major natural systems. All four ecosystem services are recognised as contributing to wider system efficiency and all are

the focus of government interventions. The focus is on low-cost interventions. In terms of provisioning, mixed land use and irrigation are promoted. In terms of regulating, tree planting is the focus. In terms of habitat, biological corridors are created, as are green spaces with native species along waterways. Finally, in terms of cultural services the conservation of wildlife and biodiversity in natural heritage sites and protected areas is promoted.

D - System Restructuring (SR) (high investment/high commitment to policy change)

This policy direction embraces a pre-emptive fundamental change at every level in order to completely transform the current social-ecological and economic systems and thus changing the social and physical functioning of archipelago/islands sectors. In this APT there is a guiding belief that significant/radical landscape and societal modifications are justified to create long term system restructuring despite the short-term costs that may be accrued, among some social groups or economic sectors. This policy direction focuses on fundamentally restructuring and redesigning the current mode of infrastructure service provision and deploying a combination of targeted centralisation and decentralisation approaches.

Within the System Restructuring APT it is possible to set out three broad examples of policy intervention. Although seeking a different end goal, all these highly transformational and restructuring policies require a high level of investment and a high commitment to significant policy change:

Protect: broadly following the Dutch model with use of extensive protective infrastructure and significant landscape changes to protect the current status quo in terms of livelihoods. Under this policy sub-direction, land and the blue economy sectors are protected from any further change so that communities can continue to maintain business as usual livelihoods.

Accommodate: under this policy sub-direction livelihoods may significantly change in order to 'live with nature' and assume the aspiration to 'work with nature' to adapt to changes to the natural environment.

Retreat: this sub-policy direction means a policy of population and infrastructural relocation, for example, the abandonment of coastal areas at risk by populations and services.

Key elements

Vulnerability Reduction

This policy direction can mean a significant change to the natural system (i.e., protect) or a significant change to livelihoods (i.e., accommodate and/or retreat) to make sure populations are protected from major climate impacts. Vulnerability is reduced by focusing on financial and human capital (accommodate and/or retreat) to which natural capital can be added (in the case of protect). Development and use of open spaces, green belts, and other ecologically sensitive areas for farming (protect), promotion of private sector investments in eco-tourism (accommodate) and financial incentives to relocate and pursue other income sources (retreat) are possible examples.

Disaster Risk Reduction

In this policy direction Disaster Risk Reduction (DRR) can focus on managing long term risk (protect and/or accommodate) or in post disaster recovery and rehabilitation (retreat). Example of this policy direction include the creation of dikes to manage flood water (protect), infrastructure that allows people to remain in potentially dangerous locations, such as early warning systems and shelters (accommodate) and government-led reallocation financial schemes (retreat).

Social-Ecological Resilience

This policy direction may target social-ecological resilience by allowing traditionally based agricultural livelihoods to continue or by promoting river course management (protect). Additionally, new habitats may be created as an incidental impact of the policy (accommodate and/or retreat.

Adaptation choices for the islands blue economy sectors

Having defined the classes of adaptation and the APT narratives, we can now establish a link for them. To achieve this, we first[2] link the APT narratives to each class of adaptation (Figure 5) and then develop the Adaptation Options for each Blue Economy sector (chapter 2.5). This means that this first result preludes the final purpose of allocating a set of planned policy-led option/measures into each future direction. Having this, stakeholders will be able to more clearly choose options/measures which have a link to each APT narrative.

We consider that this link exists when the weight that is given to each class of adaptation in each policy direction (Suckall et al., 2018) is greater than one. Although the original method does admit limitations and subjectivity (to the weights themselves) the link criterion we chose (our implementation solution) is both simple and coherent. It deals at the same with the challenges within the contingency plan (Covid-19) and the need to maintain scientific coherence.

			Adaptation Policy Trajectory (APT)			
		Classes of Adaptation	APT A Minimum Intervention (MI) *low investment, low commitment*	APT B Economic Capacity Expansion (ECE) *high investment, low commitment*	APT C Efficiency Enhancement (EE) *medium investment, medium commitment*	APT D System Restructuring (SR) *high investment, high commitment*
Adaptation climate variability/change and related drivers	Addressing drivers of vulnerability	1. Finantial capital		✓		✓
		2. Human capital	✓	✓	✓	✓
		3. Social capital			✓	
		4. Natural capital			✓	✓
		5. Physical capital		✓		
	Disaster Risk Reduction	6. Managing long term risk	✓	✓	✓	✓
		7. Preparedness			✓	
		8. Response	✓			
		9. Post disaster recovery and rehabilitation	✓			✓
	Landscape /ecosystem resilience	10. Provisioning services	✓	✓	✓	✓
		11. Regulating and Maintenance Services		✓	✓	
		12. Cultural services			✓	

Figure 5 - The 12 classes of adaptation are structured in three broader objectives (Vulnerability reduction, Disaster Risk reduction and Ecosystem and social resilience) and linked to each APT narrative.

Both the way this link was established, and the list of Adaptation Options can be tailored, perfected, and updated both independently and continuously[3]. To this effect the next step was to identify a set of Adaptation Options for each adaptation class.

[2] In the original method (Suckall et al., 2018), first the classes of adaptation were identified, then the current or planned policy-led adaptations were identified and then the weights of each class of adaptation were assigned to each policy direction.
[3] Even after the conclusion of the project SOCLIMPACT

2.5 Development and Characterization of the Adaptation Options

Following the objectives in WP7, packages of adaptation and risk management options were developed and characterized which represent the current or planned state of policy-led adaptations. For each sector, 24 options were developed considering the classes of the adaptation (two different options per class). Those options were then improved for the sectors and geographical context under development in SOCLIMPACT. To compile climate options at European level, most of the option were based on Climate-ADAPT and sector specific literature.

Accordingly, the evaluation starts with a revision of adaptation options available on Climate-Adapt for the blue economy sectors. A list of adaptation options was prepared to address the identified risks/challenges for each sector. In a second step, this list of options was complemented following the gaps in some classes of adaptation classes sector based. All the adaptation options are present in annex with sources.

Furthermore, up to six additional adaptation options per island and per sector could be added by the LWG (class of adaptation "Local Knowledge"). The developed options were then characterized by each of the IFP using the five criteria defined (Table 3).

To develop the options for adaptation in the islands and to create a rational from the mainstream of the Blue Economy sectors, a review of concepts and references for each sector was made in D7.1. The starting point of the adaptation options was the definitions, scope and boundaries of sectors that can be found in D3.1 and D3.2.

This database of adaptations options was used by LWG to explore with the hazards and impacts in each sector, which was at that time developed in other project WPs for their island. The adaptation options screened at Island level fit in the concept of shared policy assumptions (SPA) presented in D7.1. The SPA definition used follows Kriegler et al. 2014 and captures key elements of climate policies considering their geographical application and time dependency. Also, policies that are different from the global tendencies and that strongly influence local vulnerability and climate-related risks were considered.

The adaptation options were characterized and evaluated in each respective archipelago/island according to the local particularities and benefits (step 1c of the Online Workshop framework). This evaluation was later used by stakeholders in the islands in the Online Survey Tool to help them choose the options for their adaptation pathways (step 2b of the Online Workshop framework). Finally, the MCA was be applied to characterize the adaptation pathways developed.

This process intends to serve as a generic guidance for the evaluation of adaptation options using Local Working Groups (LWGs). A list of 24 adaptation options per sector was provided to the IFP for criteria-based evaluation.

A set of extended criteria was defined to furthered develop a more concise criteria with were then used to evaluate the adaptation options and thus rank the pathways scenarios for climate change adaptation[4], based on a review of research papers (Vaillancourt et al., 2004; Konidari et al. 2007; De Bruin et al., 2009; Blechinger et al., 2011; Gialoni et al., 2012; Haque, 2016; Verkerk et al., 2017). Table 1 presents the list of selected main and sub-criteria and their explanation.

Table 2 – Extended list of selected grouped- and sub-criteria and their explanation

Grouped criteria	Sub-criteria	Explanation	Comments
Economic	Economic performance	Ability of the measure to enhance economic growth and generate employment	Higher score stands for higher economic performance

[4] In the new version of the Project mitigation is not considered. Mitigation will be considered as trade-offs of the adaptation measures.

	Cost effectiveness	Ability of the measure to address the objective (i.e., to secure sufficient adaptation action) under the perspective of a financial burden acceptable and affordable by the involved entities	Higher score refers to higher cost effectiveness
	Economic robustness	Ability of the measure to perform satisfactorily under changing economic conditions	Higher score refers to higher economic robustness
Environmental and climate-related	Environmental performance	Ability of the measure to reduce greenhouse gas (GHG) emissions	Higher score refers to higher GHG emissions reduction
	Climate robustness	Ability of the measure to perform satisfactorily under changing climatic conditions	Higher score stands for higher climate robustness
Feasibility of implementation	Feasibility	Ability to implement the measure under the current physical, technical, financial regulatory or organizational conditions	Higher score stands for higher feasibility
	Flexibility	Ability of the measure to be flexible and allow for adjustments and incremental implementation depending on the level and degree of climate change	Higher score refers to higher flexibility
	Technical readiness	Ability of the measure to be implemented with relatively ease	Higher score stands for higher technical readiness
	Urgency	The need of implementing the measure immediately and not a later point in time	Higher score refers to higher urgency
	No-regret character	Measures for which non-climate related benefits exceeds the costs of implementation, i.e., the measure is good to implement irrespective of climate change	Higher score refers to no-regret characteristics
	Coherence	Synergies of the measure with other strategic objectives, i.e., the provision of co-benefits to other sectors and domains	Higher score refers to higher coherence
Social and political acceptability	Social acceptability	Ability of the measure to meet societal acceptance	Higher score stands for higher social acceptability
	Legitimacy	Ability of the measure to meet political acceptance	Higher score refers to higher legitimacy
	Environmental and climate-related trade-offs	Ability of the measure to fairly distribute compliance costs, emission rights and benefits among sectors for accomplishing GHG reductions	Higher score stands for higher equity
	Social equity	Ability of the measure to benefit vulnerable groups and communities	Higher score stands for higher social equity

A set of criteria collected from reference bibliography were then grouped and used to evaluate the final adaptation options in each of the Island by the IFP partner. The sub-criteria express the theoretical basis to develop the final method used by the WP7 team when evaluating the adaptation options.

The final criteria used to evaluate the adaptation options in SOCLIMPACT Project are expressed in Table 3.

Table 3 – Description of the grouped criteria used to evaluate the adaptation pathways performance.

Criteria	Description	
Cost Efficiency	Ability to efficiently address current or future climate hazards/risks in the most economical way	Higher score = higher cost efficiency
- *Environmental protection*	Ability to protect the environment, now and in the future	Higher score = higher environmental protection
- *Mitigation (GHG emissions) win-wins and trade-offs*	Current ability to meet (win-win) or not (trade-off) the island/archipelago's mitigation objectives	Higher score = higher mitigation win-wins and lower trade-offs
- *Technical applicability*	Current ability to technically implement the option/measure in the island/archipelago	Higher score = higher technical applicability
- *Social acceptability*	Current social acceptability of the option/measure in the island/archipelago	Higher score = higher social acceptability

The evaluation preformed used a multi-criteria analysis with leads to the characterization of the sustainability performance of the pathway selected. In this context was also possible analyse the decarbonization performance of the pathway.

2.6 Definition of results for Sector Adaptation Pathways

The results of the Adaptation Pathways are presented for each island in chapter 4 and for all islands[5] in chapter 5. They are organized in two different outputs per sector:

(1) Selected Adaptation Pathways

(2) Sustainability Performance

The (**1) Selected Adaptation Pathways** outputs aim to capture how the selected Adaptation Options in each pathway, within each APT context, respond to the three main strategic vectors of adaptation for climate resilience (chapter 2.4.2):

a) actions that reduce socio-economic vulnerability - **vulnerability reduction**;

b) actions that address disaster risk reduction - **disaster risk reduction**;

c) actions that affect social-ecological resilience - **social-ecological resilience**.

Optionally some stakeholders analysed the acceptance of each adaptation option regarding selection ratio. This is defined by the number of times an option was selected divided by the maximum number of times they can be selected (Ratio – Selected/Maximum). This considers the number of times the option was selected by all stakeholders in all four APTs and in the three timeframes.

The **(2) Sustainability performance** outputs aim to evaluate each pathway using the characterization of the options chosen in each APT. The options selected in each APTs were evaluated considering a set of characterization criteria (chapter 2.5): Cost Efficiency; Environmental protection; Mitigation (GHG emissions) win-wins and trade-offs; Technical applicability and Social acceptability (Table 3). This allows for a comparison to be made between APTs and timeframes in a radar graph.

[5] Still under development

2.7 FAQ from IFP

1. Each IFP need have stakeholders to but what if they do not?
   We have to assess that in the future if that happens. The assumption for the project is that there are stakeholders, even if they are a few.

2. How to reach the stakeholders and what is expected from IFP?
   The standard flow of information is:

   - We (WP7) will work with IFPs in excel format, exchanging information this way.
   - IFPs can do the same as well.
   - The standard option is for the IFP:
     - first complete the Adaptation Options sheet for each sector, by providing local knowledge measures/options and the characterization of measures (points from one to four).
     - Having this in hand IFP can proceed to the first meeting with stakeholders. There the task will be explained to stakeholders who will individually fill the Adaptation Pathways sheet.
     - After all stakeholders finish the information will be sent to FCiencias.ID by IFPs and we will produce results for discussion in the second meeting with stakeholders.
     - IFPs will moderate the first and the second meeting.
   - There is the option to include stakeholders in the Adaptation Options sheet, but this has to be managed by each IFP. This means they will provide each one with their take on the local knowledge measures and the evaluation of measures using the criteria. This task should happen before the first webinar so that the contribution of a given stakeholders is available to other stakeholders when they are making the adaptation pathways. We do not advise for this option due to time restrictions.

3. Measures to include are filled by stakeholders or IFPs?
   There are standard options that come from the project and that will not be changed in the process. The local knowledge measures for each island are the responsibility of each IFPs (see previous issue). IFPs can choose to include stakeholders in this task but we advise them no to do so due to time restrictions.

   Whatever the case, we ask IFPs to add something in the references so that everyone knows were the idea came from and where to find more information to implement those measures. We advise that the sources to be provided are preferably from adaptation knowledge databases or scientific references. These sources which can be easily recognizable from both inside and outside the project and enrich the work that was already made. News, opinion articles or commercial brochures are possible, but they do not provide such robust sources. Also, IFPs (like AREAM) can refer themselves if they are engaged in local plans.

4. Measures proposed by us (IFPs) or stakeholders? (Adaptation Options sheet)
   Adding (extra) local knowledge options is an IFP task and responsibility. As explained before (issue 5 and 6) there are two alternative ways to proceed: you either consult the stakeholders or you do it just by yourself. Again, due to time restrictions, we advise that the stakeholders only define the Adaptation Pathways (the final sheet) and are not involved in the Adaptation Options. Nevertheless, having extra measures is not mandatory, it is only expected that you might need to include other measures which were not included in this state-of-the-art review.

5. Definition of adaptation measures should use thresholds instead of short- or long-term time frames. Why not proceed this way and define measures according to thresholds?
   That approach cannot be applied for all the islands as there are information constrains in the project. For instance, those thresholds are not readily available at this stage and some islands will not have the same information. The timing and the available time to pursue this task advise us to proceed using this approach. We suggest that IFPs who have that background information can relate those thresholds with the time periods by consulting the available background material.

6. Deadline to fill in the sheet.
   The Adaptation Options should be filled before the first webinar with stakeholders. In the first webinar the Adaptation Pathways sheet will be presented to stakeholders who will be filling the sheet individually. Results will be processed, and the second webinar will discuss those results. Nevertheless, IFPs should start filling the sheet now so that we can provide the necessary assistance beforehand.

7. What happens if the measures are changed by stakeholders?
   The measures were prepared for IFP to work with them. New ones can be added in the Local Knowledge area. (issues 5, 6 and 7). Once this is done the measures cannot be changed in the Adaptation Pathways stage. In the previous stage IFPs can include stakeholders in this process (as we explained before). Afterwards the first webinar happens, stakeholders will choose the options according with what was defined in the previous stage (issue 5). Therefore, at this stage the measures will not change.

8. If you make a new measure will it appear on the ATPs automatically?
   Yes, they will be available on each ATP under Local Knowledge. The rest of the measures appear according to their own class of adaptation (each ATP has a set of different adaptation classes in them).

9. Why must you choose only one measure?
   The exercise is to select one measure for each timeframe and ATP. If you have both as a third option, there will be no choice in the end. The result will be just a list of measures. The act of choice is relevant. In total for the four different APTs, there are 29 choices to be made in each sector, times three time periods give 116 different choices to be made. If for instance if a stakeholder is involved in all four sectors this will add to a total of 464 choices. What is apparently seems to be a limitation (to choose from one of two measures and not both) is in fact quite rich for just one person. If the APTs are used correctly the result is even richer. Also keep in mind that, measures which are not present in one APT can be included in another one.

10. Some islands will have many stakeholders and thus more combinations of these options, but some IFP may have a limited number of stakeholders to answer this.
    The overall number of stakeholders in all islands will provide a rich information about these choices for the project. Per island, even one stakeholder may have up to 464 choices (see previous issue) and the overall quality of this work can be further enhanced with a deeper understanding of APTs. Also, if there is a limited number of stakeholders it is easier to engage them to participate also in the Adaptation Options sheet as well. This was something we advised not to do due to time restrictions but if there are only a few stakeholders it will be easier to manage. This will also enrich the final result. Having no choice (with an option of having both) will diminish the quality of the work (see previous issue).

11. About the balance between having simplifications in the process and its usefulness. If you have such a simple task to perform, choosing just one out of two options per adaptation class, will the results be useful?
    Choosing from two options means making a discrete choice. Individual choices will be summed together to simulate what would happen in a live workshop discussion. This task is simple enough to guarantee success in an online and social distancing reality (COVID-19) but still useful and rich, due to high number of choices and input possibilities (please refer to issues 12 and 13). How much can be extracted from the stakeholders depends on the choices that IFPs about how far they will involve them in the process.

    Also, in a presential workshop context more options could be added by stakeholders, but they could discuss each one before including them. This would act as a filter for excess measures or repetitions. For the online context, the extra local adaptations options (Local Knowledge) can fill in specific gaps in each island. Each island has a total 96 adaptation options already available for the four sectors, plus 24 potential extra local options, adding to a total of 110 adaptation options. This total amount concerns only 4 sectors so there are great in number. All these can make their way into the pathways and the choice is made by stakeholders. This will make the pathways very rich due to their many possibilities, yet respecting an accessible, adaptable, and untestable structure for different IFPs.

3 Online Survey Tool

3.1 Motivation

The Online Survey Tool is an essential part of the Online Workshop framework. It was developed within the Covid-19 contingency plan to allow for the fulfilment of the "Online SOCLIMPACT Regional Workshops: co-developing Sector Adaptation Pathways". It is based on an Excel file containing links to the findings section of the SOCLIMPACT website for the background material based on D7.2. This was done in this format so that the project partners, namely WPs leaders and IFPs, could have a simple and robust tool that would be readily available, controllable, and straightforward to use. Other solutions were considered but this solution allowed IFPs and other partners to manipulate the tool[6] according to their needs and making their inputs without depending on third parties. This was believed to be necessary to deal with uncertainties regarding the project. Those uncertainties relate with the confinement context associated with the pandemic and because D7.2 was not finished before the tool's development.

Pursuing the framework objectives within the Covid-19 contingency plan the tools main purpose is to allow for individual stakeholder inputs to co-develop the **SOCLIMPACT Adaptation Pathways** using the following time periods (coherent with the SOCLIMPACT framework):

- Short term (up to 2030)
- Mid-century (up to 2050)
- End-century (up to 2100)

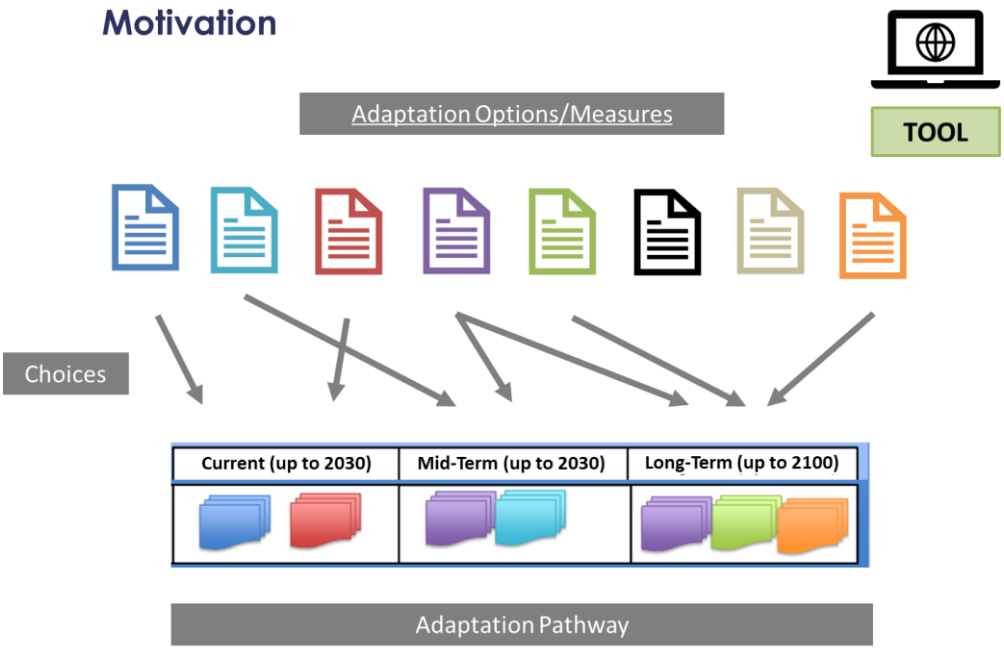


Figure 6 - Motivation for the use of the Online Survey Tool

[6] Within limits that don't impair the use of analysis tools to be used later on

3.2 Structure and use

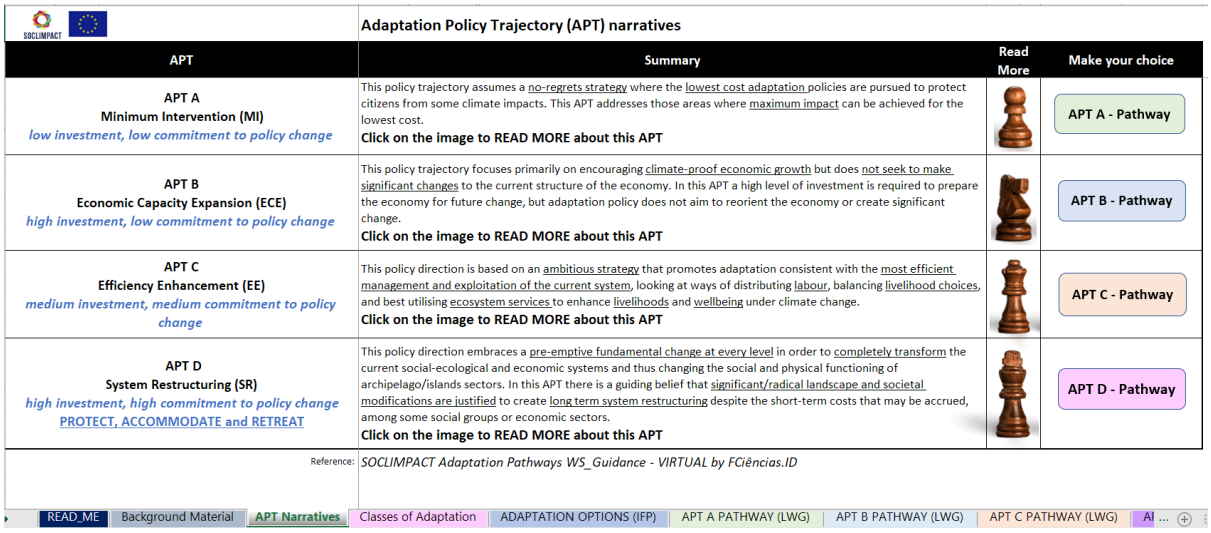
The tool[7] is made per **sector**, **customized** per **island,** and consists in a set of six different parts (9 excel tabs) which are used by the IPFs (in steps 1c and step 2 of the Online workshop framework) and LWGs (in step 2b) as follows:

1. Read me.
2. Background material
3. APT narratives
4. Classes of adaptation
5. Adaptation options
6. Pathways section:
   i. APT A
   ii. APT B
   iii. APT C
   iv. APT D

The **Read Me** tab includes the identification of the island, sector, and stakeholder, as well as a short description of the tool and some references on how to use it, namely the definition of the criteria to be used in the measure characterization (step 1c).

The **Background material** is an important tab that provides **customized** information to the **island sector** stakeholder regarding the projected risks accessed by project SOCLIMPACT. The WP8 prepared a series of icons that directed the user to the projects findings section where the results from D7.2 where summarized (in some cases using interactive PDFs). This allowed stakeholders to review the sector and island risks[8] when choosing between measures of the same class and within each APT context narrative.

The **APT narratives** tab as co-developed with WP8 and contains a summarized version as well as links to the projects findings section where a fully detailed version designed by WP8 could be consulted.



Adaptation Policy Trajectory (APT) narratives

APT	Summary	Read More	Make your choice
APT A **Minimum Intervention (MI)** *low investment, low commitment to policy change*	This policy trajectory assumes a no-regrets strategy where the lowest cost adaptation policies are pursued to protect citizens from some climate impacts. This APT addresses those areas where maximum impact can be achieved for the lowest cost. **Click on the image to READ MORE about this APT**		APT A - Pathway
APT B **Economic Capacity Expansion (ECE)** *high investment, low commitment to policy change*	This policy trajectory focuses primarily on encouraging climate-proof economic growth but does not seek to make significant changes to the current structure of the economy. In this APT a high level of investment is required to prepare the economy for future change, but adaptation policy does not aim to reorient the economy or create significant change. **Click on the image to READ MORE about this APT**		APT B - Pathway
APT C **Efficiency Enhancement (EE)** *medium investment, medium commitment to policy change*	This policy direction is based on an ambitious strategy that promotes adaptation consistent with the most efficient management and exploitation of the current system, looking at ways of distributing labour, balancing livelihood choices, and best utilising ecosystem services to enhance livelihoods and wellbeing under climate change. **Click on the image to READ MORE about this APT**		APT C - Pathway
APT D **System Restructuring (SR)** *high investment, high commitment to policy change* PROTECT, ACCOMMODATE and RETREAT	This policy direction embraces a pre-emptive fundamental change at every level in order to completely transform the current social-ecological and economic systems and thus changing the social and physical functioning of archipelago/islands sectors. In this APT there is a guiding belief that significant/radical landscape and societal modifications are justified to create long term system restructuring despite the short-term costs that may be accrued, among some social groups or economic sectors. **Click on the image to READ MORE about this APT**		APT D - Pathway

Reference: *SOCLIMPACT Adaptation Pathways WS_Guidance - VIRTUAL by FCiências.ID*

READ_ME | Background Material | APT Narratives | Classes of Adaptation | ADAPTATION OPTIONS (IFP) | APT A PATHWAY (LWG) | APT B PATHWAY (LWG) | APT C PATHWAY (LWG) | Al ...

Figure 7 - Print screen of the APT narratives tab design

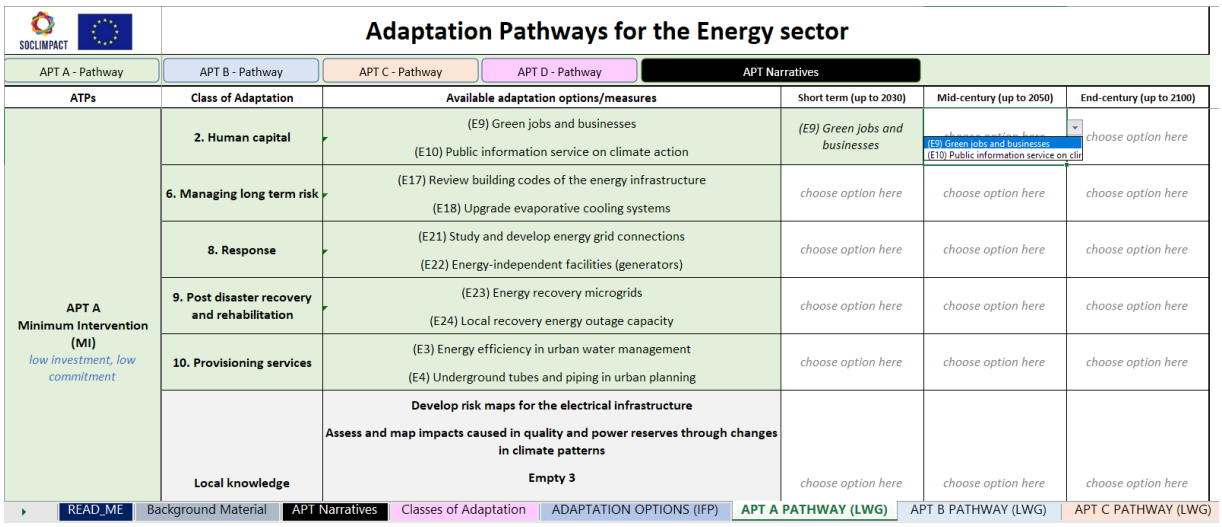
[7] An example of the tool for each sector can be found in the Annex

[8] IFPs have presented in their island reports screenshots containing this background material tab as well as other sources of information they may have used to inform the stakeholders of the climate related risks

The **classes of adaptation** tab contains a picture with the list of the classes with a link to the findings section where a short description of the classes can be found.

The **Adaptation Options** tab contains the list of 24 measures witch , the Local knowledge measures and the Adaptation Options characterization (see step 1.c (in chapter 2.3.1) and chapter 260).

The **four APT** tabs contain the Classes of Adaptation (see chapter 2.4.2), which are specific with to each APT (see Figure 5), and the sector Local knowledge measures which are present across all APTs. The stakeholder chooses one measure per class (step 2b) considering the APT narrative and the risks presented in the background material.



Adaptation Pathways for the Energy sector

APT A - Pathway | APT B - Pathway | APT C - Pathway | APT D - Pathway | APT Narratives

ATPs	Class of Adaptation	Available adaptation options/measures	Short term (up to 2030)	Mid-century (up to 2050)	End-century (up to 2100)
APT A Minimum Intervention (MI) *low investment, low commitment*	2. Human capital	(E9) Green jobs and businesses (E10) Public information service on climate action	*(E9) Green jobs and businesses*	(E9) Green jobs and businesses (E10) Public information service on clir	*choose option here*
	6. Managing long term risk	(E17) Review building codes of the energy infrastructure (E18) Upgrade evaporative cooling systems	*choose option here*	*choose option here*	*choose option here*
	8. Response	(E21) Study and develop energy grid connections (E22) Energy-independent facilities (generators)	*choose option here*	*choose option here*	*choose option here*
	9. Post disaster recovery and rehabilitation	(E23) Energy recovery microgrids (E24) Local recovery energy outage capacity	*choose option here*	*choose option here*	*choose option here*
	10. Provisioning services	(E3) Energy efficiency in urban water management (E4) Underground tubes and piping in urban planning	*choose option here*	*choose option here*	*choose option here*
	Local knowledge	**Develop risk maps for the electrical infrastructure** **Assess and map impacts caused in quality and power reserves through changes in climate patterns** **Empty 3**	*choose option here*	*choose option here*	*choose option here*

READ_ME | Background Material | APT Narratives | Classes of Adaptation | ADAPTATION OPTIONS (IFP) | APT A PATHWAY (LWG) | APT B PATHWAY (LWG) | APT C PATHWAY (LWG)

Figure 8 - Example of the choice made by stakeholders in an APT A tab of customized Online Survey Tool for the energy sector in Azores.

The use of the tool was explained by IFPs to the stakeholders by in the first webinar (step 2a) who would then use the tool individually (step 2b). The rationale behind this use can be summarized in Figure 9, but simplifications and adjustments were made given its complexity and the needs of stakeholders.

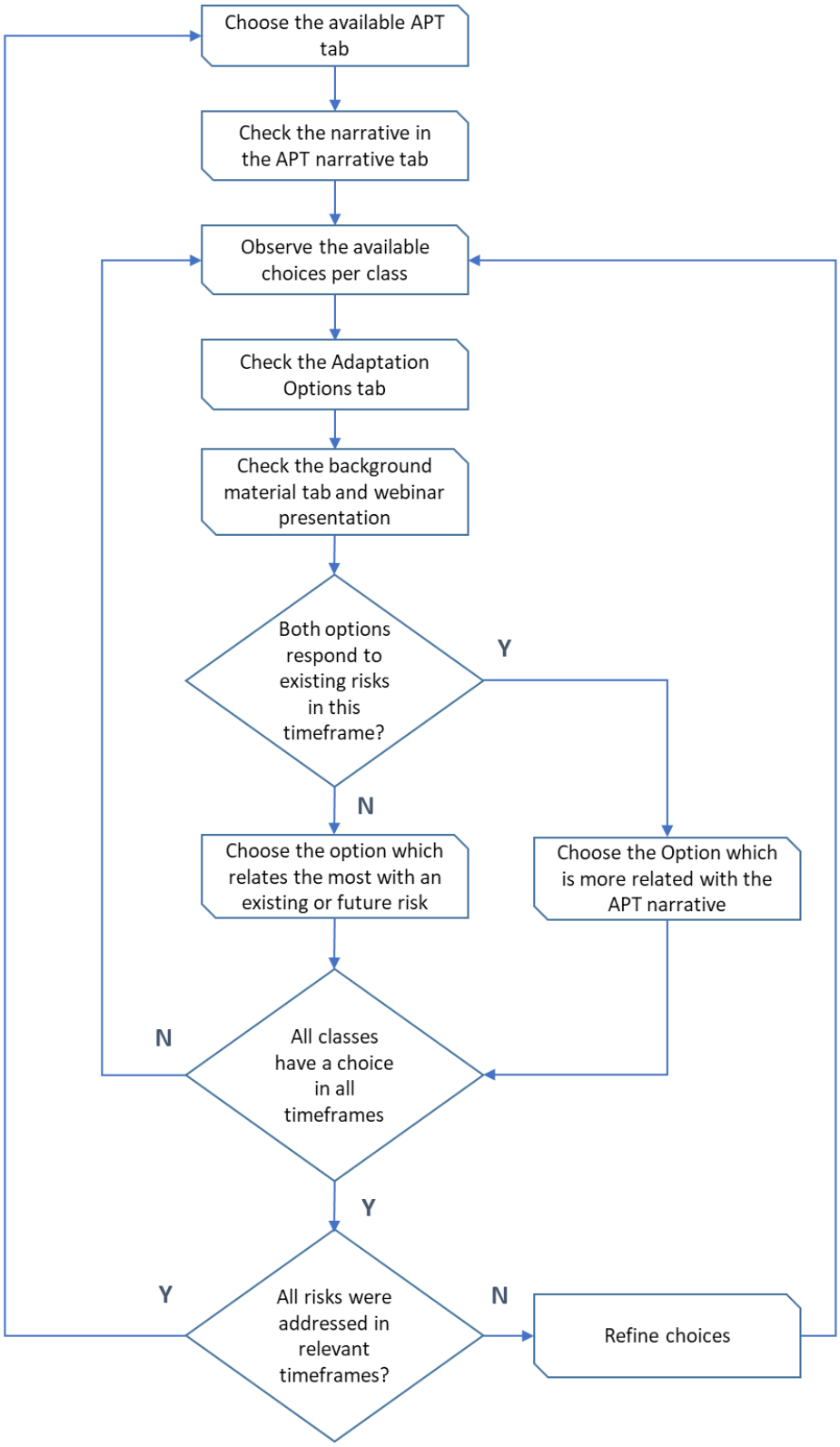


Figure 9 - Online Survey Tool use rationale

3.3 Online Survey Tool Files

The Online Survey Tool was developed in Microsoft Excel software and is an integral part of the D7.3. The Background material for the SOCLIMPACT Regional online workshops was embedded in the Online Survey Tool files and was set differently for each Island.

Online Survey Tool - Excel Files	Sectors			
	Aquaculture	Energy	Maritime Transport	Tourism
	SOCLIMPACT_Online_Survey_Tool_Aqua	SOCLIMPACT_Online_Survey_Tool_Ener	SOCLIMPACT_Online_Survey_Tool_MarT	SOCLIMPACT_Online_Survey_Tool_Touri

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4 Sector Adaptation Pathways for each island

In this chapter we present the Selected Adaptation Pathways and the Sustainability Performance given by the results of each island regarding their Sector Adaptation Pathways, which are presented in the respective island reports. For each island we will also briefly summarize how each IFP adopted the Online Workshop framework.

The methodological framework (chapter 1) was applied in a main set of islands: Azores, Corsica, Crete, Cyprus, Fehmarn, Madeira, Malta, Sardinia and Sicily. The individual answers from the stakeholders of these islands were added to compile and formulate the Sector Adaptation Pathways for SOCLIMPACT. The results for this main set of islands are presented in Chapter 5. Alternatively, for Balearic and Canary Islands, the method applied follows a changed approach but with a similar output. In this case the methodology approach is described in the Island Report of the Islands (chapter 8).

The total amount of participating stakeholders was 233 for the eleven islands that perused the stakeholder engagement, with the distribution per island and per sector presented below (Figure 10).

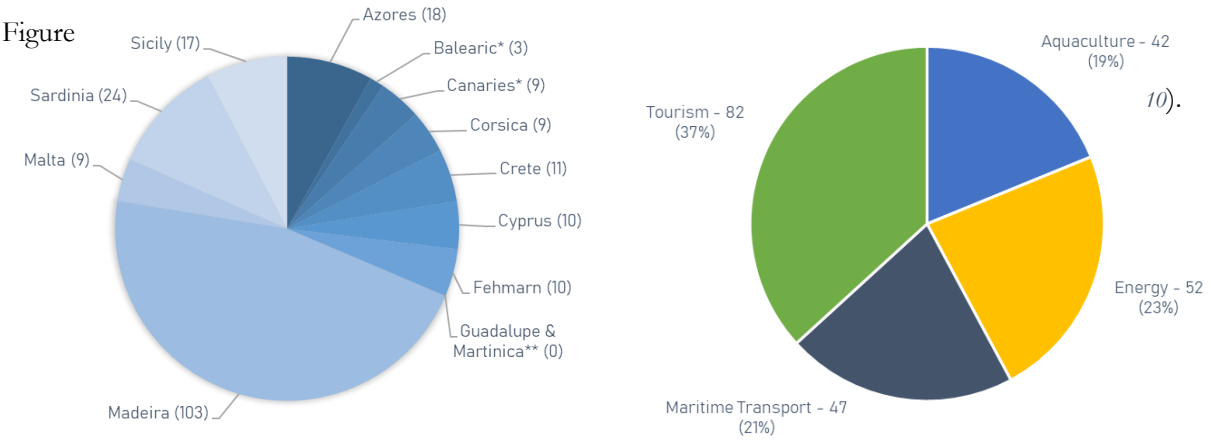

*Figure 10 - Number of stakeholder distribution per sector and per island (temporary result). * - Both the Balearic and the Canary Islands followed a different method and are still wating on additional results ** - Guadalupe & Martinica could not achieve stakeholder engagement*

From a total of 211 stakeholders in the main group of islands (nine islands) there was a total of 113 individuals (see the distribution per island in Figure 11) who made 17196 individual choices (such as the one shown in the example of Figure 8).

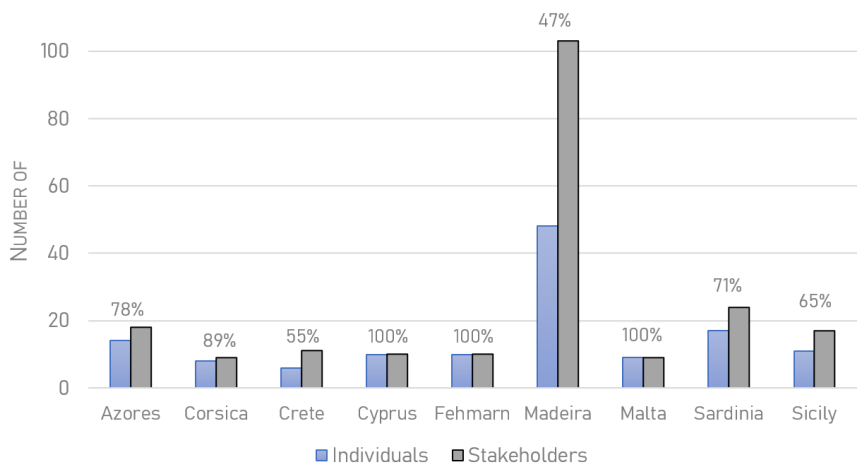

Figure 11 - Number of individuals and stakeholders per island and the ratio between the two numbers

4.1 Azores

The Azores Islands made their two online webinars spoken in Portuguese, with the presentations in English, where the Local knowledge options were proposed by the IFP (FCiências.ID), the characterization adaptation options were made by the IFP.

4.1.1 Tourism

Tourism pathways are based on choices made by 8 expert island stakeholders.

Selected Adaptation Pathways

ID	Name	Class number	APT A			APT B			APT C			APT D		
			S	M	L	S	M	L	S	M	L	S	M	L
T1	Economic Policy Instruments (EPIs)	1					B						D	
T2	Financial incentives to retreat from high-risk areas	1					B						D	
T9	Activity and product diversification	2		A			B			C			D	
T10	Public awareness programmes	2		A			B			C			D	
T11	Local circular economy	3								C				
T12	Tourist awareness campaigns	3								C				
T13	Local sustainable fishing	4								C			D	
T14	Water restrictions, consumption cuts and grey-water recycling	4								C			D	
T15	Beach nourishment	5					B							
T16	Desalination	5					B							
T17	Coastal protection structures	6		A			B			C			D	
T18	Drought and water conservation plans	6		A			B			C			D	
T19	Mainstreaming Disaster Risk Management (DRM)	7								C				
T20	Using water to cope with heat waves	7								C				
T22	Health care delivery systems	8		A										
T21	Fire management plans	8		A										
T24	Pre-disaster early recovery planning	9		A									D	
T23	Post-Disaster recovery funds	9		A									D	
T4	Monitoring, modelling and forecasting systems	10		A			B			C			D	
T3	Adaptation of groundwater management	10		A			B			C			D	
T6	River rehabilitation and restoration	11					B			C				
T5	Dune restoration and rehabilitation	11					B			C				
T7	Adaptive management of natural habitats	12								C				
T8	Ocean pools	12								C				
T25	Adapt tourism promotion to Climate Change risks	Local		A			B			C			D	
T26	Improve Natura 2000 habitats - terrestrial, coastal and marine	Local		A			B			C			D	
T30	Define protection regime for "Maximum Infiltration Zones", within	Local		A			B			C			D	
T28	Create water storage reservoirs to ensure water availability	Local		A			B			C			D	
T27	Adapt agroforestry systems to drought conditions	Local		A			B			C			D	
T29	Create a mosquito detection information system	Local		A			B			C			D	

Figure 12 - Adaptation options for the tourism sector. Options are identified with an ID number, full name, and class of adaptation number. Adaptation objectives are identified in each option by colour: ***vulnerability reduction (red), Disaster Risk Reduction (blue); Social-Ecological Resilience (green); Local Knowledge adaptation options (grey).*** *Each ATP (APT A; APT B; APT C; APT D) is represented in three timeframes: S - Short term (up to 2030), M- Medium term (up to 2050), L - Long term (until 2100). Highlighted options indicate the measure was selected in each ATP and timeframe: ATP A – Minimum Intervention (light blue); ATP B – Economic Capacity Expansion (light green); ATP C – Efficiency Enhancement (Light orange) and ATP D – System Restructuring (light purple). Bold letters in each ATP indicate the option was available to be selected in the three time frames. Grey cells mean that they the options was not available in that APT.*

Overall, the adaptation pathways for the Tourism sector in Azores are characterized by a significant heterogeneity across the four potential adaptation policy trajectories (APTs) and across adaptation objectives.

Under APT B and D scenarios, the financial capital measures that were selected to address **vulnerability reduction**, indicate that the region is initially centred on the development of Economic Policy Instruments and later on Financial incentives to retreat from high-risk areas (medium to long term). The selection of the Financial incentives to retreat in the end of the century is related with the perception that the risks will increase over time.

To adapt via Human Capital (class 2), diversification of the activities and products in opposition to awareness campaigns should be implemented. However, in Minimum Intervention scenario (APT A), investment in public awareness can be appropriate for short and mid-term. At the same time, within a System Restructuring scenario (APT D), in all time periods, the diversification of the activities and products gain importance. The same pattern occurs for Social Capital class, where awareness campaigns were selected for the short-term in opposition to local circular economy which gain relevance in the middle and long-term.

The option related with water restrictions and cuts (Natural Capital) was excluded from all periods when a System Restructuring scenario (ATP D) is performed but was selected in an Efficiency Enhancement scenario (APT C) in middle and long term. The pathways developed seem to consider the growing evolution of the climate change risks and the urgency to respond to them.

This rational is coherent with the Physical Capital options taken in APT B. Beach nourishment (or replenishment) was valued in the beginning of the century while towards the end of the century, the region should invest in desalinization.

For **Disaster Risk Reduction**, and to manage long term risk, the decisions need to be sensible to the level of investment and reflects the climate change risk identified for the region. Coastal protection is a priority for the region throughout the scenarios where the level of investment and commitment are median to high - APTs B, C and D. In opposition, for APT A, drought and water conservation plans are a priority in the short and middle term. In Azores, adequate improvement of water harvesting from waterlines is possible in a scenario of low investment.

The Efficiency Enhancement scenario (ATP C) is the only scenario which considers the Preparedness class. In the short and mid-term, mainstreaming DRM was selected in detriment of using water to cope with heat waves. This result, follows the risk response rational, addressing disasters management in a first stage and heat waves when the risks related with temperature became higher towards the end of the century.

The risks related with fire were considered low in all time periods in Azores. The pathway clearly reflects the climate-risk context of the region.

Generically, to address DRR on tourism sector, it is necessary to continue to promote planning and allocate funds to develop climate change resilience in the region.

In **Social-Ecological Resilience,** groundwater management is not urgent for the sector in the short term. The Region should in the next decades (until 2050) invest efforts in information systems to improve climate information reliability. In the end of the century, with a higher drought risk, the adaptation focus should be in groundwater management. This measure was selected in the scenarios where the commitment to policy is low (Minimum Intervention – ATP A and Economic Capacity Expansion – ATP B). For the scenarios with medium and high investment and commitment (ATP C and D), the policy options were selected in short to medium timeframes.

Options for regulation of natural services in the Tourism sector will benefit from the maintenance of the rivers/valleys functions, creating recreational areas with a positive impact on tourism attractiveness. Regulating and Maintenance Services, is only defined within medium and low commitment to policy change. In this context, coastal restoration should only happen when coastal risks increase in the end of the century.

Since 2008 some islands have been under relevant meteorological droughts. For example, two years ago (2018) Azores faced a drought which originated indirect costs for the sector. During this period, it was necessary to implement measures such as water drilling or additional water treatment. Additionally, it was identified that some of the periods of drought have relevant implications in the crop yields and consequentially impacts on the milk sector. However, droughts have been worsened by the agricultural activity specially because of animal husbandry (mainly by free grazing livestock that has a relevant freshwater input). There are specific areas in each island where the problem is worse, namely where soils are poorer and in low laying areas.

The potential impacts of a reduction in precipitation on the landscape and its indirect impact on tourism attractivity were highlighted. Significant changes in landscape can be challenging for the tourism sector considering visitor's expectations and the promotion of the islands' natural resources. In this context, adapting tourism promotion was identified as a priority option.

In medium investment and medium commitment to policy change scenario (APT C - Efficiency Enhancement) cultural services are relevant. In this case, the region considered to dedicate efforts to preserve and minimize the impacts on biodiversity and ecosystems, while also preserving the attractiveness of the region.

Local knowledge options were focused on the preservation and promotion of the natural attractiveness of the region and reflect the relevance of this issue for the Azorean tourism sector, in the four pathways. All pathways reflect the need of conservation of the natural areas to continuous address multiple risk. This approach is also aimed to promoting water resource availability without hard and irreversible infrastructures. The vector borne diseases were not considered urgent for this sector. Like the options agroforestry related options sector does not have direct control on the health policy.

Sustainability Performance

Figure 13 - Pathways evaluation for the tourism sector considering: Cost Efficiency; Environmental protection; Mitigation (GHG emissions) win-wins and trade-offs; Technical applicability; Social acceptability. The policy pathways scenarios: APT A - Minimum Intervention; APT B - Economic Capacity Expansion (ECE); APT C- Efficiency Enhancement (EE); APT D - System Restructuring (SR), for different timeframes: S - Short term (up to 2030), M- Medium term (up to 2050), L - Long term (until 2100)

The performance of the four ATP scenarios for tourism sector are considerably similar during the three timeframes considered. In general, scenarios show a high level of social acceptability and technical applicability and a medium cost efficiency and environmental protection with a low performance in mitigation win-wins and trade-offs.

Additionally, for all pathway scenarios the performance level decreased with time, specially from middle to long term.

The minimum intervention scenario (APT A) tends to have socially acceptable options and adaptation solutions with technical applicability. However, in this scenario the pathway has a low performance on mitigation and environmental protection which agrees with the level of investment and commitment characterized by in ATP A, which ultimately expresses the results on mitigation and environmental protection. The efficiency enhancement scenario (ATP C) defines a pathway with a high level of environmental protection and mitigation.

In general, the pathway defined in APT D (System Restructuring scenario), has the lower performance when considering all timeframes.

4.1.2 Maritime Transport

Maritime transport pathways are based on choices made by 3 expert island stakeholders.

Selected Adaptation Pathways

ID	Name	Class number	APT A			APT B			APT C			APT D		
			S	M	L	S	M	L	S	M	L	S	M	L
MT1	Insurance mechanisms for ports	1					**B**						**D**	
MT2	Financial incentives to retreat from high-risk areas	1					**B**						**D**	
MT10	Social dialogue for training in the port sector	2		**A**			**B**			**C**			**D**	
MT9	Awareness campaigns for behavioural change	2		**A**			**B**			**C**			**D**	
MT12	Climate resilient economy and jobs	3								**C**				
MT11	Diversification of trade using climate resilient commodities	3								**C**				
MT13	Refrigeration, cooling and ventilation systems	4								**C**			**D**	
MT14	Restrict development and settlement in low-lying areas	4								**C**			**D**	
MT16	Increase operational speed and flexibility in ports	5					**B**							
MT15	Sturdiness improvement of vessels	5					**B**							
MT17	Climate proof ports and port activities	6		**A**			**B**			**C**			**D**	
MT18	Consider expansion/retreat of ports in urban planning	6		**A**			**B**			**C**			**D**	
MT19	Reinforcement of inspection, repair and maintenance of	7								**C**				
MT20	Early Warning Systems (EWS) and climate change monitoring	7								**C**				
MT21	Intelligent Transport Systems (ITS)	8		**A**										
MT22	Prepare for service delays or cancellations	8		**A**										
MT23	Backup routes and infrastructures during extreme weather	9		**A**									**D**	
MT24	Post-Disaster recovery funds	9		**A**									**D**	
MT4	Combined protection and wave energy infrastructures	10		**A**			**B**			**C**			**D**	
MT3	Marine life friendly coastal protection structures	10		**A**			**B**			**C**			**D**	
MT5	Hybrid and full electric ship propulsion	11					**B**			**C**				
MT6	Coastal protection structures	11					**B**			**C**				
MT7	Integrate ports in urban tissue	12								**C**				
MT8	Ocean pools	12								**C**				
MT25	Strengthen coastal protection, giving priority to the maintenance	Local		**A**			**B**			**C**			**D**	
MT26	Evaluate and plan retreat of buildings /infrastructures from risk	Local		**A**			**B**			**C**			**D**	
MT27	Strengthen coastal monitoring	Local		**A**			**B**			**C**			**D**	

Figure 14 - Adaptation options for the Maritime Transport sector. Options are identified with an ID number, full name, and class of adaptation number. Adaptation objectives are identified in each option by colour: ***vulnerability reduction (red), Disaster Risk Reduction (blue); Social-Ecological Resilience (green); Local Knowledge adaptation options (grey).*** *Each ATP (APT A; APT B; APT C; APT D) is represented in three timeframes: S - Short term (up to 2030), M- Medium term (up to 2050), L - Long term (until 2100). Highlighted options indicate the measure was selected in each ATP and timeframe: ATP A – Minimum Intervention (light blue); ATP B – Economic Capacity Expansion (light green); ATP C – Efficiency Enhancement (Light orange) and ATP D – System Restructuring (light purple). Bold letters in each ATP indicate the option was available to be selected in the three time frames. Grey cells mean that they the options was not available in that APT.*

The Azorean maritime transport sector adaptation pathways are characterized by a significant heterogeneity across the four potential adaptation policy trajectories (APTs) which they built upon.

In the **Minimum Intervention (APT A)** scenario which favours limited investment costs and the use of no-regret strategies, the Azorean maritime transportation sector follows a pathway of interventions that seek to sustain sector activities during and after the occurrence of extreme events. Reducing vulnerabilities in a policy scenario were changes in current policy commitment is less likely to occur, investment in **human capital** takes the form of social dialogue targeting workforce training up to 2050. After that period,

reinvestment in information and behavioural change will be necessary to respond to increasing climate related threats. Disaster risk reduction focuses on **managing long term risks** via climate proofing of infrastructure and activities while developing alternative routes during extremes events as a means of assuring **post-disaster recovery and rehabilitation** of sector value chains. This strategy is complemented by **disaster responses** that include new procedures to handle service disturbances up to 2030 and the development of tailored automated Intelligent Transport Systems after that. **Ecosystem resilience and provisioning services** in this pathway take the form of tailored protection structures, first by using marine life friendly materials and, after 2030, by strengthening the nexus port protection-energy production.

The **Capacity Expansion (APT B)** and **System Restructuring (APT D)** scenarios offer a higher level of investment but diverge in the commitment to policy change, which is low on the first case and high on the later. In terms of **human capital** differences across the two pathways developed in these scenarios are not significant. The only slight variation is an initial investment in behavioural change in APT B, that soon (after 2030) reverts to social dialogue, the preferred option in APT D throughout the century. The reason for such initial investment could be driven by a perceived small departure from the current status quo in a scenario were resources to invest are large, which in turn, translates in the need for additional education of the Archipelago's sector agents. In both pathways **financial capital** is initially focused on incentives to retreat from higher-risk areas that are later followed by the deployment of risk-sharing mechanisms such as insurance. **Natural capital** options are only available in APT D (not in APT B) and in this scenario's pathway, after an initial focus on restricting the development in low-lying risk areas there is a shift to the preservation of marketable natural resources via the investment in refrigeration and/or cooling systems. On the other hand, the APT B scenario includes the possibility to investment in **physical capital**. In this particular case, the Azorean maritime transport pathway clearly favours investments in the operationality and flexibility of ports in detriment of vessels. In relation to managing the long-term climate risk both pathways favour the climate proofing of existing infrastructure and activities, with the notable exception of a middle of the century planed revision of the localization and size of port infrastructures in APT D pathway. **Ecosystem resilience and provisioning services** in both these high-investment pathways take the form of integrated port protection-energy production structures, while **regulation and maintenance services** (available only in APT B but not in APT D) focus exclusively on hard coastal protection infrastructures, again in detriment of vessel technology.

Finally, the sector pathway in the **Efficiency Enhancing (APT C)** scenario (medium investment and medium change in policy commitment) is characterized by the flexibility of actions along the time. The Azorean maritime transportation sector will alternate between options targeting social dialogue and awareness raising (**human capital**), trade diversification and climate resilient jobs (**social capital**), and restrictions to the development in high-risk areas and investments in refrigeration and/or cooling systems for marketable products (**natural capital**). The same flexibility is seen in the **management of long-term disaster risks**, with the pathway considering the planed revision of the localization and size of port infrastructures up to 2030, followed by the climate proofing of ports and port activities. Similarly, **preparedness** actions will focus on an initial stepping up of the sector's infrastructures repair and maintenance efforts to be followed by the development of new early warning systems and monitoring schemes. Regarding **ecosystem resilience and services** in this pathway, the maritime transportation sector will, unlike in ATP B and D, focus initially on marine friendly coastal protections and ship technology, to be followed by more classical coastal protection structures (**regulation and maintenance services)** some with integrated energy technology (**provisioning services**). One additional feature of this pathway is related to **cultural services** (only available in the APT C scenario), where the sector will seek to better integrate ports in urban tissue over construction of new ocean pools.

Local knowledge options were focused on coastline protection and reflect the relevance of this issue for the Azorean maritime transport sector, in the four pathways. All pathways reflect the need for continuous maintenance of infrastructures, while coastal monitoring systems are centred around the short and long term. This is potentially in line with the prospects of using adaptive management in the region (i.e., review adaptation decisions over time in line with changes in risks factors), which would facilitate incremental

adaptation despite the level of investment scenarios. Additionally, such an approach can avoid locking-in the sector choices into hard infrastructures that are later difficult to revert.

Sustainability Performance

Figure 15 - Pathways evaluation for the maritime transport sector considering: Cost Efficiency; Environmental protection; Mitigation (GHG emissions) win-wins and trade-offs; Technical applicability; Social acceptability. The policy pathways scenarios: APT A - Minimum Intervention; APT B - Economic Capacity Expansion (ECE); APT C- Efficiency Enhancement (EE); APT D - System Restructuring (SR), for different timeframes: S - Short term (up to 2030), M- Medium term (up to 2050), L - Long term (until 2100)

All four adaptation pathways for the Azorean maritime transport sector up to 2100 reveal a similar structure in terms of their sustainability performance. These pathways are comprised of measures that have a relatively high **social acceptability** and medium **technical acceptability** and **cost efficiency**. However, these sector pathways will have difficulty in meeting the archipelago's **mitigation objectives** and will not perform well in terms of future **environmental protection**. This particularly relevant in APT A and D pathways, curiously those responding to scenarios with the lowest (highest) investment and policy change levels, respectively. In fact, the pathway with the highest investment and policy change levels and that preconizes a system restructuring (APT D) underperforms the other pathways in all sustainability criteria, with the noteworthy exception of technical applicability.

4.1.3 Energy

Energy pathways are based on choices made by 6 expert island stakeholders.

Selected Adaptation Pathways

ID	Name	Class number	APT A			APT B			APT C			APT D		
			S	M	L	S	M	L	S	M	L	S	M	L
E2	Financial support for smart control of energy in houses and	1					B						D	
E1	Financial support for buildings with low energy needs	1					B						D	
E9	Green jobs and businesses	2		A			B			C			D	
E10	Public information service on climate action	2		A			B			C			D	
E11	Small scale production and consumption (prosumers)	3								C				
E12	Risk reporting platform	3								C				
E13	Energy storage systems	4								C			D	
E14	Collection and storage of forest fuel loads	4								C			D	
E16	Demand Side Management (DSM) of Energy	5					B							
E15	Seawater Air Conditioning (SWAC)	5					B							
E17	Review building codes of the energy infrastructure	6		A			B			C			D	
E18	Upgrade evaporative cooling systems	6		A			B			C			D	
E19	Early Warning Systems (EWS)	7								C				
E20	Grid reliability	7								C				
E22	Energy-independent facilities (generators)	8		A										
E21	Study and develop energy grid connections	8		A										
E24	Local recovery energy outage capacity	9		A									D	
E23	Energy recovery microgrids	9		A									D	
E3	Energy efficiency in urban water management	10		A			B			C			D	
E4	Underground tubes and piping in urban planning	10		A			B			C			D	
E5	Biomass power from household waste	11					B			C				
E6	Urban green corridors	11					B			C				
E7	Educational garden plots	12								C				
E8	Heated pools with waste heat from power plants	12								C				
E25	Develop risk maps for the electrical infrastructure	Local		A			B			C			D	
E26	Assess and map impacts caused in quality and power reserves	Local		A			B			C			D	

Figure 16 - Adaptation options for the energy sector. Options are identified with an ID number, full name, and class of adaptation number. Adaptation objectives are identified in each option by colour: ***vulnerability reduction (red), Disaster Risk Reduction (blue); Social-Ecological Resilience (green); Local Knowledge adaptation options (grey).*** *Each ATP (APT A; APT B; APT C; APT D) is represented in three timeframes: S - Short term (up to 2030), M- Medium term (up to 2050), L - Long term (until 2100). Highlighted options indicate the measure was selected in each ATP and timeframe: ATP A – Minimum Intervention (light blue); ATP B – Economic Capacity Expansion (light green); ATP C – Efficiency Enhancement (Light orange) and ATP D – System Restructuring (light purple). Bold letters in each ATP indicate the option was available to be selected in the three time frames. Grey cells mean that they the options was not available in that APT.*

In general, the energy sector in Azores is characterized by a homogenous selection of adaptation options in all adaptation policy trajectories (APTs). This indicates that the measures/options within each adaptation class are selected regardless of the different scenarios and timeframes.

Across all ATPs, for **vulnerability reduction**, pathways mainly rely on green jobs (**Human capital**; all ATPs) and energy storage (**Natural capital**; ATP C and D). Green jobs can support Azores reliance on adaptation energy issues while serving as a form of economic diversification, reducing the dependency on the Tourism sector. In contrast, public information on climate action (also Human capital; all APTs) is not part of the pathways since it is assumed that there is and will be a sufficient level public information in the island for it to pursue climate action. Energy storage is part of pathways characterized by medium to high commitment and investment, something that is expected when considering its relevance for energy services reliability and decarbonization. The collection of forest fuel loads (**Natural capital**; ATP C and D) is limited in Azores Energy pathways because forest fires are not an issue in the region. In all other vulnerability reduction classes, adaptation measures are endorsed in the time frames where they most clearly respond to the climate risks or reflect expected sector changes. This seems to happen regardless of whether these options are dependent on technologies that are already in use today or in an initial development stage. For

example, houses with low energy needs (**Financial capital**; ATP B and D) may prove to be necessary in the short term, later evolving to smart houses in the mid and end-century time frames.

For Disaster Risk Reduction, a path is set to climate proof structures (**Managing long term risk;** All APTs), which is in line with the observed violent weather events which put the energy infrastructure in Azores under stress. Towards the end of the century, the path is set to continue to have a local recovery energy outage capacity. This will allow the islands to continue to be able to recover from disasters (or malfunctions) using a proven concept instead of using a novel and conceptual architecture based on microgrids. Evaporative cooling (**Managing long term risk**; All APTs) is excluded from the pathways because this is a technology that has proven to be unreliable and unsuited for the islands needs and climate mainly due to the high humidity levels in Azores. In addition, the measure on Grid connections between different islands proves to be economically unfeasible given the investment cost and lack of operational savings due to reliability constrains. It is considered more prudent to rely on backup power based on each island rather than depending upon a grid connection which is more vulnerable to climate hazards.

Regarding **Social-Ecological Resilience**, in **provisioning services** (all ATPs) not only show a preference for proven technology but also the need to respond to the growing problem of water scarcity in some islands. Underground piping for cooling can be a difficult energy resource concept to grasp and to account for in energy planning. Waste to energy solutions (Regulating and Maintenance Services) were preferred as the islands already have significant green areas. These solutions need Combined Heat and Power (CHP) and Combined Cold Heat and Power (CCHP) to be implemented, something which is not in use in the islands. This is because there are only a few industries working and because the existing ones did not prefer to have them. Heated pools (Cultural services), another form of CHP, were not a chosen option, thus disregarding their tourism potential to provide an off-season offer as well as to provide emergency heat sinking for power plants. Thus, Educational Garden plots were preferred instead.

The choice in local knowledge measures addresses the risks posed by extreme weather events. The second option that is chosen towards the end of the century relates with the decarbonization process and the impact of Renewable Energy Sources (RES) in the energy service quality and reliability.

Sustainability Performance

Figure 17 - Pathways evaluation for the energy sector considering: Cost Efficiency; Environmental protection; Mitigation (GHG emissions) win-wins and trade-offs; Technical applicability; Social acceptability. The policy pathways scenarios: APT A - Minimum Intervention; APT B - Economic Capacity Expansion (ECE); APT C- Efficiency Enhancement (EE); APT D - System Restructuring (SR), for different timeframes: S - Short term (up to 2030), M- Medium term (up to 2050), L - Long term (until 2100)

All four pathways in the Energy sector have a similar evaluation across all timeframes. In the energy sector, the analysis showed no differences in the scoring of criteria as a reflection of the different ATP narratives.

The cost efficiency of the pathways is the same in all APTs. The environmental protection has an overall low value but with differences in APT A (lower value), APT B and D (intermediate value) and APT C (highest value). Mitigation performance is higher and shows a wider range of values. APT A (minimal intervention) has the lowest value and APT B (capacity expansion) the highest, leaving C (efficiency enhancement) and D (system restructuring) in the middle. The option for a high use of low emissions technology is coherent with a capacity expansion scenario where high investment is the main solution for climate change challenges. Technical Ability is similar across all APTs and has an intermediate value.

Social acceptability has the highest values with APT D having more and APT B less. It can be expected that APT D would have the most challenging options in terms of social acceptability because it is the scenario with the highest commitment to policy change. It is assumed that a higher commitment could better cope with options which have a lower social acceptance. Using the same principal, in APT B (low commitment) could have had a higher (than D) social acceptability result. APTs A and C have intermediate results, which are within what can be expected from them, especially for C. In APT A this is because there are is also low

investment, which limits the available options, and APT C because it is an intermediate policy scenario (medium commitment with medium investment).

4.2 Balearic Islands

For these Islands, a different methodology was used and explained in the island report made by the IFP (UIB). The reasons present for not being possible to follow the proposed methodological framework are summarized in the following points:

- The personal interview approach was considered to be the most appropriate to obtain the views of the most representative stakeholders for three addressed sectors of the blue economy.
- This approach made it possible to understand the reasoning behind each choice and, at the same time, to clarify any doubts or misinterpretations that the questions may have caused during the exercise, in order to better qualify the information collected.
- Each interviewee was asked to choose different time frames between two adaptation options for a total of 24 options, and then to prioritize between 6 specific options from local knowledge.
- Each interviewee only responded according to their own point of view, placing themselves in a different APT than what they believed, the responses might be biased and not reflect reality.
- Consequently, in some sectors there will be empty columns, due to the fact that we did not find interviewees who fit all the profiles.
- For the Balearic Islands the process was similar to the one in the Canary Islands but based in a lesser number of stakeholders

The results presented below are just indicative of an approximation made to the standard Online Workshop framework.

4.2.1 Tourism

Tourism pathways are based on choices made by 2 expert island stakeholders.

Selected Adaptation Pathways

ID	Name	Class number	APT A			APT B			APT C			APT D		
			S	M	L	S	M	L	S	M	L	S	M	L
T1	Economic Policy Instruments (EPIs)	1					B						D	
T2	Financial incentives to retreat from high-risk areas	1					B						D	
T9	Activity and product diversification	2		A			B			C			D	
T10	Public awareness programmes	2		A			B			C			D	
T11	Local circular economy	3								C				
T12	Tourist awareness campaigns	3								C				
T13	Local sustainable fishing	4								C			D	
T14	Water restrictions, consumption cuts and grey-water recycling	4								C			D	
T15	Beach nourishment	5					B							
T16	Desalination	5					B							
T17	Coastal protection structures	6		A			B			C			D	
T18	Drought and water conservation plans	6		A			B			C			D	
T19	Mainstreaming Disaster Risk Management (DRM)	7								C				
T20	Using water to cope with heat waves	7								C				
T21	Fire management plans	8		A										
T22	Health care delivery systems	8		A										
T23	Post-Disaster recovery funds	9		A									D	
T24	Pre-disaster early recovery planning	9		A									D	
T3	Adaptation of groundwater management	10		A			B			C			D	
T4	Monitoring, modelling and forecasting systems	10		A			B			C			D	
T5	Dune restoration and rehabilitation	11					B			C				
T6	River rehabilitation and restoration	11					B			C				
T7	Adaptive management of natural habitats	12								C				
T8	Ocean pools	12								C				
T25	Thermal isolation of buildings	Local		A			B			C			D	
T26	Zero sewage discharge to the sea	Local		A			B			C			D	
T27	Distributed electric grids powered by renewables	Local		A			B			C			D	
T28	Forest fire prevention	Local		A			B			C			D	
T29	Effective plan of water demand management and investment in re	Local		A			B			C			D	
T30	Residual organic matter composting to reduce methane emissions,	Local		A			B			C			D	

Figure 18 - Adaptation options for the tourism sector. Options are identified with an ID number, full name, and class of adaptation number. Adaptation objectives are identified in each option by colour: ***vulnerability reduction (red), Disaster Risk Reduction (blue); Social-Ecological Resilience (green); Local Knowledge adaptation options (grey).*** *Each ATP (APT A; APT B; APT C; APT D) is represented in three timeframes: S - Short term (up to 2030), M- Medium term (up to 2050), L - Long term (until 2100). Highlighted options indicate the measure was selected in each ATP and timeframe: ATP A – Minimum Intervention (light blue); ATP B – Economic Capacity Expansion (light green); ATP C – Efficiency Enhancement (Light orange) and ATP D – System Restructuring (light purple). Bold letters in each ATP indicate the option was available to be selected in the three time frames. Grey cells mean that they the options was not available in that APT.*

The adaptation options and choices for the tourism sector are summarized in Figure 18. At first glance, it can be noted that the *APT A (Minimum Intervention)* and *APT B (Economic capacity expansion)* have not been supported by any of the experts.

Vulnerability Reduction

The first class of adaptation considered under the reduction of socio-economic vulnerability is *Financial Capital*. In this case, there is only APT D scenario, where the adaptation option *Economic Policy Instruments (EPIs) (T1)* was selected in the short and medium-term. While for the long-term, the adaptation option *Financial incentives to retreat from high-risk areas (T2)*, was chosen since these are much deeper and structural measures, which involve relocating people, that it is difficult to do in a short period of time.

When considering Human Capital, between the two Adaptation Policy Trajectories analysed, there is a clear difference. For APT D, *Public awareness programmes* (T10) is selected for all time frames. Seeing awareness, as a crucial aspect for citizens to be aware of the importance of nature and its resources, as a driver of change. Whereas, in APT C, *Activity and product diversification* (T9) is selected for all time frames. Seeing this measure as more urgent, in the belief that awareness is most useful when people see real alternatives.

In the *Social Capital* class, the adaptation options are available only under the APT C – Efficiency Enhancement, where *Local circular economy (T11)* is selected in all time frames in opposition to *Tourist awareness campaigns (T12)*. With the idea that we have to start now, since there is little time. Being too late to start raising awareness among tourist, if we want to achieve changes in the short-term.

Regarding the fourth class, *Natural Capital*, the APTs considered are C and D. From the two options available, *Local sustainable fishing* (T13) and *Water restrictions, consumption cuts and grey-water recycling* (T14), the chosen one under both APTs and in all timeframes is the latter. The pathways developed consider the growing evolution of the climate change risks in particular for the Balearic Islands: the urgency to respond to water scarcity, one of the biggest issues in the archipelago. Water must be managed correctly, as there is a great shortage of water, with many tourists, swimming pools, etc. Action must be taken, regulating it more efficiently in order to achieve a responsible management of water. However, T13 is also seen as important for the archipelago.

Disaster Risk Reduction

For *Disaster Risk Reduction*, and to manage long term risk, the decisions need to be sensible to the level of investment and reflect the climate change risk identified for the region. *Drought and water conservation plans (T18)* is the most important measure for the region throughout the scenarios. However, APT C includes *Managing long term risk* and *Coastal protection (T17)* on the long-term, clearly showing, once again, the issue of water scarcity.

The Efficiency Enhancement scenario (ATP C) is the only scenario which considers the *Preparedness* class. *Mainstreaming DRM (T19)* was selected in the short-term, because it is something that needs to be developed immediately. While *Using water to cope with heat waves (T20)* has been selected for medium and long-term.

In *Post disaster recovery*, to address DRR on the tourism sector, in APT D, the *Pre-disaster early recovery planning (T24)* was selected for all time frames over *Post-disaster recovery funds (T23)*. Even if T23 is also important, many future problems could be solved with T24, while there is still a lot to do in this sense.

Social-Ecological Resilience

For *Provisioning services*. *Adaptation of groundwater management* (T3) is urgent for APT D in all time frames, due to the importance of a healthy ecosystem; if we protect ourselves, there is no need for a monitoring system. However, incorporating *Monitoring, modelling and forecasting systems* (T4) for APT C is important in the medium and longer term, because the most severe impacts of climate change will occur in the upcoming years.

Regulating and maintenance services, is considered only in scenario C. Where the priority for *Dune restoration and rehabilitation* (T5) is shown, since beaches are already suffering. Then for the long-term, *River rehabilitation and restoration* (T6) is selected, because right now they are not so affected, but they will be in the future. However, it should be noted that both are seen as important.

Cultural services are only considered for the APT C - Efficiency Enhancement (medium investment and medium commitment to policy change scenario). In this case, the region considered to dedicate efforts in the short and medium-term to preserve and minimize the impacts on biodiversity and ecosystems, while also preserving the attractiveness of the region (*Adaptive management of natural habitats* - T7). As opposed to *Ocean pools* (T8), in the long-term.

Local Knowledge adaptation options

The specific adaptation options for the tourism sector include solutions of various kinds. Where the problem of water scarcity throughout the archipelago can be clearly seen, being *Effective plan of water demand management and investment in reducing losses along the water distribution system (T29)* the most urgent adaptation

option selected along with T27. The issue of the huge energy consumption the tourism sector has becomes clear, as *Distributed electric grids powered by renewables (T27)* is also selected as urgent. Showing the need this sector has to transform its energy into renewable sources. The *Zero sewage discharge to the sea (T26)* is also clearly emphasized in both APTs, due to the impact it has in the entire marine ecosystem.

Even if they are selected for the end of the century or not selected, the other measures are also important for the archipelago, but having to choose among six options for three scenarios, shows the priority other measures have. *Thermal isolation of buildings (T25)* is crucial since the Balearic Islands Architects Association recognises around 45% of buildings at the island exhibit a deficient level of thermal isolation; and the potential reduction of energy consumption and emissions would range from 30 to 80% with respect to the current levels. Then, the problem of wildfires is mainly due to the lack of management and prevention of them. The measure *Forest fire prevention* (T28) emphasises the importance of prevention rather than action to extinguish the fire, which would be a much more effective measure. *Residual organic matter composting to reduce methane emissions (T30)* shows how the issue of waste it is also a major problem on the islands, especially the challenge of properly managing organic waste.

Sustainability Performance

Figure 19 - Pathways evaluation for the maritime transport sector considering: Cost Efficiency; Environmental protection; Mitigation (GHG emissions) win-wins and trade-offs; Technical applicability; Social acceptability. The policy pathways scenarios: APT A - Minimum Intervention; APT B - Economic Capacity Expansion (ECE); APT C- Efficiency Enhancement (EE); APT D - System Restructuring (SR), for different timeframes: S - Short term (up to 2030), M- Medium term (up to 2050), L - Long term (until 2100)

The pathways selected in the Tourism sector in the Balearic Islands, APT C (Efficiency Enhancement) and APT D (System Restructuring), have almost an identical evaluation across all timeframes. Moreover, the analysis showed no significant differences in the scoring of criteria as a reflection of these two different ATP narratives.

The cost efficiency of the pathways is the one with highest score, and the rest have a medium score, practically similar. On this sector there is no one with a lower value. In conclusion, not many differences between APTs are made clear.

4.2.2 Maritime Transport

As all islands, the Balearic exhibit high dependency from imports and exports and, as a consequence, from the maritime transport and port operations. Additionally, to the extent in which the Balearic also show an extreme economic dependence from tourism, it exacerbates the necessity of a wide range of intermediate and final goods import, and also encourages the development of an extensive sector of recreational navigation. Nowadays, the Balearic holds around 24.200 boat mooring points, 5% of the whole Mediterranean Sea and 17% of those held by the Spanish coasts. As a result, the economy of the Balearic Islands is highly exposed to the climate change hazards that affect the marine conditions for navigability and keeping port operations on.

To date, relevant stakeholders from port activity have not scheduled time to participate providing information either through questionnaires or through in-depth interviews. Yet, their participation over the next few weeks is still open so this absence could be reversed before SOCLIMPACT ends and their opinions would be included in further versions of the present Deliverable. In any case, opinions from the best adaptation options for this sector of activity have been collected from SOCLIMPACT researchers belonging to local research institutions, who besides having a vast knowledge of the effects of climate change in the Mediterranean and especially in the Balearic Islands, are familiar with port infrastructures, after having participated in some working sessions on the expected impacts of climate change on the Balearic economy and society. In those sessions, they had the opportunity to meet high representatives of the Archipelago ports sector and exchange relevant information about the challenges Balearic ports will face due to climate change impacts.

Complementarily, we have resorted to indirect sources of information about plans and policies related to climate change mitigation and adaptation in the field of maritime transport and ports at the Balearic Islands. In a recent Report by the Economic and Social Council of the Balearic Government 2019 (file:///D:/descargas/CES-UIB%20H2030%20SEPARATA.pdf), it was informed that the authority is starting to study the vulnerability factors for the maritime infrastructures, a priori appointing to the relevance of the sea level rise, as it exacerbates the potential damages from high waves and storm surges (pg.36). For that purpose, the regional Government, which co-manage together with the Spanish central port authority the whole regional port system, hired the services of the Maritime Engineering laboratory of the Universitat Politècnica de Catalunya (LIM / UPC) to develop a detailed plan of climate plan adaptation assisted by complex numeric modelling.

In addition, in June 2020 a General Plan for Ports of the Balearic Islands was launched planning to concentrate main efforts to ameliorate and strengthen the current port infrastructures to better face climate change and adapt to the future challenges of the maritime transport, refusing to build new ports or enlarge those which are currently operative. This information, also in the hands of the key informants, will be useful to contextualise the answers provided, together with the research outcomes delivered from SOCLIMPACT Project in previous phases, as well as from other research projects. Regarding this, it is relevant to underline that extreme wind and waves and storm surges height are not expected to increase around the Balearic Islands over the present century in any of the studied emissions scenarios. As a consequence, sea level rise and the frequency of extreme heat are the main hazards that will threaten the operability of the Balearic Islands ports over the levels already mentioned above.

Knowing what is currently being undertaken and what is already planned to prepare ports and the maritime transport for climate change impacts, allowed consulted experts to provide an accurate opinion of what really needs to be done and over what time horizon in the Balearic Islands. The following section displays the tables containing the experts' opinions gathered from questionnaires and in-depth interviews.

Selected Adaptation Pathways

ID	Name	Class number	APT A			APT B			APT C			APT D		
			S	M	L	S	M	L	S	M	L	S	M	L
MT1	Insurance mechanisms for ports	1					B						D	
MT2	Financial incentives to retreat from high-risk areas	1					B						D	
MT9	Awareness campaigns for behavioural change	2		A			B			C			D	
MT10	Social dialogue for training in the port sector	2		A			B			C			D	
MT11	Diversification of trade using climate resilient commodities	3								C				
MT12	Climate resilient economy and jobs	3								C				
MT13	Refrigeration, cooling and ventilation systems	4								C			D	
MT14	Restrict development and settlement in low-lying areas	4								C			D	
MT15	Sturdiness improvement of vessels	5					B							
MT16	Increase operational speed and flexibility in ports	5					B							
MT17	Climate proof ports and port activities	6		A			B			C			D	
MT18	Consider expansion/retreat of ports in urban planning	6		A			B			C			D	
MT19	Reinforcement of inspection, repair and maintenance of infrastruct	7								C				
MT20	Early Warning Systems (EWS) and climate change monitoring	7								C				
MT21	Inteligent Transport Systems (ITS)	8		A										
MT22	Prepare for service delays or cancellations	8		A										
MT23	Backup routes and infrastructures during extreme weather	9		A									D	
MT24	Post-Disaster recovery funds	9		A									D	
MT3	Marine life friendly coastal protection structures	10		A			B			C			D	
MT4	Combined protection and wave energy infrastructures	10		A			B			C			D	
MT5	Hybrid and full electric ship propulsion	11					B			C				
MT6	Coastal protection structures	11					B			C				
MT7	Integrate ports in urban tissue	12								C				
MT8	Ocean pools	12								C				
MT25	Development of an adaptation plan to adequate infrastructure to c	Local		A			B			C			D	
MT26	Improve and ensure operational safety in ship repair	Local		A			B			C			D	
MT27	Develop the potential of maritime navigation between the Balearic	Local		A			B			C			D	
MT28	Strengthen and prepare the provisioning system to heat waves	Local		A			B			C			D	
MT29	Improve monitoring systems	Local		A			B			C			D	
MT30	Encourage the adaptation of recreational marinas to the main clim	Local		A			B			C			D	

Figure 20 - Adaptation options for the maritime transport sector. Options are identified with an ID number, full name, and class of adaptation number. Adaptation objectives are identified in each option by colour: ***vulnerability reduction (red), Disaster Risk Reduction (blue); Social-Ecological Resilience (green); Local Knowledge adaptation options (grey).*** *Each ATP (APT A; APT B; APT C; APT D) is represented in three timeframes: S - Short term (up to 2030), M- Medium term (up to 2050), L - Long term (until 2100). Highlighted options indicate the measure was selected in each ATP and timeframe: ATP A – Minimum Intervention (light blue); ATP B – Economic Capacity Expansion (light green); ATP C – Efficiency Enhancement (Light orange) and ATP D – System Restructuring (light purple). Bold letters in each ATP indicate the option was available to be selected in the three time frames. Grey cells mean that they the options was not available in that APT.*

The adaptation options and choices for the maritime transport sector are summarized in Figure 20. At first glance, it can be noted that the *APT A (Minimum Intervention)* and *APT B (Economic capacity expansion)* have not been supported by any of the experts.

Vulnerability Reduction

The first class of adaptation considered under the reduction of socio-economic vulnerability is *Financial Capital*. In this case, there is only APT D scenario, where the adaptation option *Insurance mechanisms for ports (MT1)* was selected in all time frames over *Financial incentives to retreat from high-risk areas (MT2)*. Basically, because there is no way to retract from high-risk areas as there is no space available to expand or locate the ports.

When considering *Human Capital*, both Adaptation Policy Trajectories analysed are quite similar. Both consider important to start with *Awareness campaigns for behavioural change (MT9),* so that money to protect ports can be justified. APT C considers that MT9 should be extended until 2050 since 2030 is very close, and the effects of CC will be seen at the end of the century. In contrast, APT D shows that *Social dialogue for training in the port sector (MT10)* should start earlier, in the mid-term and be extended to the long-term,

since MT9 would be already implemented for that time, and the port sector should be trained on how to act, giving security.

In the *Social Capital* class, the adaptation options are available only under the APT C – Efficiency Enhancement, where *Diversification of trade using climate resilient commodities (MT11)* is preferred over *Climate resilient economy and jobs (MT12)*.

Regarding the fourth class, *Natural Capital*, the APTs considered are C and D. From the two options available, *Refrigeration, cooling and ventilation systems (MT13)* and *Restrict development and settlement in low-lying areas (MT14)*, the chosen one under both APTs and in all timeframes is the latter; since it makes more sense than the MT13, with little chance of improving the thermal conditions of the stevedores.

Disaster Risk Reduction

For *Disaster Risk Reduction*, and to manage long term risk, the decisions need to be sensible to the level of investment and reflect the climate change risk identified for the region. *Climate proof ports and port activities (MT17)* is clearly seen as the priority. Climate change risks have to be analysed, to better adapt and prepare for those impacts. All investments must take climate change into account before moving forward with them. *Consider expansion/retreat of ports in urban planning (MT18)* does not make sense for this archipelago, since there is no possible location for relocating the ports.

The Efficiency Enhancement scenario (ATP C) is the only scenario which considers the *Preparedness* class. *Reinforcement of inspection, repair and maintenance of infrastructure (T19)* was selected in all time frames over *Early Warning Systems (EWS) and climate change monitoring (MT20)*. Since the latter, despite being crucial, is already in place. The monitoring of the ports, on the other hand, is something local that they have to do.

In *Post disaster recovery*, to address DRR on the tourism sector, in APT D, *Backup routes and infrastructures during extreme weather (MT23)* was selected for all time frames over *Post-Disaster recovery funds (MT24)*.

Social-Ecological Resilience

For *Provisioning services*. *Marine life friendly coastal protection structures (MT3)* is urgent for APT C in the short-term, due to the importance of protecting marine life. As it is currently a process that is already underway, for the medium and long-term *Combined protection and wave energy infrastructures (MT4)* is selected; being important to ensure that this infrastructure can be made productive from the investments that are made. In contrast, for APT D it is just the opposite, selecting MT4 for the short and medium-term, and MT4 in the long term.

Regulating and maintenance services, is considered only in scenario C. Where the priority for *Hybrid and full electric ship propulsion (MT5)* is shown, because to lessen the fuel used by ships is crucial, since vessels pollute the marine environment. Then for the long-term, *Coastal protection structures (MT6)* is selected, because is when the greatest rise in the sea level will occur, and when the structure can be affected.

In regard to *Cultural services,* the sector will seek to better *Integrate ports in urban tissue (MT7)* over construction of new Ocean pools (MT8) as the latter is not seen as a relevant aspect for this sector.

Local Knowledge adaptation options

Local knowledge options are mainly focused on coastline and infrastructure protection, reflecting how having safe and operational ports is of paramount importance for the Balearic maritime transport sector: *Development of an adaptation plan to adequate infrastructure to climate threats (MT25)* and *Encourage the adaptation of recreational marinas to the main climate change hazards (MT30)*. MT25 focuses on adapting mooring structures,

increase of dikes and the free board in old docks, particularly to the rise in sea level, so as to enable the Balearic Islands to maintain and improve their position in international recreational boating and recreational cruise traffic. Also highlighting the importance of freight traffic. And MT30, to stimulate and encourage the adaptation of recreational marinas to the main climate change hazards, in order to guarantee the operation and future expansion of recreational sailing. Nautical activities are of special importance for the Balearic Islands tourism, since tourism accounts for about 45% of the GDP.

Linked to climate hazards, to *Improve monitoring systems (MT29),* since they still can be improved, Identifying operational working windows in case of extreme events. Then, *Improve and ensure operational safety in ship repair (MT26)* to improve and guarantee the operational safety of large ship repair activity against climatic events, the Balearic Islands being very specialized in recreational boating and mega-yachts. Also, transfer knowledge and capacities for the adaptation to climate change to the Spanish peninsula and the Mediterranean region, which will guarantee their future connectivity with the Balearic Islands and the development of the potential of maritime navigation between the Balearic Islands and the Mediterranean region: *Develop the potential of maritime navigation between the Balearic Islands and the Mediterranean region (MT27)*. Lastly, *Strengthen and prepare the provisioning system to heat waves (MT28*), to reinforce and improve, in the face of possible climatic events, in particular to heat waves, the storage areas.

Sustainability Performance

Figure 21 - Pathways evaluation for the maritime transport sector considering: Cost Efficiency; Environmental protection; Mitigation (GHG emissions) win-wins and trade-offs; Technical applicability; Social acceptability. The policy pathways scenarios: APT A - Minimum Intervention; APT B - Economic Capacity Expansion (ECE); APT C- Efficiency Enhancement (EE); APT D - System Restructuring (SR), for different timeframes: S - Short term (up to 2030), M- Medium term (up to 2050), L - Long term (until 2100)

The pathways selected in the Maritime Transport sector in the Balearic Islands, APT C (Efficiency Enhancement) and APT D (System Restructuring), all four adaptation pathways reveal a similar structure during the three timeframes considered, according to the answers obtained. Social acceptability shows the highest score along with technical applicability. While the other three; cost efficiency, environmental protection and mitigation win-wins and trade-offs show medium score. The only time frame that shows a clearer variation is the third one (end-century), where environmental protection scores the lowest for APT C.

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4.2.3 Energy

Energy pathways are based on choices made by 1 expert island stakeholders.

Selected Adaptation Pathways

ID	Name	Class number	APT A			APT B			APT C			APT D		
			S	M	L	S	M	L	S	M	L	S	M	L
E1	Financial support for buildings with low energy needs	1					B						D	
E2	Financial support for smart control of energy in houses and building	1					B						D	
E9	Green jobs and businesses	2		A			B			C			D	
E10	Public information service on climate action	2		A			B			C			D	
E11	Small scale production and consumption (prosumers)	3								C				
E12	Risk reporting platform	3								C				
E13	Energy storage systems	4								C			D	
E14	Collection and storage of forest fuel loads	4								C			D	
E15	SeaWater Air Conditioning (SWAC).	5					B							
E16	Demand Side Mangement (DSM) of Energy	5					B							
E17	Review building codes of the energy infrastructure	6		A			B			C			D	
E18	Upgrade evaporative cooling systems	6		A			B			C			D	
E19	Early Warning Systems (EWS)	7								C				
E20	Grid reliability	7								C				
E21	Study and develop energy grid connections	8		A										
E22	Energy-independent facilities (generators)	8		A										
E23	Energy recovery microgrids	9		A									D	
E24	Local recovery energy outage capacity	9		A									D	
E3	Energy efficiency in urban water management	10		A			B			C			D	
E4	Underground tubes and piping in urban planning	10		A			B			C			D	
E5	Biomass power from household waste	11					B			C				
E6	Urban green corridors	11					B			C				
E7	Educational garden plots	12								C				
E8	Heated pools with waste heat from power plants	12								C				
E25	Promotion of domestic and small-scale photovoltaic solar energy	Local		A			B			C			D	
E26	Financial support for the energy rehabilitation of buildings	Local		A			B			C			D	
E27	Mass development of the public transport network powered by rer	Local		A			B			C			D	
E28	Encourage electric individual transport and car-sharing	Local		A			B			C			D	
E29	Training development in installation and thermal insulation of build	Local		A			B			C			D	
E30	Promoting storage systems for renewable energy installations	Local		A			B			C			D	

Figure 22 - Adaptation options for the energy sector. Options are identified with an ID number, full name, and class of adaptation number. Adaptation objectives are identified in each option by colour: ***vulnerability reduction (red), Disaster Risk Reduction (blue); Social-Ecological Resilience (green); Local Knowledge adaptation options (grey).*** *Each ATP (APT A; APT B; APT C; APT D) is represented in three timeframes: S - Short term (up to 2030), M- Medium term (up to 2050), L - Long term (until 2100). Highlighted options indicate the measure was selected in each ATP and timeframe: ATP A – Minimum Intervention (light blue); ATP B – Economic Capacity Expansion (light green); ATP C – Efficiency Enhancement (Light orange) and ATP D – System Restructuring (light purple). Bold letters in each ATP indicate the option was available to be selected in the three time frames. Grey cells mean that they the options was not available in that APT.*

The adaptation options and choices for the energy sector are summarized in Figure 22. Being APT D *(System restructuring)* the only one supported.

Vulnerability Reduction

The first class of adaptation considered under the reduction of socio-economic vulnerability is *Financial Capital*. In this case, the adaptation option *Financial support for buildings with low energy needs (E1)* is necessary in the short and medium-term. While *Financial support for smart control for energy in houses and buildings* (E2) has been selected for the long-term, showing the need of evolving to smart houses in the end-century.

When considering *Human Capital*, for the only Adaptation Policy Trajectories analysed (APT D), sees as urgent need for *Green jobs and businesses (E9),* where a radical change is needed. These being able to support the Balearic Islands reliance on adaptation energy issues while serving as a form of economic diversification,

reducing the dependency on the Tourism sector. Then, *Public information service on climate action (E10)* being selected for the medium and long-term.

Regarding the fourth class, *Natural Capital*, APT D selected *Collection and storage of forest fuel loads (E14)* as a required for the short-term, since it is something they are already suffering from. Followed by *Energy storage systems (E13)* for the medium and long-term, since in the short-term they will not be so necessary, as they are not so developed yet. It is expected to have a surplus of renewable energy and this will be required. Energy storage is crucial for energy services reliability and decarbonization objectives, since it will be key to the development and penetration of renewable energy.

Disaster Risk Reduction

For Disaster Risk Reduction, and to *Manage long term risk*, the decisions need to be sensible to the level of investment and reflect the climate change risk identified for the region. APT D considers *Review building codes of the energy infrastructure (E17)* a priority in the short and medium term, since many things need to be changed in order to adapt to climate change. Then, *upgrade evaporative cooling systems (E18)* for the long term, in case the technology already exists for the end of the century.

In *Post disaster recovery*, to address DRR on the energy sector, in APT D, the *Local recovery energy outage capacity (E24)* was selected for the shorter term, whereas *Energy recovery microgrids (E23)* for the medium and longer term, in order to make them more autonomous.

Social-Ecological Resilience

For *Provisioning services*. *Energy efficiency in urban water management (E3)* is urgent for the sector in all time frames. Showing again, the need to respond to the growing problem of water scarcity in the archipelago. E3 was selected over *Underground tubes and piping in urban planning (E4)* since it can be a difficult energy resource concept to grasp and to account for in energy planning.

Local Knowledge adaptation options

The specific adaptation options for the energy sector include solutions of various kinds. Taking APT D, *Promotion of domestic and small-scale photovoltaic solar energy (E25)* and *Financial support for the energy rehabilitation of buildings (E26)* are categorized as urgent. It is urgent to encourage the massive development of photovoltaic energy sources (the one with most potential on the islands) on rooftops, instead of creating photovoltaic parks that occupy territory that could be used for other uses. These incentives would allow citizens to install solar panels, thus socialising electricity production. Then, E25 will allow improvements in old buildings with terrible energy efficiency. Usually, owners cannot afford to insulate the house, in order to make it passive building. In addition, it could give many people an alternative job.

Then the *Mass development of the public transport network powered by renewable energies (E27)* it is also of vital importance. Improving the public transport network will reduce the GHG emissions, making it much more effective and useful for citizens, in order to encourage its use. In particular, developing the railway network (tramway networks), taking advantage of the existing infrastructure of the old railway network. GHG emissions cannot be reduced if this following measure is not applied: *Encourage electric individual transport and car-sharing (E28)*. This measure is focused on individual mobility, promoting the use of hydrogen-powered vehicles. Additionally, encouraging the use of vehicle sharing, in order to avoid the need to acquire a vehicle to move around the islands. The concept of sharing includes cars, motorbikes and bicycles.

Then, to condition housing, *Training development in installation and thermal insulation of buildings (E29)* would be necessary, which consist in training initiatives in installation and thermal insulation of buildings. Lastly, with the aim of solving or diminishing surplus problems, the idea of *Promoting storage systems for renewable energy*

installations (E30). Being key, since besides being the most mature technology and the one that has the most potential in the islands, photovoltaic energy is the one that everyone can adopt.

Sustainability Performance

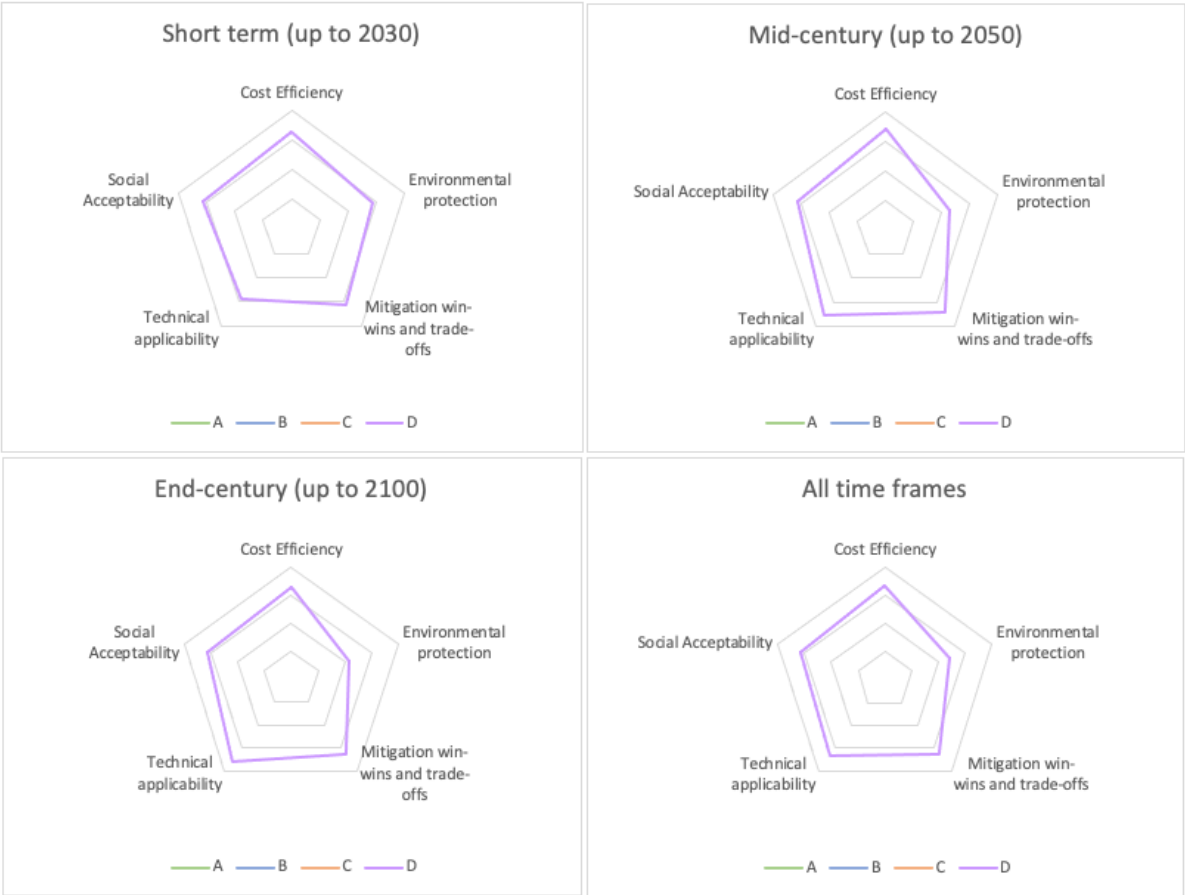

Figure 23 - Pathways evaluation for the maritime transport sector considering: Cost Efficiency; Environmental protection; Mitigation (GHG emissions) win-wins and trade-offs; Technical applicability; Social acceptability. The policy pathways scenarios: APT A - Minimum Intervention; APT B - Economic Capacity Expansion (ECE); APT C- Efficiency Enhancement (EE); APT D - System Restructuring (SR), for different timeframes: S - Short term (up to 2030), M- Medium term (up to 2050), L - Long term (until 2100)

The only pathway selected in the Energy sector in the Balearic Islands is APT D (System Restructuring), All four adaptation pathways reveal a similar structure during the three timeframes considered: scoring high in four criteria (cost efficiency, social acceptability, technical applicability and mitigation wins-wins and trade-offs) except for the short-term scenario, where environmental protection criterion also scores high. In this scenario, the five criteria score practically the same. Whereas in the other two scenarios, environmental protection scores the lowest by a considerable difference.

4.3 Canary Islands

For these Islands, a different methodology was used and explained in the island report made by the IFP (ULPGC). The reasons present for not being possible to follow the proposed methodological framework are summarized in the following points:

- The personal interview approach was considered to be the most appropriate to obtain the views of the most representative stakeholders for three addressed sectors of the blue economy.
- This approach made it possible to understand the reasoning behind each choice and, at the same time, to clarify any doubts or misinterpretations that the questions may have caused during the exercise, in order to better qualify the information collected.
- Each interviewee was asked to choose different time frames between two adaptation options for a total of 24 options, and then to prioritize between 6 specific options from local knowledge.
- Each interviewee only responded according to their own point of view, placing themselves in a different APT than what they believed, the responses might be biased and not reflect reality.
- Consequently, in some sectors there will be empty columns, due to the fact that we did not find interviewees who fit all the profiles.
- For the Canary Islands the process was similar to the one in the Balearic Islands but based in a greater number of stakeholders

The results presented below are just indicative of an approximation made to the standard Online Workshop framework.

4.3.1 Tourism

Tourism pathways are based on choices made by 4 expert island stakeholders. As a total of 12 interviews were conducted, more information will be generated from these.

Selected Adaptation Pathways

ID	Name	Class number	APT A			APT B			APT C			APT D		
			S	M	L	S	M	L	S	M	L	S	M	L
T1	Economic Policy Instruments (EPIs)	1					B						D	
T2	Financial incentives to retreat from high-risk areas	1					B						D	
T9	Activity and product diversification	2		A			B			C			D	
T10	Public awareness programmes	2		A			B			C			D	
T11	Local circular economy	3								C				
T12	Tourist awareness campaigns	3								C				
T13	Local sustainable fishing	4								C			D	
T14	Water restrictions, consumption cuts and grey-water recycling	4								C			D	
T15	Beach nourishment	5					B							
T16	Desalination	5					B							
T17	Coastal protection structures	6		A			B			C			D	
T18	Drought and water conservation plans	6		A			B			C			D	
T19	Mainstreaming Disaster Risk Management (DRM)	7								C				
T20	Using water to cope with heat waves	7								C				
T21	Fire management plans	8		A										
T22	Health care delivery systems	8		A										
T23	Post-Disaster recovery funds	9		A									D	
T24	Pre-disaster early recovery planning	9		A									D	
T3	Adaptation of groundwater management	10		A			B			C			D	
T4	Monitoring, modelling and forecasting systems	10		A			B			C			D	
T5	Dune restoration and rehabilitation	11					B			C				
T6	River rehabilitation and restoration	11					B			C				
T7	Adaptive management of natural habitats	12								C				
T8	Ocean pools	12								C				
T25	Passive, low carbon adaptation of tourist buildings	Local		A			B			C			D	
T26	Zero sewage discharge to the sea	Local		A			B			C			D	
T27	Distributed electric grids powered by renewables	Local		A			B			C			D	
T28	Forest fire prevention	Local		A			B			C			D	
T29	Bottom-up managed marine protected micro-areas	Local		A			B			C			D	
T30	Residual organic matter composting to reduce methane emissions	Local		A			B			C			D	

Figure 24 - Adaptation options for the tourism sector. Options are identified with an ID number, full name, and class of adaptation number. Adaptation objectives are identified in each option by colour: ***vulnerability reduction (red), Disaster Risk Reduction (blue); Social-Ecological Resilience (green); Local Knowledge adaptation options (grey).*** *Each ATP (APT A; APT B; APT C; APT D) is represented in three timeframes: S - Short term (up to 2030), M- Medium term (up to 2050), L - Long term (until 2100). Highlighted options indicate the measure was selected in each ATP and timeframe: ATP A – Minimum Intervention (light blue); ATP B – Economic Capacity Expansion (light green); ATP C – Efficiency Enhancement (Light orange) and ATP D – System Restructuring (light purple). Bold letters in each ATP indicate the option was available to be selected in the three time frames. Grey cells mean that they the options was not available in that APT.*

The adaptation options and choices for the tourism sector are summarized in Figure 24.

Vulnerability Reduction

The first class of adaptation considered under the reduction of socio-economic vulnerability is *Financial Capital*. In this case, the adaptation option *Financial incentives to retreat from high-risk areas (T2)* has only been selected under APT B in the medium- and long-term. Conversely, the adaptation option *Economic Policy Instruments (EPIs)* (T1) has been chosen under APT B in the short-term (up to 2030), and under APT D in all timeframes: under the believe that the adaptation option T2 does not solve the problem. This is explained by the difference in vision in each APT: since APT B, which instead of reorienting the economy and making it more resilient (as APT D), focuses more on large investment to prepare the economy for future changes.

When considering *Human Capital*, all the Adaptation Policy Trajectories are analysed, and two adaptation measures are possible: *Activity and product diversification* (T9) and *Public awareness programmes* (T10). Here there is also a clear difference between the different APTs. For APT C and D, investment in public awareness can be appropriate for the short-term since these awareness programmes also diversify, but then the importance of activities and products diversification gain importance in the mid and long-term. Whereas,

for APT A and B it is just the opposite, where it is believed that there will be no diversification without awareness. Diversification will be brought about by the training of human capital.

The same pattern occurs for *Social Capital* class, where *Tourist awareness campaigns (T12)* were selected for the short-term in opposition to *Local circular economy (T11)* which gain relevance in the middle and long-term. On this one, the adaptation options are available only under the APT C – Efficiency Enhancement. Showing the importance of awareness, as the beginning of many things. But also, how awareness is also the result of other kinds of actions.

Regarding the fourth class, *Natural Capital*, the APTs considered are C and D. From the two options available, *Local sustainable fishing* (T13) and *Water restrictions, consumption cuts and grey-water recycling* (T14), the chosen one under both APTs and in all timeframes is the latter. The pathways developed consider the growing evolution of the climate change risks in particular for the Canary Islands: the urgency to respond to water scarcity, one of the biggest issues in the archipelago.

The final class included actions to reduce socio-economic vulnerability is *Physical Capital*. In this case, only the APT B – Economic Capacity Expansion is considered. While *Desalination* (T16) is selected in the short- and medium-term, *Beach nourishment* (T15) is the preferred option for the timeframe up to 2100 (long-term). Again, the issue of water scarcity is made clear here, whereas by the middle of the century progress will have been made in this area, and beaches will have to be nourished at the end of the century due to the impacts of climate change and rising sea levels.

Disaster Risk Reduction

For *Disaster Risk Reduction*, and to manage long term risk, the decisions need to be sensible to the level of investment and reflect the climate change risk identified for the region. In *Managing long term risk, Coastal protection (T17)* is the most important for the region throughout the scenarios. However, for APT D, *Drought and water conservation plans (T18)* are vital and a priority in the short term; although, it has to be mentioned that both measures are seen as equally important on this APT. In contrast to ATP A and B, include T18 on the long term.

The Efficiency Enhancement scenario (ATP C) is the only scenario which considers the *Preparedness* class. In all the time frames, *Mainstreaming DRM (T19)* was selected in detriment of *Using water to cope with heat waves (T20)*. Being a more global and generic measure, and therefore more important.

For the *Disaster response* class, the risks related with fire – *Fire management plans (T21)* - were considered high in all time periods in the Canary Islands, in contrast to *Health care delivery systems (T22)*. The pathway clearly reflects the climate-risk context of the region.

In *Post disaster recovery*, to address DRR on the tourism sector, in both APTs (A and D), the *Pre-disaster early recovery planning (T24)* was selected for all time frames, since many future problems could be solved this way and there is still a lot to do in this sense. Except for APT A where in the short-term *Post-disaster recovery funds (T23)* was selected, mainly due to the low probability of T24 effectiveness in the short term. Being necessary to continue to promote planning and allocate funds to develop climate change resilience in the region.

Social-Ecological Resilience

For *Provisioning services. Adaptation of groundwater management (T3)* is urgent for the sector in the short-term, however, incorporating *Monitoring, modelling and forecasting systems (T4)* for the medium and longer term it is important, since there is still a lot to do in this field. This does not mean that adaptation option T3 is not important, but this is because even if groundwater management is done badly, it is being done; in contrast to the other measure (T4), where there is still more to be done.

Regulating and maintenance services, is considered only for APT B and C scenarios, where the priority for *Dune restoration and rehabilitation* (T5) is shown. The tourism sector will benefit from the maintenance of dunes as this has a positive impact on tourism, since one of the biggest attractions of the destination are its beaches. However, for APT B, *River rehabilitation and restoration* (T6) is selected for mid and long term; showing again the importance of water for this region.

Cultural services are only considered for the APT C - Efficiency Enhancement (medium investment and medium commitment to policy change scenario). In this case, the region considered to dedicate efforts in all time frames to preserve and minimize the impacts on biodiversity and ecosystems, while also preserving the attractiveness of the region (*Adaptive management of natural habitats* - T7). As opposed to *Ocean pools* (T8), since T7 is more general, which includes the latter.

Local Knowledge adaptation options

The specific adaptation options for the tourism sector include solutions of various kinds. Where the problem of sewage throughout the archipelago can be clearly seen, being *Zero sewage discharge to the sea* (T26) the most urgent adaptation option selected in all APTs. Then if we take APT C and D, the issue of the huge energy consumption the tourism sector has becomes clear, as *Distributed electric grids powered by renewables* (T27) is also selected as urgent. Showing the need this sector has to transform its energy into renewable sources. The problem of wildfires is mainly due to the lack of management and prevention of them. The measure *Forest fire prevention* (T28) emphasises the importance of prevention rather than action to extinguish the fire, which would be a much more effective measure. This one is clearly emphasized in all APTs. Then, *Bottom-up managed marine protected micro-areas* (T29) appear to be important, due to the value the coastal resources have for the islands both, for their inhabitants and for the attractiveness to tourists. Even if it has been selected for the long term, the issue of waste is also a major problem on the islands, especially the challenge of properly managing organic waste. In particular, in APT A and B, *Residual organic matter composting to reduce methane emissions (T30)* has been highlighted for the short and medium term. Ultimately, even if *Passive, low carbon adaptation of tourist buildings* (T25) has not been selected in any scenario, it does not mean it is not important, but having to choose among six options for three scenarios, shows the priority other measures have.

Sustainability Performance

Figure 25 - Pathways evaluation for the tourism sector considering: Cost Efficiency; Environmental protection; Mitigation (GHG emissions) win-wins and trade-offs; Technical applicability; Social acceptability. The policy pathways scenarios: APT A - Minimum Intervention; APT B - Economic Capacity Expansion (ECE); APT C- Efficiency Enhancement (EE); APT D - System Restructuring (SR), for different timeframes: S - Short term (up to 2030), M- Medium term (up to 2050), L - Long term (until 2100)

The performance of the four ATP scenarios for tourism sector are the ones that vary more between them (compared to the other sectors) during the three timeframes considered, even if they still keep some sort of similarity. In general, scenarios show a high level of cost efficiency, environmental protection and technical applicability, and medium mitigation win-wins and trade-off. While social acceptability has the lowest performance and varies most among the different APTs.

For middle term, pathway scenarios perform quite similar. However, for short-term and end of the century differences are more visible. In the short-term, the minimum intervention scenario (APT A) and the economic capacity expansion scenario (APT B) tend to have socially acceptable options and adaptation solutions with technical applicability, and lower mitigation win-wins and trade-offs. However, the efficiency enhancement scenario (APT C) and the system restructuring scenario (APT D) tend to have higher cost-efficiency, higher environmental protection and higher mitigation win-wins and trade-offs. In the case of the mid-century (up to 2050), the structure of the spider diagram is similar, but the difference between ATPs decreases. Finally, at the end of the century, the APT A has higher scores on social acceptability, environmental protection and mitigation win-wins and trade-offs than the rest of APTs. APT B scores lowest in all criteria used to evaluate the adaptation pathways performance, while APT D scores highest in technical applicability.

4.3.2 Maritime Transport

Maritime transport pathways are based on choices made by 1 expert island stakeholders.

Selected Adaptation Pathways

ID	Name	lass numbe	APT A			APT B			APT C			APT D		
			S	M	L	S	M	L	S	M	L	S	M	L
MT1	Insurance mechanisms for ports	1					B						D	
MT2	Financial incentives to retreat from high-risk areas	1					B						D	
MT9	Awareness campaigns for behavioural change	2		A			B			C			D	
MT10	Social dialogue for training in the port sector	2		A			B			C			D	
MT11	Diversification of trade using climate resilient commodities	3								C				
MT12	Climate resilient economy and jobs	3								C				
MT13	Refrigeration, cooling and ventilation systems	4								C			D	
MT14	Restrict development and settlement in low-lying areas	4								C			D	
MT15	Sturdiness improvement of vessels	5					B							
MT16	Increase operational speed and flexibility in ports	5					B							
MT17	Climate proof ports and port activities	6		A			B			C			D	
MT18	Consider expansion/retreat of ports in urban planning	6		A			B			C			D	
MT19	Reinforcement of inspection, repair and maintenance of infrastructures	7								C				
MT20	Early Warning Systems (EWS) and climate change monitoring	7								C				
MT21	Inteligent Transport Systems (ITS)	8		A										
MT22	Prepare for service delays or cancellations	8		A										
MT23	Backup routes and infrastructures during extreme weather	9		A									D	
MT24	Post-Disaster recovery funds	9		A									D	
MT3	Marine life friendly coastal protection structures	10		A			B			C			D	
MT4	Combined protection and wave energy infrastructures	10		A			B			C			D	
MT5	Hybrid and full electric ship propulsion	11					B			C				
MT6	Coastal protection structures	11					B			C				
MT7	Integrate ports in urban tissue	12								C				
MT8	Ocean pools	12								C				
MT25	Adapt infrastructure to climate threats	Local		A			B			C			D	
MT26	Improve and ensure operational safety in ship repair	Local		A			B			C			D	
MT27	Develop the potential of maritime navigation between the Canary Islands	Local		A			B			C			D	
MT28	Strengthen and improve the bunkering facilities	Local		A			B			C			D	
MT29	To plan the expansion of the port linked to the locational rent of the islan	Local		A			B			C			D	
MT30	Encourage the adaptation of recreational marinas to the main climate cha	Local		A			B			C			D	

Figure 26 - Adaptation options for the maritime transport sector. Options are identified with an ID number, full name, and class of adaptation number. Adaptation objectives are identified in each option by colour: ***vulnerability reduction (red), Disaster Risk Reduction (blue); Social-Ecological Resilience (green); Local Knowledge adaptation options (grey).*** *Each ATP (APT A; APT B; APT C; APT D) is represented in three timeframes: S - Short term (up to 2030), M- Medium term (up to 2050), L - Long term (until 2100). Highlighted options indicate the measure was selected in each ATP and timeframe: ATP A – Minimum Intervention (light blue); ATP B – Economic Capacity Expansion (light green); ATP C – Efficiency Enhancement (Light orange) and ATP D – System Restructuring (light purple). Bold letters in each ATP indicate the option was available to be selected in the three time frames. Grey cells mean that they the options was not available in that APT.*

The adaptation options and choices for the maritime transport sector are summarized in Figure 26.

Since only one interview was conducted, and as mentioned above, each respondent only answered in regard to their own point of view, for the maritime transport only APT C (Efficiency Enhancing) will be analysed. This scenario (medium investment and medium change in policy commitment) is characterized by the flexibility of actions along the time.

Vulnerability Reduction

In this case, the Canarian maritime transport sector is quite clear on its priorities, selecting most of the measures for all time frames. When considering *Social dialogue for training in the port sector (MT10)* is selected, since it is much more important for the port to train the port sector on how to act, which gives security, rather than creating *Awareness campaigns for behavioural change (MT9).*

Regarding *Social capital*, the *Diversification of trade using climate resilient commodities (MT11)* is preferred over *Climate resilient economy and jobs (MT12)*,

In terms of *Natural Capital*, *Refrigeration, cooling and ventilation systems (MT13)* are preferred over *Restrict development and settlement in low-lying areas (MT14)*, since keeping passengers, employees and goods in good thermal conditions is of vital importance for the operation and good service of the port.

Disaster Risk Reduction

For *Management of long-term disaster risks, Climate proof ports and port activities (MT17)* is clearly seen as the priority. Climate change risks have to be analysed, to better adapt and prepare for those impacts. All investments must take climate change into account before moving forward with them.

In terms of *Preparedness,* it is of great urgency to implement *Early Warning Systems (EWS) and climate change monitoring (MT20)*, being one of the most important measures to be implemented. Being the most immediate and easy thing to implement. Having that information, enables to make a decision on how to deal with these changes and act on the different infrastructures depending on what that alert tells.

Social-Ecological Resilience

Provisioning services will focus initially on *Marine life friendly coastal protection structures (MT3)* and for the long-term *Combined protection and wave energy infrastructures (MT4).* Protecting marine life is essential, but then it is important to ensure that this infrastructure can be made productive from the investments that are made.

In terms of *Regulating and maintenance services,* it will be a combination of both options. However, *Coastal protection structures (MT6)* are selected for the short term since *Hybrid and full electric ship propulsion (MT5)* is not realistic in the short term. However, to lessen the fuel used by ships is crucial.

In regard to *Cultural services,* the sector will seek to better *Integrate ports in urban tissue (MT7)* over construction of new Ocean pools (MT8) as the latter is not seen as a relevant aspect for this sector.

Local Knowledge adaptation options

Local knowledge options are mainly focused on coastline and infrastructure protection, reflecting how having safe and operational ports is of paramount importance for the Canarian maritime transport sector: *Adapt infrastructure to climate threats (MT25)* and *Encourage the adaptation of recreational marinas to the main climate change hazards (MT30).* By adapting mooring structures and related services, especially the electrical connection to ships during the stay in port (cold ironing), to climatic threats, and particularly to the rise in sea level, so as to enable the Canary Islands to maintain and improve their position in international recreational cruise traffic. Same for recreational marinas.

After the tourism sector (direct and indirect), only the sub-sectors that we include in the blue economy, especially port activity and maritime transport have a significant weight in the region's GDP (around 7%). This means that preparing and strengthening these sectors in the face of the threat of climate change is key for the Islands. Therefore, *To plan the expansion of the port linked to the locational rent of the island in areas not exposed*

to risks (MT29) is also important from the point of view of diversification of the Canarian economy, since the actions that strengthen the competences of the Canary Islands in the territorial waters (as defined in the new Statute) are of fundamental importance. Planning with climate security (areas not exposed to risks) the expansion of the port area to accommodate new and more activity related to the opportunities offered by the special regimes of the Canary Islands (RUP, ZEC, Registry of ships (REBECA); with special attention to mobility and the relationship between the port and the city.

Then, *Improve and ensure operational safety in ship repair (MT26)* aims to improve and guarantee the operational safety of ship repair activity against climatic events, including shipyards and workshops with deep-sea repair capacity. Also, to transfer knowledge and capacities for the adaptation to climate change of nearby West African ports, which will guarantee their future connectivity with the Canary Islands and the development of the potential of maritime navigation between the Canary Islands and North West Africa: *Develop the potential of maritime navigation between the Canary Islands and North-West Africa (MT27)*. Lastly, *Strengthen and improve bunkering facilities (MT28*), since the bunkering activity is one of the most important activities the Canarian ports, in order to favour the transition to the use of new fuels and the electrical connection to the ships. This initiative would include cutting edge solutions in the adoption of bunkering facilities to power renewable energy-based technologies.

Sustainability Performance

Figure 27 - Pathways evaluation for the maritime transport sector considering: Cost Efficiency; Environmental protection; Mitigation (GHG emissions) win-wins and trade-offs; Technical applicability; Social acceptability. The policy pathways scenarios: APT A - Minimum Intervention; APT B - Economic Capacity Expansion (ECE); APT C- Efficiency Enhancement (EE); APT D - System Restructuring (SR), for different timeframes: S - Short term (up to 2030), M- Medium term (up to 2050), L - Long term (until 2100)

The only pathway selected in the Maritime Transport sector in the Canary Islands is APT C (Efficiency Enhancement). All four adaptation pathways for the Canarian maritime transport sector reveal a similar structure during the three timeframes considered, according to the answer obtained. Social acceptability shows the highest score, while technical applicability and cost efficiency show medium score, and environmental protection and mitigation win-wins and trade-offs the lowest. Moreover, except for the cost efficiency criterion, all the criteria score equal or lower over time.

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4.3.3 Energy

Energy pathways are based on choices made by 4 expert island stakeholders.

Selected Adaptation Pathways

ID	Name	Class number	APT A			APT B			APT C			APT D		
			S	M	L	S	M	L	S	M	L	S	M	L
E1	Financial support for buildings with low energy needs	1					B						D	
E2	Financial support for smart control of energy in houses and buildings	1					B						D	
E9	Green jobs and businesses	2		A			B			C			D	
E10	Public information service on climate action	2		A			B			C			D	
E11	Small scale production and consumption (prosumers)	3								C				
E12	Risk reporting platform	3								C				
E13	Energy storage systems	4								C			D	
E14	Collection and storage of forest fuel loads	4								C			D	
E15	SeaWater Air Conditioning (SWAC).	5					B							
E16	Demand Side Mangement (DSM) of Energy	5					B							
E17	Review building codes of the energy infrastructure	6		A			B			C			D	
E18	Upgrade evaporative cooling systems	6		A			B			C			D	
E19	Early Warning Systems (EWS)	7								C				
E20	Grid reliability	7								C				
E21	Study and develop energy grid connections	8		A										
E22	Energy-independent facilities (generators)	8		A										
E23	Energy recovery microgrids	9		A									D	
E24	Local recovery energy outage capacity	9		A									D	
E3	Energy efficiency in urban water management	10		A			B			C			D	
E4	Underground tubes and piping in urban planning	10		A			B			C			D	
E5	Biomass power from household waste	11					B			C				
E6	Urban green corridors	11					B			C				
E7	Educational garden plots	12								C				
E8	Heated pools with waste heat from power plants	12								C				
E25	Hydrogen as energy vector	Local		A			B			C			D	
E26	Renewable technology hybridization	Local		A			B			C			D	
E27	Low and high enthalpy geothermal energy	Local		A			B			C			D	
E28	Shared self-consumption facilities	Local		A			B			C			D	
E29	Promote cogeneration	Local		A			B			C			D	
E30	Micro smart grids	Local		A			B			C			D	

Figure 28 - Adaptation options for the energy sector. Options are identified with an ID number, full name, and class of adaptation number. Adaptation objectives are identified in each option by colour: ***vulnerability reduction (red), Disaster Risk Reduction (blue); Social-Ecological Resilience (green); Local Knowledge adaptation options (grey).*** *Each ATP (APT A; APT B; APT C; APT D) is represented in three timeframes: S - Short term (up to 2030), M- Medium term (up to 2050), L - Long term (until 2100). Highlighted options indicate the measure was selected in each ATP and timeframe: ATP A – Minimum Intervention (light blue); ATP B – Economic Capacity Expansion (light green); ATP C – Efficiency Enhancement (Light orange) and ATP D – System Restructuring (light purple). Bold letters in each ATP indicate the option was available to be selected in the three time frames. Grey cells mean that they the options was not available in that APT.*

The adaptation options and choices for the energy sector are summarized in Figure 28. At first glance, it can be noted that the *APT A – Minimum Intervention* has not been supported by any of the experts.

Vulnerability Reduction

The first class of adaptation considered under the reduction of socio-economic vulnerability is *Financial Capital*. In this case, the adaptation option *Financial support for smart control for energy in houses and buildings* (E2) has been selected in both APTs (B and D) for all time frames, over *Financial support for buildings with low energy*

needs (E1). Since the Canaries are already immersed in the E1, energy efficiency certificates are already required for buildings. What is needed is financial support with regard to the digitalisation of buildings (intelligent buildings), in order to modify the structure of an existing building to lower the energy demand.

When considering *Human Capital*, the three Adaptation Policy Trajectories analysed, agreeing on the importance of *Green jobs and businesses (E9)*. These being able to support the Canaries reliance on adaptation energy issues while serving as a form of economic diversification, reducing the actual dependency on the Tourism sector. In contrast, except for APT B in the long term, *Public information service on climate action (E10)* is not part of the pathways since it is assumed that there is and will be a sufficient level public information in the island for it to pursue climate action.

The same pattern occurs for *Social Capital* class, where *Small scale production and consumption (E11)* were selected in all time frames in opposition to *Risk reporting platform (E12)*, with the idea of empowering local consumers before large companies, in order to be more resilient to the effects of climate change. On this one, the adaptation options are available only under the APT C – Efficiency Enhancement.

Regarding the fourth class, *Natural Capital*, the APTs considered are C and D. From the two options available, *Energy storage systems (E13)* was chosen over *Collection and storage of forest fuel loads (E14)* in all time frames. Even if forest fires are an issue in the Canaries, the benefits of clearing forest fuel loads are still not so clear, since plant cover has a mission and it is also essential for the forest. However, in APT C it is selected as urgent in the short term due to the big issue wildfires are in the archipelago. Energy storage is crucial for energy services reliability and decarbonization objectives, since it will be key to the development and penetration of renewable energy.

The final class included actions to reduce socio-economic vulnerability is *Physical Capital*. In this case, only the APT B – Economic Capacity Expansion is considered. Here again, *Demand Side Management (DMS) of Energy (E16)* is the preferred option in all time frames, over *Sea Water Air Conditioning (SWAC) (E15)*. Energy demand management (E16) is key in the archipelago. Even if it can be used when needed, energy storage is inefficient, since batteries often cost more than the renewable technology itself. Therefore, it is crucial to efficiently manage the energy demand.

Disaster Risk Reduction

For Disaster Risk Reduction, and to *Manage long term risk*, the decisions need to be sensible to the level of investment and reflect the climate change risk identified for the region. Except for APT D that clearly selects *Upgrade evaporative cooling systems (E18)* for all time frames, both APT B and C, consider *Review building codes of the energy infrastructure (E17)* as a priority in the short and medium term, and E18 for the long term.

The Efficiency Enhancement scenario (ATP C) is the only scenario which considers the *Preparedness* class. In all the time frames, *Grid reliability (E20)* was selected in detriment of *Early Warning Systems (EWS))*, since it is more important that the energy system is resilient to climate risk. However, in some way, both are related.

In *Post disaster recovery*, to address DRR on the energy sector, in APT D, the *Energy recovery microgrids (E23)* was selected for all time frames over *Local recovery energy outage capacity (E24)*. Micro grids are very important to recover power. Indeed, E23 encompasses E24.

Social-Ecological Resilience

For *Provisioning services*. *Energy efficiency in urban water management (E3)* is urgent for the sector in all time frames, as it is more oriented to other environments where thermal consumption does exist. Showing again, the need to respond to the growing problem of water scarcity in the archipelago. Underground piping for cooling can be a difficult energy resource concept to grasp and to account for in energy planning. However,

APT B which selects *Underground tubes and piping in urban planning (E4)* for the longer term, perhaps because of the future improvement of this technology.

Regulating and maintenance services, is considered only for APT B and C scenarios. Where the priority for *Biomass power from household waste (E5)* is shown, with the aim of taking advantage of all that can be done without affecting the ecosystem. Then, for the medium and long term *Urban green corridors (E6)* are selected, in order to decrease energy efficiency, which cannot be done overnight, whereas the first one can.

Cultural services are only considered in APT C - Efficiency Enhancement (medium investment and medium commitment to policy change scenario). In this case, it is considered to dedicate efforts in the short and medium term into *Educational garden plots (E7),* and then in the long-term *Heated pools with waste heat from power plants (E8).* Even if E7 has a more social part, and not so much the energy part, it is preferred since the Canaries are getting rid of thermal generation, and it remains to be seen if there is another way of generating electricity other than by thermal means.

Local Knowledge adaptation options

The specific adaptation options for the energy sector include solutions of various kinds. If we take APT C and D, *Promote cogeneration (E29)* and *Micro smart grids (E30)* are categorized as urgent. These show the importance of having a greater resilience, since in the event of possible power failures in the electrical system, they will always have a guaranteed power supply. Then the *Low and high enthalpy geothermal energy (E27)* which also gives stability to the electrical network. This is explained by the fact that the Canary Islands are isolated energy systems, each island generating its own electricity. Therefore, these measures are of the utmost importance, to prevent run out of energy.

The difference comes in APT D which aims to transform the current social-ecological and economic system, supports *Shared self-consumption facilities (E28).* To encourage the shared use of facilities in order to share costs and maximize the efficiency and management capacity of these facilities. While APT C, focuses on *Hydrogen as energy vector (E25)*, with the aim of using the renewable effluents for hydrogen production. The hydrogen could then be used after storage in high-pressure tanks as vehicle fuel, especially for heavy mobility. In contrast, APT B selects this measure (E25) as the priority. Followed by *Renewable technology hybridization (E26)* to assure a balanced electrical system and guarantee quality supply. For example, if photovoltaic technology means that energy is only available during daylight hours, other technologies such as wind power should be used proportionally to cover what photovoltaic technology cannot. Lastly, *Micro smart grids (E30),* with the aim of providing greater resilience; since in the event of possible power failures in the electrical system, they will always have a guaranteed power supply.

Sustainability Performance

Figure 29 - Pathways evaluation for the energy sector considering: Cost Efficiency; Environmental protection; Mitigation (GHG emissions) win-wins and trade-offs; Technical applicability; Social acceptability. The policy pathways scenarios: APT A - Minimum Intervention; APT B - Economic Capacity Expansion (ECE); APT C- Efficiency Enhancement (EE); APT D - System Restructuring (SR), for different timeframes: S - Short term (up to 2030), M- Medium term (up to 2050), L - Long term (until 2100)

All four pathways in the Energy sector have a similar evaluation across all timeframes. In the energy sector, the analysis showed no differences in the scoring of criteria as a reflection of the different ATP narratives.

The cost efficiency of the pathways is the same in all APTs. The environmental protection has an overall low value but with differences in APT D (lowest value). Mitigation performance is higher for APT D in the short-term, but similar for the rest; although this difference increases by the end of the century, having a higher score for APTs D and C. Technical Applicability and Social Acceptability are similar across all APTs and have an intermediate value, with the former presenting small differences by mid-century in APT B.

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4.3.4 Aquaculture

Aquaculture pathways are based on choices made by 2 expert island stakeholders.

Selected Adaptation Pathways

ID	Name	Class number	APT A			APT B			APT C			APT D		
			S	M	L	S	M	L	S	M	L	S	M	L
A1	Financial schemes, insurance and loans	1					B						D	
A2	Tax benefits and subsidies	1					B						D	
A9	Awareness campaigns for behavioural change	2		A			B			C			D	
A10	Efficient feed management	2		A			B			C			D	
A11	Addressing consumer and environmental concerns at the local level	3								C				
A12	Promote cooperation to local consumption	3								C				
A13	Integrated multi-trophic aquaculture (IMTA)	4								C			D	
A14	Short-cycle aquaculture	4								C			D	
A15	Recirculation Aquaculture Systems (RAS)	5					B							
A16	Submersible cages	5					B							
A17	Climate proof aquaculture activities	6		A			B			C			D	
A18	Risk-based zoning and site selection	6		A			B			C			D	
A19	Disease prevention methods	7								C				
A20	Environmental monitoring and Early Warning Systems (EWS)	7								C				
A21	Mainstreaming Disaster Risk Management (DRM)	8		A										
A22	Contingency for emergency management, earlyharvest and/or reloca	8		A										
A23	Recovery Post-Disaster plans	9		A									D	
A24	Recovery Post-Disaster funds	9		A									D	
A3	Feed production	10		A			B			C			D	
A4	Species selection	10		A			B			C			D	
A5	Selective breeding	11					B			C				
A6	Best Management Practices	11					B			C				
A7	Create educational visits	12								C				
A8	Promote aquaculture cuisine	12								C				
A25	Increase POSEI and REF incentives	Local		A			B			C			D	
A26	Knowledge transfer and financial support of emerging industries	Local		A			B			C			D	
A27	Review and streamline administrative processes	Local		A			B			C			D	
A28	Promote tourist and non-tourist consumption	Local		A			B			C			D	
A29	Favor the development of off-shore aquaculture	Local		A			B			C			D	
A30	Reformulate the POEM (Zoning)	Local		A			B			C			D	

Figure 30 - Adaptation options for the aquaculture sector. Options are identified with an ID number, full name, and class of adaptation number. Adaptation objectives are identified in each option by colour: ***vulnerability reduction (red), Disaster Risk Reduction (blue); Social-Ecological Resilience (green); Local Knowledge adaptation options (grey).*** *Each ATP (APT A; APT B; APT C; APT D) is represented in three timeframes: S - Short term (up to 2030), M- Medium term (up to 2050), L - Long term (until 2100). Highlighted options indicate the measure was selected in each ATP and timeframe: ATP A – Minimum Intervention (light blue); ATP B – Economic Capacity Expansion (light green); ATP C – Efficiency Enhancement (Light orange) and ATP D – System Restructuring (light purple). Bold letters in each ATP indicate the option was available to be selected in the three time frames. Grey cells mean that they the options was not available in that APT.*

The adaptation options and choices for the tourism sector are summarized in Figure 30. At first glance, it can be noted that the *APT A (Minimum Intervention)* and *APT D (System restructuring)* have not been supported by any of the experts.

Vulnerability Reduction

The first class of adaptation considered under the reduction of socio-economic vulnerability is *Financial Capital*. In this case, there is only APT B scenario, the adaptation option *Tax benefits and subsidies (A2)* has been selected in all time frames, over *Financial schemes, insurance and loans (A1),* because it helps investment. When companies are profitable, they need to innovate and grow. In the Canary Islands there are good tax benefits for reinvestment. Which has brought about tremendous economic development.

When considering *Human Capital*, the two Adaptation Policy Trajectories analysed, agree on the importance of *Awareness campaigns for behavioural change (A9),* over *Efficient feed management (A10)* due to the challenge it represents. Aquaculture is based on a biased and deteriorated public perception, due to of preconceived ideas. The industry is already immersed in a communication plan to change this perception.

The same pattern occurs for *Social Capital* class, where *Addressing consumer and environmental concerns at the local level (A11)* was selected in all time frames in opposition to *Promote cooperation to local consumption (A12)*, since local consumption will not be enough due to the small population, with the idea that aquaculture will progress with exports.

Regarding the fourth class, *Natural Capital*, APT C, from the two options available, *Short-cycle aquaculture (A14)* was chosen over *Integrated multi-trophic aquaculture (A13)* in all time frames. In the private sector efficiency is what matters, so if cycles are shortened, the sector will be more efficient and make it more productive. In addition, A13 does not make much sense in the Canary Islands, because the carrying capacity will never be reached, given that it is an open ocean.

The final class included actions to reduce socio-economic vulnerability is *Physical Capital*. In this case, only the APT B – Economic Capacity Expansion is considered. Here again, *Submergible cages (A16)* is the preferred option without any doubt in all time frames, over *Recirculation Aquaculture Systems (RAS) (A15)).* Aquaculture is the future if we want to have more fish available to feed the world population.

Disaster Risk Reduction

For Disaster Risk Reduction, and to *Manage long term risk*, the decisions need to be sensible to the level of investment and reflect the climate change risk identified for the region. For both APT B and C, consider *Climate proof aquaculture activities (A17)* as a priority in the short-term, since it is easier to fight the open sea and the big waves, than to be close to the land. Then *Risk-based zoning and site selection (E18)* for medium and long-term; since from the point of view of risk, when we concentrate a herd of animals, it is conducive to natural enemies. These exert a greater health risk than economic benefits; so, the more dispersion the better.

The Efficiency Enhancement scenario (ATP C) is the only scenario which considers the *Preparedness* class. In all the time frames, *Disease prevention methods (A19)* was selected in detriment of *Environmental monitoring and Early Warning Systems (EWS) (A20)* from the private sector's point of view. But from the public point of view the A20 is a necessity, public institutions have to invest in it.

Social-Ecological Resilience

For *Provisioning services*. For APT C, *Species selection (A4)* is urgent for the sector in all time frames, However, APT B which selects *Feed production (A3)* for the short and medium-term, since it has been found that nutrients that fish need can be transformed, finding new alternatives. Whereas E4 for the longer term, with the idea of replacing inefficient species.

Regulating and maintenance services, is considered only for APT B and C scenarios. Where the priority for *Selective breeding (A5)* is shown. Mainly due to the fact that it contributes to development, enables to be more efficient and more economical. This is common business practice, but it is still in its infancy and a lot to improve. A lot will be invested in the coming decades. In contrast, APT C that selects *Best management practices (A6)* as a priority in the short-term, since they are not exclusive.

Cultural services are only considered for the APT C - Efficiency Enhancement (medium investment and medium commitment to policy change scenario) - . In this case, it is considered to dedicate efforts in in the short and medium term into *Create educational visits (A7)* and then in the long-term *Promote aquaculture cuisine (A8*). Both measures will go hand in hand; it is very important that the A8 is known, but social acceptance is above that (A9). Without social acceptance there is nothing to do in the Canary Islands. A8 is vital, since the public the perception is biased, but in the chefs, there is a lot of environmental awareness, which will create awareness around consuming local products.

Local Knowledge adaptation options

The specific adaptation options for the aquaculture sector include solutions of various kinds. If we take APT C, *Reformulate the POEM (A30)* is identified as the most important. With the aim to address the impact of climate change, the criteria for determining areas to be used in the future need to be improved and expanded: planning. Increasing depth reduces impact, improves habitats, and increases production. Followed by *Review and streamline administrative processes (A27),* since improving governance is key to addressing the impact of climate change. Reviewing and streamlining administrative procedures will help minimize the impact on production volumes. Lastly*, Favour the development of offshore aquaculture (A29*), which means introducing a cultivation system that does not exist on the islands. It improves the resistance to catastrophic weather episodes as a result of climate change and consequently contributes to reducing the environmental impact, favouring an increase in production.

Regarding APT B, *Increase POSEI and REF incentives (A25*) is selected as the most urgent, as they are incentives that compensate for the distance and insularity. Followed by *Knowledge transfer and financial support of emerging industries (A26)* and *Promote tourist and non-tourist consumption (A28).* On the one hand, with the aim of enabling local production of raw materials and juveniles, and the introduction of new species more resilient to climate change and its effects. On the other hand, to increase consumption on the islands which will help to reduce emissions, enhance the zero km concept, contributes to the development of food sovereignty with high quality protein, and strengthen social cohesion. Lastly, both APTs match in the long-term measure, A29.

Sustainability Performance

Figure 31 - Pathways evaluation for the aquaculture sector considering: Cost Efficiency; Environmental protection; Mitigation (GHG emissions) win-wins and trade-offs; Technical applicability; Social acceptability. The policy pathways scenarios: APT A - Minimum Intervention; APT B - Economic Capacity Expansion (ECE); APT C- Efficiency Enhancement (EE); APT D - System Restructuring (SR), for different timeframes: S - Short term (up to 2030), M- Medium term (up to 2050), L - Long term (until 2100)

The pathways selected in the Aquaculture sector in the Canary Islands, APT B (Economic Capacity Expansion) and APT C (Efficiency Enhancement) have a similar evaluation across all timeframes. Moreover, the analysis showed no significant differences in the scoring of criteria as a reflection of these two different ATP narratives.

The cost efficiency of the pathways is the same in all APTs, and the one with highest score, along with social acceptability and technical applicability. Environmental protection and mitigation win-wins and trade-offs the ones with medium score, which decreases slightly over time in the latter case. However, not many differences between APTs are made clear.

4.4 Corsica

For these Islands two online webinars were made and spoken in French, with the presentations in French and the Online Survey Tool with the options and classes in French as well. There were no Local knowledge options proposed by the IFP (TEC-RAMBOLL) and the characterization of all adaptation options was made by the IFP.

4.4.1 Tourism

Tourism pathways are based on choices made by 5 expert island stakeholders.

Selected Adaptation Pathways

ID	Name	Class number	Ratio	APT A S	APT A M	APT A L	APT B S	APT B M	APT B L	APT C S	APT C M	APT C L	APT D S	APT D M	APT D L
T1	Instruments économiques (EPIs)	1	70%												
T2	Incitations financières à se retirer des zones de risques	1	30%												
T10	Programmes de sensibilisation du public	2	50%												
T9	Diversification des produits et de l'activité touristique	2	50%												
T11	Economie circulaire locale	3	80%												
T12	Campagne de sensibilisation des touristes	3	20%												
T14	Restriction d'usages de l'eau et recyclage	4	87%												
T13	Pêche locale durable	4	13%												
T15	Rechargement des plages	5	60%												
T16	Désalinisation	5	0%												
T17	Ouvrage de protection des côtes	6	65%												
T18	Plan de gestion des sécheresse	6	35%												
T19	Gestion des risques naturels	7	60%												
T20	Uilisation de l'eau pour le rafraîchissement urban	7	40%												
T22	Amélioration des systèmes de santé	8	73%												
T21	Plan de gestion des feux de forêt	8	27%												
T24	Plan d'anticipation des crises	9	63%												
T23	Fonds de récupération post crise	9	37%												
T4	Systèmes de suivi, modélisation et prévision	10	70%												
T3	Adaptation de la gestion des eaux souterraines	10	30%												
T5	Restauration et réhabilitation des dunes	11	60%												
T6	Restauration et réhabilitation des rivières	11	40%												
T7	Gestion adaptative des habitats naturels	12	67%												
T8	Piscines d'eau de mer	12	33%												

Figure 32 - Averaged adaptation options and pathways for the aquaculture ***sector in Corsica or organized by class of adaptation****. Options are identified with an ID number, full name, and class of adaptation number. Adaptation objectives are identified in each option by colour:* ***vulnerability reduction (red),*** *Disaster* ***Risk Reduction (blue); Social-Ecological Resilience (green); Local Knowledge adaptation options (grey).*** *Each ATP (APT A; APT B; APT C; APT D) is represented in three timeframes: S - Short term (up to 2030), M- Medium term (up to 2050), L - Long term (until 2100). Bold letters in each ATP indicate the option was available to be selected in the three time frames. Highlighted options indicate the measure was selected in each ATP and timeframe: ATP A (light blue); ATP B (light green); ATP C (Light orange) and ATP D (light purple).*

We can see in the results that:

- Few solutions linked to water (T6 River restoration, T16 : Desalination, T18 Drought management) are chosen, since water scarcity is not a real problem in Corsica
- On the short terme, actions like awareness raising campaign (T12 or T10) are chosen, while on the longer term, actions that require more investment (T9) are chosen.

In APTA, actions that are less resource intensive (T10) are prefered to actions more intensive in investment (T12). Respondents explained during the WS n°2, that raising awareness of tourists that removing seagrass banks on the beaches can be detrimental to beach erosion, is a cost intensive and high impact measure.

In APTB, economic instruments (T1) are preferred over incentives to relocate activities, which is in line with the economic orientation of the scenario.

In APTC, circular economy (T11), is by far prefered to tourist awarenss raising (T12). Circular economy is an important challenge with large political interest in Corsica.

From APT A to D, and especially in APTD, the diversification of tourism (T9) is chosen earlier and more often than awareness raising (T10). This illustrates the good understanding of APTs by respondents.

When compared to the results compiled to 8 other SOCLIMPACT islands (Figure 33). It appears that Corsica makes the same hierarchisation of choices, except for water. Indeed, since Corsica is a low-risk area for water scarcity, the adaptation solutions linked to this risk are less chosen.

ID	Name	Class number	Ratio	APT A			APT B			APT C			APT D		
				S	M	L	S	M	L	S	M	L	S	M	L
T2	Financial incentives to retreat from high-risk areas	1	44%												
T1	Economic Policy Instruments (EPIs)	1	56%												
T10	Public awareness programmes	2	38%												
T9	Activity and product diversification	2	62%												
T12	Tourist awareness campaigns	3	34%												
T11	Local circular economy	3	66%												
T13	Local sustainable fishing	4	41%												
T14	Water restrictions, consumption cuts and grey-water	4	59%												
T16	Desalination	5	46%												
T15	Beach nourishment	5	54%												
T18	Drought and water conservation plans	6	50%												
T17	Coastal protection structures	6	50%												
T20	Using water to cope with heat waves	7	31%												
T19	Mainstreaming Disaster Risk Management (DRM)	7	69%												
T21	Fire management plans	8	49%												
T22	Health care delivery systems	8	51%												
T23	Post-Disaster recovery funds	9	38%												
T24	Pre-disaster early recovery planning	9	62%												
T3	Adaptation of groundwater management	10	44%												
T4	Monitoring, modelling and forecasting systems	10	56%												
T5	Dune restoration and rehabilitation	11	48%												
T6	River rehabilitation and restoration	11	52%												
T8	Ocean pools	12	32%												
T7	Adaptive management of natural habitats	12	68%												

Figure 33 - Averaged adaptation options and pathways for the tourism ***sector in 8 other islands (Azores, Crete, Cyprus, Fehmarn, Madeira, Malta, Sardinia and Sicily****).). Options are identified with an ID number, full name, and class of adaptation number. Adaptation objectives are identified in each option by colour:* ***vulnerability reduction (red),*** *Disaster* ***Risk Reduction (blue); Social-Ecological Resilience (green).*** *Each ATP (APT A; APT B; APT C; APT D) is represented in three timeframes: S - Short term (up to 2030), M- Medium term (up to 2050), L - Long term (until 2100). Bold letters in each ATP indicate the option was available to be selected in the three time frames. Highlighted options indicate the measure was selected in each ATP and timeframe: ATP A (light blue); ATP B (light green); ATP C (Light orange) and ATP D (light purple).*

Sustainability Performance

Figure 34 - Pathways evaluation for the tourism sector considering: Cost Efficiency; Environmental protection; Mitigation (GHG emissions) win-wins and trade-offs; Technical applicability; Social acceptability. The policy pathways scenarios: APT A - Minimum Intervention; APT B - Economic Capacity Expansion (ECE); APT C- Efficiency Enhancement (EE); APT D - System Restructuring (SR), for different timeframes: S - Short term (up to 2030), M- Medium term (up to 2050), L - Long term (until 2100)

The performance of the four ATP scenarios for tourism sector are considerably similar during the three timeframes considered. In general, scenarios show a high level of social acceptability and technical applicability and a medium cost efficiency and environmental protection with a low performance in mitigation win-wins and trade-offs.

Some differences across pathways exist:

- APTA (minimal intervention) tends to have a higher acceptability (since little action is taken) than others.
- APTD (system restructuring) contributes more to environmental protection, which is also understandable, since this is a very voluntarist scenario.
- APT C (system efficiency) has a better score for mitigation.

4.4.2 Aquaculture

Aquaculture pathways are based on choices made by 3 expert island stakeholders. Given that the minimum threshold for data processing was 3 interviews, and that the 3rd interview was only received after the 2nd workshop, we decided to process the result, but we could not collect the feedback of stakeholders.

Selected Adaptation Pathways

We can see in the results that there is a clear hierarchy of stakeholders preference (Figure 35), the Multitrophic integrated aquaculture is often chosen, as well as local consumption, species selection, disease prevention; while short cycle aquaculture or fish food production are more rarely chosen.

ID	Name	Class number	Ratio	APT A			APT B			APT C			APT D		
				S	M	L	S	M	L	S	M	L	S	M	L
A13	Aquaculture intégrée multi-trophique (IMTA)	4	78%												
A12	Promition de la consommation locale des produits de l'aquac	3	78%												
A4	Sélection d'espèces	10	75%												
A19	Méthode de prévention des maladies	7	67%												
A16	Cages submersibles	5	67%												
A9	Sensibilisation et changement de comportements	2	58%												
A8	Promotion de recettes à base de poissons d'élevage	12	56%												
A5	Elevage de souches résistantes	11	56%												
A24	Fonds pour la récupération post crise	9	56%												
A21	Gestion des risques naturels	8	56%												
A17	Infrastructures d'aquaculture résistante au climat	6	53%												
A1	Dispositifs financiers, assurances et prêts	1	50%												
A2	Taxes et subventions	1	50%												
A18	Zonage et sélection de sites	6	47%												
A7	Organisation de visites éducatives	12	44%												
A6	Amélioration de la gestion globale	11	44%												
A22	Plan de déplacement des fermes aquacoles	8	44%												
A23	Plan de récupération post crise	8	44%												
A10	Amélioration du nourrissage / alimentation	2	42%												
A20	Suivi environnementale et système d'alerte précoce	7	33%												
A15	Aquaculture indoor avec recirculation de l'eau	5	33%												
A3	Actions sur la production d'aliments pour poissons	10	25%												
A11	Répondre aux attentes environnementales au niveau locale	3	22%												
A14	Aquaculture à cycle de production court	4	22%												

Figure 35 - Averaged adaptation options and pathways for the aquaculture ***sector in Corsica or organized by order of preference****. Options are identified with an ID number, full name, and class of adaptation number. Adaptation objectives are identified in each option by colour:* ***vulnerability reduction (red),*** *Disaster* ***Risk Reduction (blue); Social-Ecological Resilience (green); Local Knowledge adaptation options (grey).*** *Each ATP (APT A; APT B; APT C; APT D) is represented in three timeframes: S - Short term (up to 2030), M- Medium term (up to 2050), L - Long term (until 2100). Bold letters in each ATP indicate the option was available to be selected in the three time frames. Highlighted options indicate the measure was selected in each ATP and timeframe: ATP A (light blue); ATP B (light green); ATP C (Light orange) and ATP D (light purple).*

When choices and APT are considered (Figure 35), we see that:

- Local consumption of aquaculture products (A12) is preferred to Local environmental concerns (A11).
- Integrated multitrophic aquaculture (A13) is preferred by far too short cycle aquaculture (A14)
- Submersible cages (A16) are preferred to indoor aquaculture (A15)
- Species selection (A4) are preferred to fish food improvement (A3)

In APTA, short term soft measures are preferred more often and at long term, while in APT B, C, and even more on D, actions including some restructuring of relocation are chose, which seems consistent with the pathway's rationale.

ID	Name	Class number	Ratio	APT A			APT B			APT C			APT D		
				S	M	L	S	M	L	S	M	L	S	M	L
A1	Dispositifs financiers, assurances et prêts	1	50%												
A2	Taxes et subventions	1	50%												
A9	Sensibilisation et changement de comportements	2	58%												
A10	Amélioration du nourrissage / alimentation	2	42%												
A12	Promition de la consommation locale des produits de	3	78%												
A11	Répondre aux attentes environnementales au niveau locale	3	22%												
A13	Aquaculture intégrée multi-trophique (IMTA)	4	78%												
A14	Aquaculture à cycle de production court	4	22%												
A16	Cages submersibles	5	67%												
A15	Aquaculture indoor avec recirculation de l'eau	5	33%												
A17	Infrastructures d'aquaculture résistante au climat	6	53%												
A18	Zonage et sélection de sites	6	47%												
A19	Méthode de prévention des maladies	7	67%												
A20	Suivi environnementale et système d'alerte précoce	7	33%												
A21	Gestion des risques naturels	8	56%												
A22	Plan de déplacement des fermes aquacoles	8	44%												
A23	Plan de récupération post crise	8	44%												
A24	Fonds pour la récupération post crise	9	56%												
A4	Sélection d'espèces	10	75%												
A3	Actions sur la production d'aliments pour poissons	10	25%												
A5	Elevage de souches résistantes	11	56%												
A6	Amélioration de la gestion globale	11	44%												
A8	Promotion de recettes à base de poissons d'élevage	12	56%												
A7	Organisation de visites éducatives	12	44%												

Figure 36- Averaged adaptation options and pathways for the aquaculture ***sector in Corsica or organized by class of adaptation****. Options are identified with an ID number, full name, and class of adaptation number. Adaptation objectives are identified in each option by colour:* ***vulnerability reduction (red),*** *Disaster* ***Risk Reduction (blue); Social-Ecological Resilience (green); Local Knowledge adaptation options (grey).*** *Each ATP (APT A; APT B; APT C; APT D) is represented in three timeframes: S - Short term (up to 2030), M- Medium term (up to 2050), L - Long term (until 2100). Bold letters in each ATP indicate the option was available to be selected in the three time frames. Highlighted options indicate the measure was selected in each ATP and timeframe: ATP A (light blue); ATP B (light green); ATP C (Light orange) and ATP D (light purple).*

Sustainability Performance

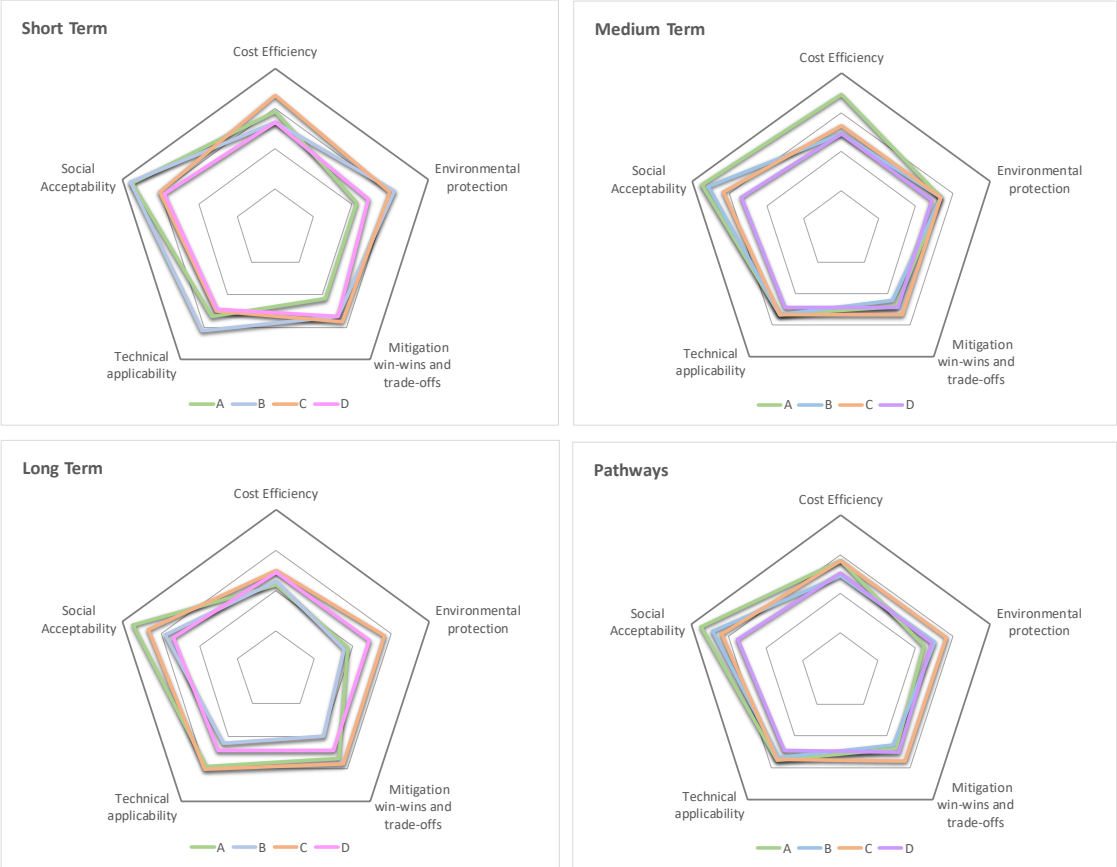

Figure 37 - Pathways evaluation for the aquaculture sector considering: Cost Efficiency; Environmental protection; Mitigation (GHG emissions) win-wins and trade-offs; Technical applicability; Social acceptability. The policy pathways scenarios: APT A - Minimum Intervention; APT B - Economic Capacity Expansion (ECE); APT C- Efficiency Enhancement (EE); APT D - System Restructuring (SR), for different timeframes: S - Short term (up to 2030), M- Medium term (up to 2050), L - Long term (until 2100)

Some differences across pathways exist:

- APTA (minimal intervention) tends to have a higher social acceptability (since little action is taken) and cost efficiency, at short and medium term.
- APTD (system restructuring) never performs the best, for none of the criteria.
- APT B (Economic Capacity Expansion) seems very efficient on the medium term, and APT C Efficiency enhancement) on the long term.

4.5 Crete

For these Islands two online webinars were made and spoken in Greek, with the presentations in Greek and the Online Survey Tool with the options and classes in Greek as well. There were no Local knowledge options proposed by the IFP (KRITI) and the characterization of all adaptation options was made by the IFP.

4.5.1 Final Adaptation Pathways

Each APT has a set of adaptation classes each one with two options/measures to choose from. Each individual stakeholder choices will be clustered with other choices made by different stakeholders. If the majority of the stakeholders chose one option, then that measure will be in the island adaptation pathway for that specific class in each APT, per sector. The result for the series of choices in the three timeframes will define the pathway. If there is a tie between two options, then they will both be included and become part of the adaptation pathway in each time frame. Furthermore, Local Knowledge measures will be included if they were chosen by at least 20% of all stakeholders.*

***Definition**: Measures which were chosen 50% or more per APT and per time frame*
Adaptation aims and used frameworks (Suckall et al., 2018)***:***
***(1) vulnerability reduction** - Five capitals of Sustainable Livelihoods Approach (SLA).*
***(2) Disaster Risk Reduction** - Hyogo and Sendai Frameworks.*
***(3) Social-Ecological Resilience** - Millennium Ecosystem Assessment (MEA) and Common International Classification of Ecosystem Services (CICES)*

4.5.2 Tourism

Selected Adaptation Pathways

Tourism pathways are based on choices made by 6 island stakeholders.

ID	Name	Class number	Ratio	APT A			APT B			APT C			APT D		
				S	M	L	S	M	L	S	M	L	S	M	L
T1	Economic Policy Instruments (EPIs)	1	69%					B						D	
T2	Financial incentives to retreat from high-risk areas	1	31%					B						D	
T9	Activity and product diversification	2	74%		A			B			C			D	
T10	Public awareness programmes	2	26%		A			B			C			D	
T11	Local circular economy	3	72%								C				
T12	Tourist awareness campaigns	3	28%								C				
T14	Water restrictions, consumption cuts and grey-water recycling	4	81%								C			D	
T13	Local sustainable fishing	4	19%								C			D	
T15	Beach nourishment	5	67%					B							
T16	Desalination	5	33%					B							
T17	Coastal protection structures	6	53%		A			B			C			D	
T18	Drought and water conservation plans	6	47%		A			B			C			D	
T19	Mainstreaming Disaster Risk Management (DRM)	7	78%								C				
T20	Using water to cope with heat waves	7	22%								C				
T22	Health care delivery systems	8	56%		A										
T21	Fire management plans	8	44%		A										
T24	Pre-disaster early recovery planning	9	69%		A									D	
T23	Post-Disaster recovery funds	9	31%		A									D	
T4	Monitoring, modelling and forecasting systems	10	57%		A			B			C			D	
T3	Adaptation of groundwater management	10	43%		A			B			C			D	
T6	River rehabilitation and restoration	11	56%					B			C				
T5	Dune restoration and rehabilitation	11	44%					B			C				
T7	Adaptive management of natural habitats	12	67%								C				
T8	Ocean pools	12	33%								C				

Figure 38 - Adaptation options for the tourism sector. Options are identified with an ID number, full name, and class of adaptation number. Adaptation objectives are identified in each option by colour: ***vulnerability reduction (red), Disaster Risk Reduction (blue); Social-Ecological Resilience (green).*** *Each ATP (APT A; APT B; APT C; APT D) is represented in three timeframes: S - Short term (up to 2030), M- Medium term (up to 2050), L - Long term (until 2100). Highlighted options indicate the measure was selected in each ATP*

and timeframe: ATP A – Minimum Intervention (light blue); ATP B – Economic Capacity Expansion (light green); ATP C – Efficiency Enhancement (Light orange) and ATP D – System Restructuring (light purple). Bold letters in each ATP indicate the option was available to be selected in the three time frames. Grey cells mean that they the options was not available in that APT.

Under APT B and D scenarios, the financial capital measures that were selected to address **vulnerability reduction**, indicate that the region of Crete is initially centred on the development of Economic Policy Instruments and later on Financial incentives to retreat from high-risk areas.

To adapt via Human Capital (class 2), diversification of the activities and products in opposition to awareness campaigns should be implemented. However, in Minimum Intervention scenario (APT A) and Efficiency Enhancement scenario (APT C), investment in public awareness can be appropriate for short term.

For Social Capital (class 3), local circular economy gains relevance in all periods. This reflects the effort of the Region in the development of the circular economy on the island.

The option related with water restrictions and cuts (Natural Capital) was selected for all periods in a System Restructuring scenario (ATP D) and in an Efficiency Enhancement scenario (APT C) vs local sustainable fishing. This obviously reflects the Region's inability to take management measures for sustainable fishing as this depends exclusively on national and European regulations.

Beach nourishment was selected for all time periods within the Physical Capital options taken in APT B.

For **Disaster Risk Reduction**, and to manage long term risk, the decisions need to be sensible to the level of investment and reflects the climate change risk identified for the region. Coastal protection is a priority for the region throughout all the scenarios.

The Efficiency Enhancement scenario (ATP C) is the only scenario which considers the Preparedness class. In all time periods, mainstreaming DRM was selected in detriment of using water to cope with heat waves. This result, follows the risk response rational, addressing disasters management in a first stage.

Health care delivery systems in Minimum Intervention scenario (APT A) over comes the Fire management plans with small difference and reflects the climate-risk context of the region with the covid-19 situation.

Generically, to address DRR on tourism sector, it is necessary to continue to promote planning and allocate funds to develop climate change resilience in the region.

In **Social-Ecological Resilience,** groundwater management is not urgent for the sector in the short term. The Region should in the next decades invest efforts in information systems to improve climate information reliability.

Options for regulation of natural services in the Tourism sector will benefit from the maintenance of the rivers/valleys functions, creating recreational areas with a positive impact on tourism attractiveness.

In medium investment and medium commitment to policy change scenario (APT C - Efficiency Enhancement) the region considered to dedicate efforts to preserve and minimize the impacts on biodiversity and ecosystems, while also preserving the attractiveness of the region.

Sustainability performance

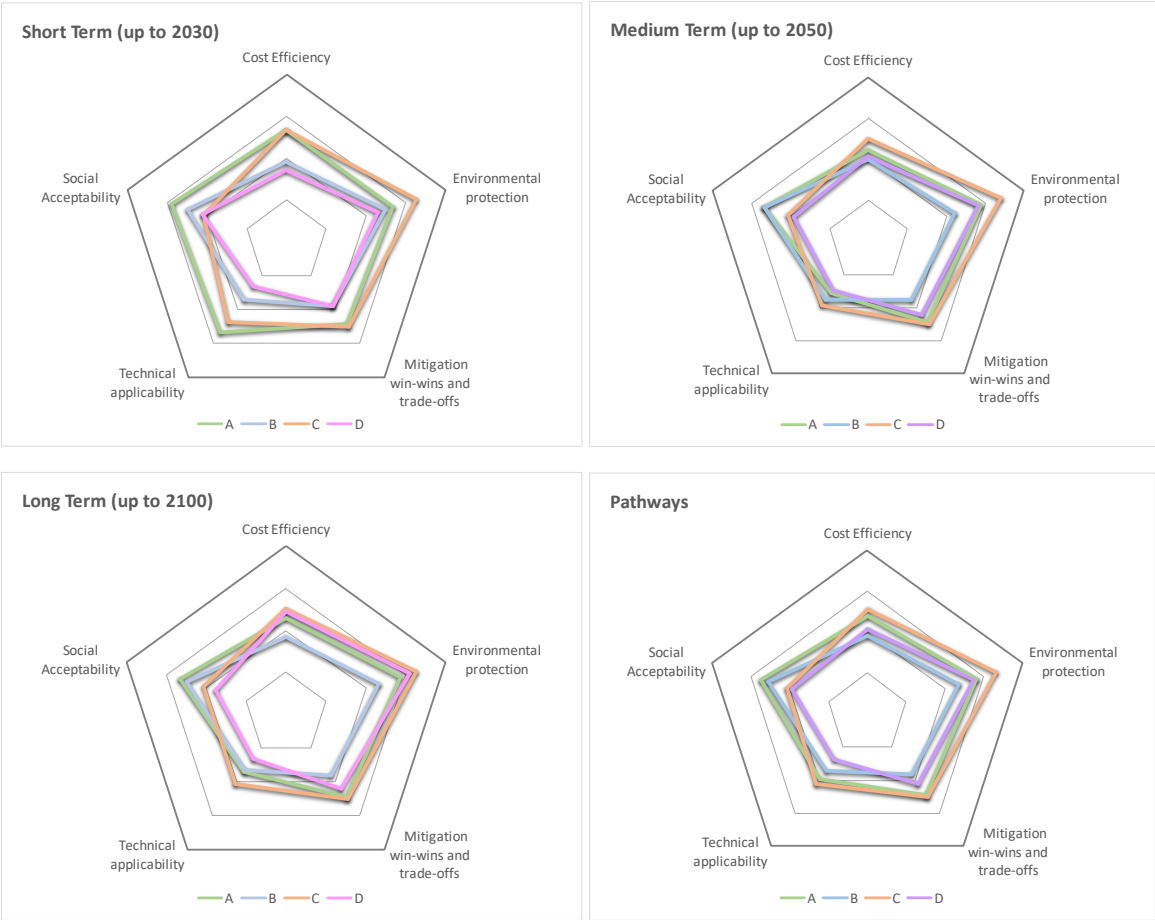

Figure 39 - Pathways evaluation for the tourism sector considering: Cost Efficiency; Environmental protection; Mitigation (GHG emissions) win-wins and trade-offs; Technical applicability; Social acceptability. The policy pathways scenarios: APT A - Minimum Intervention; APT B - Economic Capacity Expansion (ECE); APT C- Efficiency Enhancement (EE); APT D - System Restructuring (SR), for different timeframes: S - Short term (up to 2030), M- Medium term (up to 2050), L - Long term (until 2100)

All four adaptation pathways for Crete's tourism sector up to 2100 reveal a similar structure in terms of their sustainability performance. These pathways are comprised of measures that have a relatively high social acceptability and low technical acceptability and cost efficiency but performs well in terms of future environmental protection. These sector pathways will have difficulty in meeting the archipelago's mitigation objectives although they perform well in terms of future environmental protection because they have low technical applicability up to 2100. This particularly relevant in APT A and D pathways, curiously those responding to scenarios with the lowest (highest) investment and policy change levels, respectively. In fact, the pathway with the highest investment and policy change levels and that preconizes a system restructuring (APT D) underperforms the other pathways in all sustainability criteria.

4.5.3 Maritime Transport

Selected Adaptation Pathways

Maritime Transport pathways are based on choices made by 5 island stakeholders.

ID	Name	Class number	Ratio	APT A			APT B			APT C			APT D		
				S	M	L	S	M	L	S	M	L	S	M	L
MT2	Financial incentives to retreat from high-risk areas	1	60%					**B**						**D**	
MT1	Insurance mechanisms for ports	1	40%					**B**						**D**	
MT10	Social dialogue for training in the port sector	2	63%		**A**			**B**			**C**			**D**	
MT9	Awareness campaigns for behavioural change	2	37%		**A**			**B**			**C**			**D**	
MT12	Climate resilient economy and jobs	3	53%								**C**				
MT11	Diversification of trade using climate resilient commodities	3	47%								**C**				
MT13	Refrigeration, cooling and ventilation systems	4	50%								**C**			**D**	
MT14	Restrict development and settlement in low-lying areas	4	50%								**C**			**D**	
MT16	Increase operational speed and flexibility in ports	5	53%					**B**							
MT15	Sturdiness improvement of vessels	5	47%					**B**							
MT17	Climate proof ports and port activities	6	65%		**A**			**B**			**C**			**D**	
MT18	Consider expansion/retreat of ports in urban planning	6	35%		**A**			**B**			**C**			**D**	
MT20	Early Warning Systems (EWS) and climate change monitoring	7	60%								**C**				
MT19	Reinforcement of inspection, repair and maintenance of	7	40%								**C**				
MT22	Prepare for service delays or cancellations	8	80%		**A**										
MT21	Inteligent Transport Systems (ITS)	8	20%		**A**										
MT23	Backup routes and infrastructures during extreme weather	9	63%		**A**									**D**	
MT24	Post-Disaster recovery funds	9	37%		**A**									**D**	
MT3	Marine life friendly coastal protection structures	10	52%		**A**			**B**			**C**			**D**	
MT4	Combined protection and wave energy infrastructures	10	48%		**A**			**B**			**C**			**D**	
MT6	Coastal protection structures	11	60%					**B**			**C**				
MT5	Hybrid and full electric ship propulsion	11	40%					**B**			**C**				
MT7	Integrate ports in urban tissue	12	67%								**C**				
MT8	Ocean pools	12	33%								**C**				

Figure 40 - Adaptation options for the maritime transport sector. Options are identified with an ID number, full name, and class of adaptation number. Adaptation objectives are identified in each option by colour: ***vulnerability reduction (red), Disaster Risk Reduction (blue); Social-Ecological Resilience (green).*** *Each ATP (APT A; APT B; APT C; APT D) is represented in three timeframes: S - Short term (up to 2030), M- Medium term (up to 2050), L - Long term (until 2100). Highlighted options indicate the measure was selected in each ATP and timeframe: ATP A – Minimum Intervention (light blue); ATP B – Economic Capacity Expansion (light green); ATP C – Efficiency Enhancement (Light orange) and ATP D – System Restructuring (light purple). Bold letters in each ATP indicate the option was available to be selected in the three time frames. Grey cells mean that they the options was not available in that APT.*

The maritime transport sector adaptation pathways are characterized by a heterogeneity across the four potential adaptation policy trajectories (APTs) which they built upon.

Vulnerability reduction under APT B and D scenarios, Region of Crete is initially centred on Financial incentives to retreat from high-risk areas.

To adapt via Human Capital (class 2), social dialogue for training in the port sector in opposition to awareness campaigns should be implemented.

For Social Capital (class 3), is focus on trade diversification and climate resilient jobs.

Under the Efficiency Enhancing (APT C) scenario (medium investment and medium change in policy commitment) and the **System Restructuring (APT D)** after an initial focus on the preservation of marketable natural resources via the investment in refrigeration and/or cooling systems there is a shift to restrictions to the development in high-risk areas (**natural capital**).

Crete's maritime transport pathway favours investments in the operationality and flexibility of ports in detriment of improvement on vessels (physical capital).

Disaster risk reduction, focused on **managing risks** via climate proofing of infrastructure and activities, while developing alternative routes during extremes events as a means of assuring **post-disaster recovery**.

This strategy is complemented by **disaster responses** that include new procedures to handle service disturbances and the development of early warning systems.

Ecosystem resilience and provisioning services take the form of tailored protection structures, first by using marine life friendly materials and, coastal protection structures.

Sustainability performance

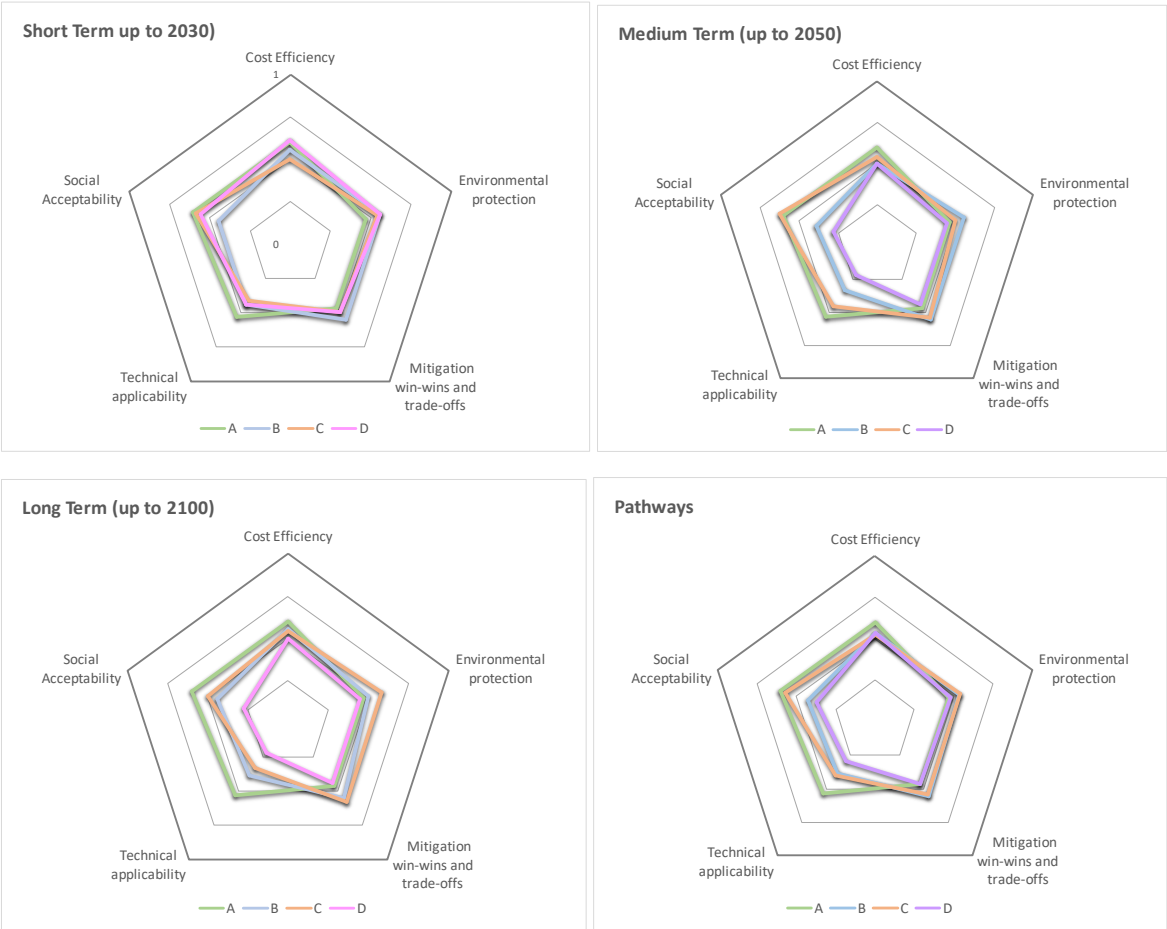

Figure 41 - Pathways evaluation for the maritime transport sector considering: Cost Efficiency; Environmental protection; Mitigation (GHG emissions) win-wins and trade-offs; Technical applicability; Social acceptability. The policy pathways scenarios: APT A - Minimum Intervention; APT B - Economic Capacity Expansion (ECE); APT C- Efficiency Enhancement (EE); APT D - System Restructuring (SR), for different timeframes: S - Short term (up to 2030), M- Medium term (up to 2050), L - Long term (until 2100)

All four adaptation pathways for the Crete's maritime transport sector up to 2100 reveal a similar structure in terms of their sustainability performance. These pathways are comprised of measures that have a relatively medium **social acceptability** and **cost efficiency** and low **technical acceptability**. These sector pathways will have difficulty in performing well in terms of future **environmental protection because they have low technical applicability.** This particularly relevant in APT B, C and D pathways, responding to scenarios with the medium and high investment and policy change levels. The pathway with the highest investment and policy change levels and that preconizes a system restructuring (APT D) underperforms the other pathways in all sustainability criteria.

4.6 Cyprus

For this Islands two online webinars were conducted in Greek. The presentations were in Greek and the Online Survey Tool with the options and classes in also Greek and English as well. There were no Local knowledge options proposed by the IFP (INTERFUSION) and the characterization of all adaptation options was made by the stakeholders.

4.6.1 Tourism

The adaptation pathways for the tourism sector were developed based on the choices made by six expert stakeholders from various organizations and SMEs, including the Cyprus Sustainable Tourism Initiative, the Cyprus Tourism Organization, and the Cyprus Marine Environment Protection Association.

Selected Adaptation Pathways

Based on the choices of the stakeholders, the adaptation pathways for the tourism sector in Cyprus seem to be consistent with the characteristics of the adaptation pathway trajectories (APTs).

ID	Name	Class number	Ratio	APT A			APT B			APT C			APT D		
				S	M	L	S	M	L	S	M	L	S	M	L
E1	Financial support for buildings with low energy needs	1	50%					**B**						**D**	
E2	Financial support for smart control of energy in houses and	1	50%					**B**						**D**	
E9	Green jobs and businesses	2	67%		**A**			**B**			**C**			**D**	
E10	Public information service on climate action	2	33%		**A**			**B**			**C**			**D**	
E11	Small scale production and consumption (prosumers)	3	67%								**C**				
E12	Risk reporting platform	3	33%								**C**				
E13	Energy storage systems	4	67%								**C**			**D**	
E14	Collection and storage of forest fuel loads	4	33%								**C**			**D**	
E16	Demand Side Mangement (DSM) of Energy	5	75%					**B**							
E15	SeaWater Air Conditioning (SWAC).	5	25%					**B**							
E18	Upgrade evaporative cooling systems	6	54%		**A**			**B**			**C**			**D**	
E17	Review building codes of the energy infrastructure	6	46%		**A**			**B**			**C**			**D**	
E20	Grid reliability	7	58%								**C**				
E19	Early Warning Systems (EWS)	7	42%								**C**				
E22	Energy-independent facilities (generators)	8	58%		**A**										
E21	Study and develop energy grid connections	8	42%		**A**										
E23	Energy recovery microgrids	9	71%		**A**									**D**	
E24	Local recovery energy outage capacity	9	29%		**A**									**D**	
E4	Underground tubes and piping in urban planning	10	58%		**A**			**B**			**C**			**D**	
E3	Energy efficiency in urban water management	10	42%		**A**			**B**			**C**			**D**	
E5	Biomass power from household waste	11	54%					**B**			**C**				
E6	Urban green corridors	11	46%					**B**			**C**				
E8	Heated pools with waste heat from power plants	12	75%								**C**				
E7	Educational garden plots	12	25%								**C**				

Figure 42 - Adaptation options for the tourism sector. Options are identified with an ID number, full name, and class of adaptation number. Adaptation objectives are identified in each option by colour: ***vulnerability reduction (red), Disaster Risk Reduction (blue); Social-Ecological Resilience (green).*** *Each ATP (APT A; APT B; APT C; APT D) is represented in three timeframes: S - Short term (up to 2030), M- Medium term (up to 2050), L - Long term (until 2100). Highlighted options indicate the measure was selected in each ATP and timeframe: ATP A – Minimum Intervention (light blue); ATP B – Economic Capacity Expansion (light green); ATP C – Efficiency Enhancement (Light orange) and ATP D – System Restructuring (light purple). Bold letters in each ATP indicate the option was available to be selected in the three time frames. Grey cells mean that they the options was not available in that APT.*

For the case of APT A, vulnerability reduction is achieved via human capital and specifically, by implementing programmes to raise public awareness in the short-term, though the diversification of tourist activities and products are deemed necessary in the mid- and long-term to combat the issue of seasonality that is heavily observed on the island. Measures for disaster risk reduction are almost identical for all three timeframes of APT A. Specifically, drought and water conservation plans are recommended in this APT as it is considered a more feasible and cost-efficient option for managing long term risk, particularly as Cyprus

will face an increase in temperature. Similarly, Pre-disaster early recovery planning is preferred to deal with post-disaster recovery and rehabilitation. The reason being that proactive measures (such as best practices and knowledge bases) rather than reactive measures will be less costly and more environmentally protective, thus safekeeping the attractiveness of Cyprus as a tourist destination. With regards to response adaptation, the short-term option of fire management plans is generally beneficial for the island given the FWI projections. However, the mid-term and long-term measure should focus on reinforcing and improving the healthcare delivery system to deal with the possible increase in heatstroke episodes that the risk of rise in temperature will cause. Finally, for satisfying the social-ecological resilience objective, stakeholders opted for monitoring, modelling, and forecasting systems as the measure for provisioning services for all three timeframes. It is deemed necessary that reliable and timely climate information and the ability to assess climate hazard impacts under this APT (low commitment and low investment) would be more suitable for mitigating GHG emissions, as well as a more technically applicable and socially acceptable measure.

For the case of APT B, vulnerability reduction consists of adaptation via financial capital, human capital, and physical capital. Stakeholders recommended economic policy instruments (EPIs) as a financial capital measure throughout the three timeframes given that high investment is a characteristic of this APT. This is due to climate hazard projections indicating that risks will be continually increasing. Also, financial incentives to retreat from high-risk areas is not considered to be as a socially accepted or technically applicable measure. With respect to human capital, the implementation of public awareness programmes is a desired measure for the short-term, whereas activity and product diversification is more suitable for the mid- and long-term. Again, it is important to deal with the issue of seasonality but also to be in line with commitments to the Paris Agreement and EU directives. The only class of adaptation for disaster risk reduction involves managing long-term risk. Here, the short- and mid-term option selected for this APT (low commitment, high investment) is the construction of coastal protection structures, mainly because the SLR and wind wave projections indicate extensive beach reduction at coastal areas, which in turn would decrease the attractiveness of the island as a tourist destination. For the long-term, the development of drought and water conservation plans is the most appropriate measure, again, based on the increase in mean daily temperature on the island. Regarding social-ecological resilience, provisioning services and regulating and maintenance services are the two adaptation classes involved. For adaptation via provisioning services, monitoring, modelling, and forecasting systems was chosen as the measure for all three timeframes. For adaptation via regulating and maintenance services, the measure chosen was dune restoration and rehabilitation for all three timeframes. In addition, for the long-term the pathway also includes the measure for river rehabilitation and restoration given that in the future there will be both higher temperatures and water demand. Hence this measure will increase available leisure areas for improved thermal comfort and increase water availability.

For the case of APT C, vulnerability reduction includes human capital, social capital, and natural capital. With respect to adaptation via human capital, this pathway includes the same choices of APT B for the same reasons, that is, public awareness programmes for the short-term, but activity and product diversification for the mid- and long-term. For social capital adaptation, the most suitable short-term measure is the preparation of tourist awareness campaigns to inform tourists about Climate Change. This measure, while not directly protecting the environment or the mitigating GHG emissions, is more relevant in the short-term since changing visitors' attitudes and behaviours is considered a more immediate action. In the mid- and long-term, the creation of a local circular economy is preferred since it becomes more vital to promote and adopt decarbonization practices through waste elimination and continual resource utilization. As for adaptation via natural capital, stakeholders recommend the pathway water restrictions, consumption cuts and grey-water recycling for all three timeframes. This measure will be able to tackle the issue of increases in water demand as a result of extremely dry weather (based on SPEI projections) in the future. Disaster risk reduction is achieved through managing long-term term risk and preparedness. The most appropriate measure for managing long-term risk was chosen to be the construction of coastal protection structures up until 2030, whereas the development of drought and water conservation plans up were chosen as the most suitable until both 2050 and 2100. This is similar to the choices for APT B, with the only difference being the mid-term measure. Since APT C has medium commitment and medium

investment (as opposed to high investment in APT B) the construction of coastal protection structures is considered a more costly adaptation measure. Adaptation via preparedness contains the measure using water to cope with heat waves for all three timeframes. Additionally, for the mid-term mainstreaming disaster risk management is also included in this pathway. All three classes of adaptation concerning social-ecological resilience are included in APT C. For provisioning services adaptation, similarly to APTs A and B, all three timeframes consist of the measure for implementing monitoring, modelling, and forecasting systems. For adaptation via regulating and maintenance services, the measure for dune restoration and rehabilitation is chosen for all three timeframes. Moreover, the mid- and long-term also include the measure for river rehabilitation and restoration based on the forecasts for temperature and water demand (both increasing). Finally, for cultural services adaptation, the preferred measure is adaptive management of natural habitats in order to deal with the impacts and pressures of human activities on the island's biodiversity and ecosystems that are aggravated by Climate Change. This measure is more relevant based on the projections for hazards like fire weather index, seagrass evolution, and beach reduction.

For APT D, financial capital, human capital, and natural capital are the classes of adaptation contributing towards vulnerability reduction. For financial capital adaptation, similarly to APT B, implementing economic policy instruments is the most suitable measure for all three timeframes since it is technically easier to apply and considered to be more socially acceptable. Furthermore, this specific APT assumes high investment and high commitment, therefore the measure is also cost-effective. For adaptation via human capital, stakeholders suggest the improving the activity and product diversification of the island for all three timeframes. Since there will be high commitment to policy change, as well as more investment, this measure is more suitable to deal with seasonality, infrastructure overload, and the burden on ecosystems that the tourism industry faces. With regards natural capital adaptation, water restrictions, consumption cuts, and grey-water recycling is a more appropriate measure for the short-term since it will be necessary to deal with the increase in temperature and water demand. However, the mid- and long-term will benefit from measures promoting local sustainable fishing. The restructuring of the system will protect ecosystem services and decrease external dependency. Adaptations to deal with disaster risk reduction concern managing long-term risks and post-disaster recovery and rehabilitation. For the former, the construction of coastal protection structures will serve the island better in short-term, as there will be a need to protect the coast from beach reduction. If this is taken care of, then focus can shift towards development of drought and water conservation plans in the mid- and long-term to combat the problem of rising temperatures and water demand in the future. For the latter, just as in APT A, post-disaster early recovery planning is the most appropriate measure for the same reasons – maintaining Cyprus as an attractive tourist destination. With respect to social-ecological resilience, provisioning services is the only contributing class of adaptation. Here, for the short- and mid-term, it is preferred to invest in the development of monitoring, modelling, and forecasting systems so that accurate climate data is obtained as fast as possible. However, in the long-term, a measure for adaptation of groundwater management will offer better environmental protection.

Sustainability Performance

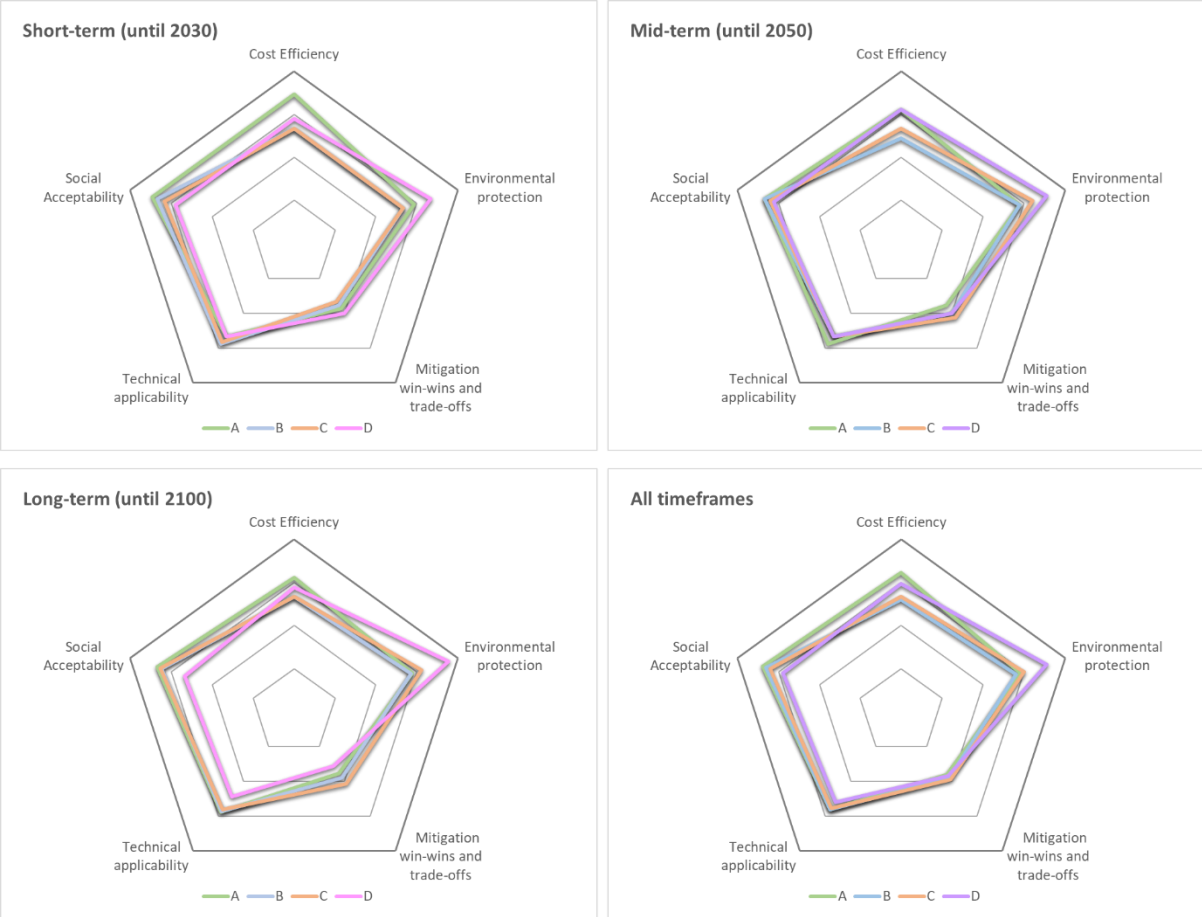

Figure 43 - Pathways evaluation for the tourism sector considering: Cost Efficiency; Environmental protection; Mitigation (GHG emissions) win-wins and trade-offs; Technical applicability; Social acceptability. The policy pathways scenarios: APT A - Minimum Intervention; APT B - Economic Capacity Expansion (ECE); APT C- Efficiency Enhancement (EE); APT D - System Restructuring (SR), for different timeframes: S - Short term (up to 2030), M- Medium term (up to 2050), L - Long term (until 2100)

The four APTs perform similarly to a large degree in all three timeframes with respect to the evaluation of the five criteria. Overall, it can be observed that the four APT scenarios have a low-to-average level of mitigation (GHG emissions) win-wins and trade-offs. In addition, they exhibit an average-to-high performance with regards to cost efficiency, technical applicability, and social acceptability. Finally, the scenarios have a high level of environmental protection.

APT A consists of adaptation measures that have been evaluated with:

- a high level of social acceptability and cost efficiency.
- an average-to-high level of environmental protection and technical applicability.
- a low-to-average level of mitigation (GHG emissions) win-wins and trade-offs.

APT B consists of adaptation measures that have been evaluated with:

- a high level of social acceptability.
- an average-to-high level of cost efficiency, environmental protection, and technical applicability.
- a low-to-average level of mitigation (GHG emissions) win-wins and trade-offs.

APT C consists of adaptation measures that have been evaluated with:

- a high level of social acceptability.
- an average-to-high level of cost efficiency, environmental protection, and technical applicability.
- a low-to-average level of mitigation (GHG emissions) win-wins and trade-offs.

APT D consists of adaptation measures that have been evaluated with:

- a high level of environmental protection.
- an average-to-high level of cost efficiency, technical applicability, and social acceptability.
- a low-to-average level of mitigation (GHG emissions) win-wins and trade-offs.

Given that APT A is characterized by low investment and low commitment it is expected that the measures included in this scenario are not ranked highly with respect to their ability to mitigate emissions and protect the environment. APT D, on the other hand, consists of measures that are rated highly with respect to environmental protection, which is in line with the high commitment and high investment assumed in this pathway trajectory.

4.6.2 Energy

The adaptation pathways for the energy sector were developed based on the choices made by four expert stakeholders. The stakeholders involved were from research organizations and government services, such as the Cyprus Institute and the Energy Department of the Ministry of Energy, Commerce, and Industry.

Selected Adaptation Pathways

By analysing the adaptation measures chosen by stakeholders, the adaptation pathways for the energy sector in Cyprus are fairly heterogenous, though there are some instances where some options are chosen irrespective of the characteristics of their adaptation pathway trajectories (APTs).

ID	Name	APT A			APT B			APT C			APT D		
		S	M	L	S	M	L	S	M	L	S	M	L
E1	Financial support for buildings with low energy needs					B						D	
E2	Financial support for smart control of energy in houses and					B						D	
E9	Green jobs and businesses		A			B			C			D	
E10	Public information service on climate action		A			B			C			D	
E11	Small scale production and consumption (prosumers)								C				
E12	Risk reporting platform								C				
E13	Energy storage systems								C			D	
E14	Collection and storage of forest fuel loads								C			D	
E16	Demand Side Mangement (DSM) of Energy					B							
E15	SeaWater Air Conditioning (SWAC).					B							
E18	Upgrade evaporative cooling systems		A			B			C			D	
E17	Review building codes of the energy infrastructure		A			B			C			D	
E20	Grid reliability								C				
E19	Early Warning Systems (EWS)								C				
E22	Energy-independent facilities (generators)		A										
E21	Study and develop energy grid connections		A										
E23	Energy recovery microgrids		A									D	
E24	Local recovery energy outage capacity		A									D	
E4	Underground tubes and piping in urban planning		A			B			C			D	
E3	Energy efficiency in urban water management		A			B			C			D	
E5	Biomass power from household waste					B			C				
E6	Urban green corridors					B			C				
E8	Heated pools with waste heat from power plants								C				
E7	Educational garden plots								C				

Figure 44 - Adaptation options for the energy sector. Options are identified with an ID number, full name, and class of adaptation number. Adaptation objectives are identified in each option by colour: ***vulnerability reduction (red), Disaster Risk Reduction (blue); Social-Ecological Resilience (green).*** *Each ATP (APT A; APT B; APT C; APT D) is represented in three timeframes: S - Short term (up to 2030), M- Medium term (up to 2050), L - Long term (until 2100). Highlighted options indicate the measure was selected in each ATP and timeframe: ATP A – Minimum Intervention (light blue); ATP B – Economic Capacity Expansion (light green); ATP C – Efficiency Enhancement (Light orange) and ATP D – System Restructuring (light purple). Bold letters in each ATP indicate the option was available to be selected in the three time frames. Grey cells mean that they the options was not available in that APT.*

For the case of APT A, vulnerability reduction is attained by promoting green jobs and businesses in all timeframes. This is because they can provide multiple benefits regarding sustainable development but also for combating the current COVID-19 pandemic. Additionally, in the short-term, the provision of a public information service on climate action is also a recommended measure as it could yield immediate results for supporting residential, hotels and commercial buildings to adapt to Climate Change. Disaster risk reduction for this APT is achieved by focusing on managing long-term risk, response, and post-disaster recovery and rehabilitation. For managing long-term risk, stakeholders deemed the inclusion of both available options as critical for all three timeframes. The review of building codes of the energy infrastructure for Cyprus is an ongoing process that is necessary for protecting the environment and mitigating GHG emissions. On the other hand, the upgrading the evaporative cooling systems is considered necessary until the end of the century given that water scarcity and heat waves are hazards that will severely impact the island. Hence, the technology to deal with this will need continuous improving over time. With respect to disaster response, being able to locally produce energy has both cost and environmental benefits, therefore, a measure for constructing energy-independent facilities (generators) is included for all timeframes. Also, the study and development of energy grid connections between islands is recommended in the short-term (contributing towards the increase of renewable energy resources (RES)) and in the long-term (for the purpose of improving the reliability of the energy system). The preferred measure for adaptation via post-disaster recovery and rehabilitation is the operation of energy recovery microgrids for all three timeframes. This measure benefits the local generation of energy and reduces costs, which is in line with the characteristics of this pathway trajectory (low commitment and low investment). In the short-term, increasing and improving the capacity of the island to recover from energy outages is also important

based on the exacerbation of climate events projected. Finally, provisioning services adaptation is the class associated with social-ecological resilience in this APT. In the short-term, the measure selected involves bolstering the energy efficiency of urban water management due to the projected decrease in water availability on the island. In the mid- and long-term, the focus shifts towards the implementation of underground tubes and piping in urban planning given their Climate Change resilience.

For the case of APT B, vulnerability reduction consists of adaptation via financial capital, human capital, and physical capital. For financial capital, the measure suggested concerns financial support for buildings with low energy needs for the short-term as this measure contributes towards the protection of the environment. However, for the mid- and long-term, the measure suggested involves financial support for smart control of energy in houses and buildings. This measure will help cut costs and mitigate GHG emissions. Regarding human capital, the selection of measures is identical to APT A, with promoting green jobs and businesses in all timeframes and the dissemination of public information service on climate action as an immediate measure in the short-term. For physical capital adaptation, a short-term measure of seawater air conditioning is included since this measure performs better in heat wave conditions. Furthermore, for all timeframes, the implementation of demand-side management of energy as a strategy for improving the coordination of energy producers and energy consumers is also recommended since it is more socially acceptable, contributes more, and is a more practical solution in the long-run. Disaster risk reduction only involves managing long-term risk in this APT. For the short- and mid-term, the option selected here is the review of building codes of the energy infrastructure since this measure is more technically applicable and cost-efficient in the immediate future and will help climate-proof the energy system of the island. For the mid- and long-term, the option of upgrading evaporative cooling systems is chosen to combat reduced water availability and increasing temperatures. With respect to social-ecological resilience, the two classes of adaptation included in this APT are provisioning services and regulating and maintenance services. For the former, the options selected follow the options selected in APT A. Specifically, energy efficiency of urban water management needs to be addressed in the immediate future, whereas the inclusion of underground tubes and piping in urban planning needs to be addressed in the distant future. For the former, the promotion of biomass power from household waste is the short-term measure recommended since it is a good GHG emissions mitigating alternative. In the mid- and long-term, however, the construction of urban green corridors is the measure of choice since it will be effective in combating the projected increase in air temperature on the island.

For the case of APT C, adaptation via human capital, social capital, and natural capital comprise the objective for vulnerability reduction. Regarding human capital adaptation, short- and mid-term measures consist of the promotion of green jobs and businesses, as well as of the provision of as public information service on climate action. The fact that there is medium commitment to policy change and medium investment makes the latter measure also viable for the long-term. Adaptation via social capital involves a measure to promote small-scale production and consumption for all timeframes. This measure will be able to deal with Climate Change events forecast for the island (particularly, heat waves). The transition to local energy production will have significant benefits on multiple levels and will contribute much more to the usage of RES, the decrease of GHG emissions, and the creation of jobs at the local level. In addition, the mid- and long-term pathways also contain the development of a risk reporting platform as a measure. As for adaptation via natural capital, the development of energy storage systems is recommended for all timeframes, which is in line with the EU's energy policy aiming for increase RES usage. Furthermore, the collection and storage of forest fuel loads is also included for the mid- and long-term pathways, as a way to deal with highly potential wildfire hazards that are projected for the island. The objective for disaster risk reduction is obtained with adaptation for managing long-term term risk and preparedness. For the former, it is suitable to have a measure for reviewing building codes of the energy infrastructure in the short-term and a measure for upgrading evaporative cooling systems in the mid- and long-term. For the latter, stakeholders selected for all timeframes to include a measure to ensure grid reliability since it important to upgrade the grid and guarantee it is constantly stable. In the short-term, it is also important to invest in early warning systems given the various immediate climate hazards. Furthermore, stakeholders suggested that investment in early warning systems in the long-term will also be necessary for the purpose of

upgrading based on new knowledge. APT C includes all three classes of adaptation relating to social-ecological resilience. For adaptation via provisioning services, the selection of measures follows APT A and APT B, with the short-term consisting of improving energy efficiency in urban water management and the mid- and long-term consisting of implementing underground tubes and piping in urban planning. Regarding regulating and maintenance services adaptation, promoting the generation of biomass power from household waste is more appropriate for all timeframes, since this APT is characterized by medium investment and medium commitment to policy change. In addition, for the mid- and long-term, the ATP also includes the creation of urban green corridors. Finally, for cultural services, the short-term measure more suitable for this APT is the provision of educational garden plots, whereas the mid- and long-term

For the case of APT D, three adaptation classes are included for vulnerability reduction: financial capital, human capital, and natural capital. Concerning financial capital adaptation, the inclusion of measures is similar to those included in APT B, with providing financial support for smart control of energy in houses and buildings in the mid- and long-term and providing financial support for buildings with low energy needs in the short-term. However, because this APT has a high degree of commitment to policy change (as opposed to a low degree of commitment in APT B), it also includes providing financial support for buildings with low energy needs in the mid- and long-term. With respect to adaptation via human capital, the choice of measures is the same as in APT A and APT B: providing a public information service on climate action in the short-term and promoting green jobs and businesses for all timeframes. The measures selected by stakeholders for natural capital adaptation is exactly as in the case of APT C for the same reasons. The development of energy storage systems is preferred for all timeframes, whereas the collection and storage of forest fuel loads is also selected for the mid- and long-term pathways. Disaster risk reduction objectives are met through managing long-term risks and post-disaster recovery and rehabilitation. For the former, again this pathway consists of measures identical to that of APT C – the short-term involves reviewing building codes of the energy infrastructure, whereas the mid- and long-term involve upgrading evaporative cooling systems. For the latter, the operation of energy recovery microgrids is recommended for all three timeframes (as in APT A), however, as this APT has a high level of investment, it is also recommended that the mid- and long-term also includes increasing and improving the capacity of the island to recover from energy outages. Regarding social-ecological resilience objectives, the only class of adaptation involves provisioning services, wherein, the selection of measures is the same as the other three APTS. Specifically, the short-term measure of improving the energy efficiency of urban water management is preferred, whereas the inclusion of underground tubes and piping in urban planning is suggested for the mid- and long-term.

Sustainability Performance

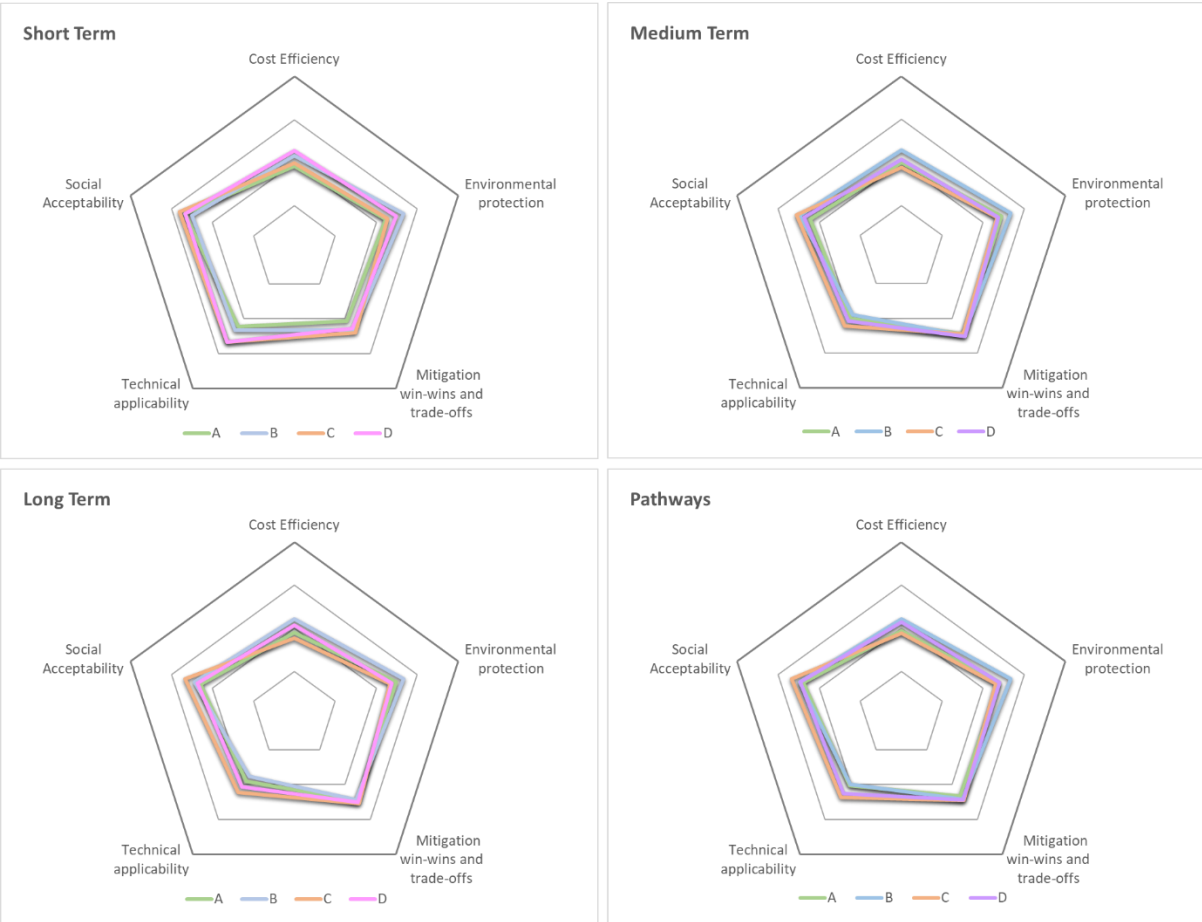

Figure 45 - Pathways evaluation for the energy sector considering: Cost Efficiency; Environmental protection; Mitigation (GHG emissions) win-wins and trade-offs; Technical applicability; Social acceptability. The policy pathways scenarios: APT A - Minimum Intervention; APT B - Economic Capacity Expansion (ECE); APT C- Efficiency Enhancement (EE); APT D - System Restructuring (SR), for different timeframes: S - Short term (up to 2030), M- Medium term (up to 2050), L - Long term (until 2100)

In the majority of the cases, the measure selected for the short-term is based on the fact that there are policies and guidelines already set forth either locally or by the EU containing targets that must be achieved in the immediate future. Thus, the stakeholders' choices were reliant on these targets. Furthermore, the mid- and long-term are indistinguishable for the case of energy, so the measures for the mid- and long-term are identical in most of the cases and were chosen by stakeholders based the level of investment and degree of commitment to policy change characterizing each APT. Overall, it can be observed that the four APT scenarios consist of measures with a low-to-average cost efficiency but an average mitigation (GHG emissions) win-wins and trade-offs and social applicability in all three timeframes. In addition, scenarios with low levels of investment contain measures that have low technical applicability.

APT A consists of adaptation measures that have been evaluated with:

- an average level of environmental protection, mitigation (GHG emissions) win-wins and trade-offs, and social acceptability.
- a low-to-average level of cost efficiency and technical applicability.

APT B consists of adaptation measures that have been evaluated with:

- an average level of environmental protection, mitigation (GHG emissions) win-wins and trade-offs, and social acceptability.
- a low-to-average level of cost efficiency and technical applicability.

APT C consists of adaptation measures that have been evaluated with:

- an average level of environmental protection, mitigation (GHG emissions) win-wins and trade-offs, technical applicability, and social acceptability.
- a low-to-average level of cost efficiency.

APT D consists of adaptation measures that have been evaluated with:

- an average level of environmental protection, mitigation (GHG emissions) win-wins and trade-offs, technical applicability, and social acceptability.
- a low-to-average level of cost efficiency.

Analysis of the results show that the measures selected in the short-term for APT A and APT B have an identical sustainability performance, as do the measures for APT C and APT D. Furthermore, for the mid- and long-term all four scenarios perform similarly to a certain extent. Thus, unlike for the case of tourism, the selection of measures seems to not consider the characteristics of the adaptation pathway to such a large degree. Again, this is attributed to the targets set out by the EU and the Cypriot government with respect to energy and Climate Change.

4.7 Fehmarn

For these Islands two seminars were made and spoken in German, with the presentations in German and the Online Survey Tool adapted to a word file translated in German, with stakeholder input being registered by the IFP (BEF Germany). There were no Local knowledge options proposed by the IFP and the characterization of all adaptation options was made by the IFP.

The results for the Tourism sector are presented in two different outputs:

(1) Final Adaptation Pathways

Tourism pathway choices were based on decisions made by 10 island stakeholders. This output aims to capture the acceptance of each AO by calculating how many times each AO was selected across all ATP scenario worlds within the maximum possible number of times they could be selected (Ratio – Selected/Maximum). This considers the number of times the option was selected by all stakeholders in all four APTs across all three timeframes.

(2) Sustainability Performance

This output aims to characterise each pathway through the evaluation of the options chosen in each APT. The options selected in each APT were evaluated considering a set of criteria: Cost Efficiency; Environmental protection; Mitigation (GHG emissions) win-wins and trade-offs; Technical applicability; Social acceptability.

4.7.1 Tourism

Selected Adaptation Pathways

Choices made by the stakeholders at the workshop lead to the creation of adaptation pathways specific to Fehmarn. In the following paragraphs, clear preferences and trends that emerged from analysing the choices are described for each of the strategic vectors. The visual representation of the pathways is displayed in Figs. 5 & 6. Not all choices could be made in each scenario world and each world had a specific set of choices to be made.

Vulnerability Reduction

Measures that address the issue of climate change adaptation through a **vulnerability reduction** showed that for most of the choices the stakeholders had clear preferences on which option to choose over time. "Activity and product diversification" were the most selected AO across all scenario worlds, being chosen 75% of the time when the question was asked. It was the preferred measure to be implemented in all 4 APTs across all three-time frames. During the webinar it became clear that "activity and product diversification" was considered a very broad term, potentially explaining why it was so popular. By being unspecific, it could encompass a whole range of activities with different capacity of durability and climate adaptation capacity, so that stakeholders making this choice could choose it as a flexible option that does not require to have specific activities in mind. The opposing choice, "information campaigns" did never enter the adaptation trajectories and was not considered a viable option to combat and prepare for climate change. This finding is interesting as communities, including Fehmarn, seem too often support and promote information campaigns to educate the public. There seems to be a discrepancy between activities and perceived usefulness. Potentially stakeholders had no clear idea of the implications of information campaigns.

It could be observed that choosing different scenario worlds could lead to differential outcomes. In the case of the choice between "economic policy measures" and "financial incentives to retreat from high-risk

areas", it seemed to matter whether a stakeholder imagined being on trajectory B or D, the two APTs in which this choice was available. In APT B, policy measures were chosen across all time steps, whereas in APT D, the two options were on par in the first-time step (up to 2030), after which the retreat incentives were chosen until the end of the century.

Contrary to this, for the choice between "water-saving and grey water recycling" and "local sustainable fisheries," it did not seem to make a difference whether the choice was made in APT C or D. in Both worlds "local fisheries" were preferred at the beginning and middle of the century, whereas the "water measures" were chosen more at the middle to end of the century. This choice in combination with the finding that "Desalination measures" were also preferred towards the end of the century might indicate that measures that appear to deal with heat and water scarcity seem to gain importance towards the end of the century. Possibly this is informed by the climate projections that predict summers to become hotter, as well as past experiences, e.g., the summer of 2018, during which Fehmarn municipality declared water shortages and asked citizens and tourists to cut down on their water consumption.

"Local circular economy" was a popular choice among stakeholders, being picked 73% of the time and entering the adaptation pathway across all three-time frames in APT C, the only scenario world in which the option was present. When asking the stakeholders how they imagined such a circular system to work, they focused on rather small-scale activities. One stakeholder suggested utilising seagrass that has been washed onto the shore as biomaterial to build housing insulations, fertilise agricultural land, and create products such as pillows. Another stakeholder mentioned that existing projects, like a local dish and cup deposit scheme could be expanded upon. Although the options were popular, the stakeholders did not have concrete ideas on how a truly circular economy would look like on Fehmarn.

Disaster Risk Reduction

For measures concerning **disaster risk reduction**, the trend continued that AOs concerning water scarcity alleviation were primarily chosen towards the end of the century continued. "Drought and water management plans" were never chosen in the first-time frame but always at the end of the century. Three out of four times they were also chosen in the middle of the century. This was explained by one stakeholder during the webinar. The climate predictions for the end of the century look more dramatic than the current climate situation. Implemented measures need to be explained by politics and decision-makers. If there is no evident necessity at the moment or soon, then the financial investment is not justified as the cost to benefit calculations are not in the favour of the adaptation measure.

"Coastal protection structures" were chosen in the beginning and middle of the century. In APT A, it was chosen throughout all periods. The rationale behind these choices could be that stakeholders might consider it important to build up structures early to avoid consequences from sea level rise towards the end of the century. The webinar revealed that trust in the local protection structure surveillance is high. Indeed, the general opinion was that if high and extensive coastal protection structures are built now, then this will be one issue less to worry about towards the end of the century. It was also mentioned that the pattern of this choice could indicate a certain optimism in that protection structures are needed in the near future, but towards the end of the century, one could be hopeful that the rising sea level trends are stopped, lessening the need for building more protective structures.

The choice for "medical systems improvement" was made across all time frames in APT A, the only trajectory where it could be chosen. Surprisingly, it was on par with "Fire management plans" in the beginning and end of the century, but not in the middle of the century. As those two choices entered the trajectory to almost equal parts in all time frames, there does not seem to be a clear preference on which AO is more important. This might indicate different perspectives, where some stakeholders might consider the medical service to be underdeveloped, whereas others consider the fire department, which also

frequently aids in disaster management in Germany, to be not sufficiently developed. This might depend on stakeholder's personal experiences with past droughts and other disasters or illnesses.

"Pre-disaster management plans" vs "post-disaster financial funds" showed that stakeholders tended to pick the financial aid for the periods in the beginning and end of the century, whereas the pre-disaster preparation seemed more relevant at the end of the century, potentially indicating that stakeholders might consider disaster preparation from an organised or municipal entity important, as climate risk and severity are predicted to increase at the end of the century. Financial support might be considered adequate towards the beginning and middle of the century to overcome the impacts of climate change or severe weather events.

Social-Ecological Resilience

Selection choices for adaptation options that are aimed at fostering **social-ecological resilience** also yielded interesting trends for Fehmarn. "Adaptation of the groundwater management system" was the dominant choice in this category and entered the adaptation trajectories in all four APT scenarios and across all time frames, apart from the end of the century in APT D, where "Monitoring, modelling and forecasting systems" were chosen. Such a clear choice preference might have to do with the island's climate predicted to become hotter and drier in the summer. So far, the island's freshwater is supplied via a connection to the mainland. However, from the workshop, we identified the desire that stakeholders would like the island to become more independent and less reliant on the mainland supply, potentially leading to the desire to improve their groundwater management. Consultations during the second webinar yielded that is not so much the supply of the freshwater that is considered a potential issue in the future, but the quality of the groundwater on the island. Dry summers, as well as more industrialised activity and over-usage of soils, are considered a threat to the groundwater on Fehmarn.

"Monitoring, modelling and forecasting systems" entered the trajectories in APTs B, C, and D at the end of the century, although across all choices, they were only picked 37% of the time. This shows that stakeholders might be interested in knowing specific occurrences of events when climate hazards are more common rather than establishing these systems now and being in a continuously alerted state. During the webinar we could find that the climate hazards of the near future are still considered to be manageable, whereas towards the end of the century the predictions seemed more dramatic, warranting forecasting systems.

"Dune restoration and rehabilitation measures" got chosen across all time frames when the option was available. Dunes are playing an important role on the island, both as natural coastal protection measures, but also from a touristic perspective. It was, therefore, a clear choice to pick, as the other option was "River rehabilitation and restoration", an option that was not important as there are no large rivers on the island and only a few small canals to drain fields.

"Restoring and managing natural habitats adaptively" was chosen in the beginning and middle of the century, whereas "establishment of ocean pools" came into play at the end of the century. This is interesting, as Fehmarn is an island that has several larger beach lakes functioning effectively as ocean pools. With rising sea levels, stakeholders seem to consider it important to establish more of these to have more natural protection from stormwater surges and rising sea levels.

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ID	Name	Class number	Ratio	APT A			APT B			APT C			APT D		
				S	M	L	S	M	L	S	M	L	S	M	L
T1	Economic Policy Instruments (EPIs)	1	53%					B						D	
T2	Financial incentives to retreat from high-risk areas	1	47%					B						D	
T9	Activity and product diversification	2	75%		A			B			C			D	
T10	Public awareness programmes	2	25%		A			B			C			D	
T11	Local circular economy	3	73%								C				
T12	Tourist awareness campaigns	3	27%								C				
T14	Water restrictions, consumption cuts and grey-water recycling	4	53%								C			D	
T13	Local sustainable fishing	4	47%								C			D	
T15	Beach nourishment	5	60%					B							
T16	Desalination	5	40%					B							
T17	Coastal protection structures	6	56%		A			B			C			D	
T18	Drought and water conservation plans	6	44%		A			B			C			D	
T19	Mainstreaming Disaster Risk Management (DRM)	7	63%								C				
T20	Using water to cope with heat waves	7	37%								C				
T22	Health care delivery systems	8	53%		A										
T21	Fire management plans	8	47%		A										
T24	Pre-disaster early recovery planning	9	52%		A									D	
T23	Post-Disaster recovery funds	9	48%		A									D	
T3	Adaptation of groundwater management	10	63%		A			B			C			D	
T4	Monitoring, modelling and forecasting systems	10	37%		A			B			C			D	
T5	Dune restoration and rehabilitation	11	72%					B			C				
T6	River rehabilitation and restoration	11	28%					B			C				
T7	Adaptive management of natural habitats	12	50%								C				
T8	Ocean pools	12	50%								C				

Figure 46: Results of the stakeholder tool choices grouped as an option within the three strategic vectors ***Vulnerability Reduction, Disaster Risk Reduction, Social-Ecological Resilience.*** *The ratio displays how many times an AO got chosen when it was available. The time frames S, M, and L correspond to the periods "up to 2030", "2030 – 2050", and "2050 – 2100". When an AO was chosen 50% or more it entered in the pathway, which is depicted as a coloured square below the time step and scenario world. If the square is grey the AO was chosen less than 50% of the time or was not available in that particular scenario world.*

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ID	Name	Class number	Ratio	APT A			APT B			APT C			APT D		
				S	M	L	S	M	L	S	M	L	S	M	L
T9	Activity and product diversification	2	75%		A			B			C			D	
T11	Local circular economy	3	73%								C				
T5	Dune restoration and rehabilitation	11	72%					B			C				
T3	Adaptation of groundwater management	10	63%		A			B			C			D	
T19	Mainstreaming Disaster Risk Management (DRM)	7	63%								C				
T15	Beach nourishment	5	60%					B							
T17	Coastal protection structures	6	56%		A			B			C			D	
T22	Health care delivery systems	8	53%		A										
T14	Water restrictions, consumption cuts and grey-water recycling	4	53%								C			D	
T1	Economic Policy Instruments (EPIs)	1	53%					B						D	
T24	Pre-disaster early recovery planning	9	52%		A									D	
T7	Adaptive management of natural habitats	12	50%								C				
T8	Ocean pools	12	50%								C				
T23	Post-Disaster recovery funds	9	48%		A									D	
T2	Financial incentives to retreat from high-risk areas	1	47%					B						D	
T13	Local sustainable fishing	4	47%								C			D	
T21	Fire management plans	8	47%		A										
T18	Drought and water conservation plans	6	44%		A			B			C			D	
T16	Desalination	5	40%					B							
T20	Using water to cope with heat waves	7	37%								C				
T4	Monitoring, modelling and forecasting systems	10	37%		A			B			C			D	
T6	River rehabilitation and restoration	11	28%					B			C				
T12	Tourist awareness campaigns	3	27%								C				
T10	Public awareness programmes	2	25%		A			B			C			D	

Figure 47: Results of the stakeholder tool choices ordered by choice popularity. The ratio displays how many times an AO got chosen when it was available. The time frames S, M, and L correspond to the periods "up to 2030", "2030 – 2050", and "2050 – 2100". When an AO was chosen 50% or more it entered the pathway, which is depicted as a coloured square below the time step and scenario world. If the square is white, the AO was chosen less than 50% of the time. If the square is grey, the option was not available in that particular scenario world.

Sustainability Performance

The combined set of AOs that entered an adaptation pathway through the choices made by stakeholders will have a certain environmental impact. This impact could be predicted as all AOs were evaluated by the IFP coordinators from BEF Germany. The created pathways differ in their environmental impacts regarding the 5 aspects "Cost Efficiency", "Environmental protection", "Mitigation (GHG emissions) win-wins and trade-offs", "Technical applicability", and "Social acceptability". Values to assess the impacts were discrete and could be "Low", Medium", and "High". The visual representation of the results can be found in Fig. 5. Please refer to the underlying scores in Section 6 "Additional Material" if you would like to find out in more detail the specific sustainability performance of single AOs.

Overall, environmental protection reached low scores, indicating that measures to prepare against catastrophe to ensure survival and comfort are rated higher than implementing measures that are beneficial to the environment. Measures that allow mitigating effects of climate change while providing adaptation to not worsen the possible climate hazard situation were therefore not considered important. This goes hand in hand with the low scores that were reached for mitigation win-wins, indicating that the trade-offs with climate adaptation would be high. Few of the proposed AOs would take care of multiple problems at the same time and implementing one would come at the cost of another. In general, measures implemented in the APT scenario world C would cause the greatest environmental protection (although values would remain at a medium level), while in all other scenarios the environmental protection would be low.

Technical applicability was rated generally high, as Germany is a developed country, and a lot of the proposed technologies are available if the question of cost is disregarded. The question then remains whether a solution would be feasible within its economic, social, and environmental contexts which have to be assessed first. Some of the proposed measures could certainly be improved in their technical development, but in general, are considered to be already at a high level and readily available if the funds are present and willing to implement is there.

Measures with the highest Social Acceptability are found in APT A scenario, reaching high values whereas all other scenario worlds have a medium score on the social acceptability of the implemented measures. This appears to be logical as decision-makers in scenario world A tend to choose cost-efficient AOs that do not do much to change the status quo. As changes are not dramatic, stakeholders should have no reason to oppose them. Unsurprisingly, social acceptability of measures is lowest for APT D, especially towards the end of the century. This possibly indicates that measures are getting more extreme, with social acceptability for them declining as time progresses. Measures that are vaster and more invasive (such as resettling whole communities), should go hand in hand with lower social acceptance.

The cost-efficiency of the chosen measures tended to be medium to high. Highest cost-efficiency occurred in APT A; the scenario world that aims to invest as little as possible in adaptation measures. Surprisingly, APT D had the second-highest cost-efficiency values for AOs chosen at the end of the century. This result could appear odd in the light that one would assume that more extreme measures would be implemented in this APT as the century progresses. However, stakeholders seem to have chosen measures that appear to be relatively cost-efficient even though they were deciding with the mindset of a decision-maker from scenario world D, who would have a high willingness to invest a lot of money in climate change adaptation measures.

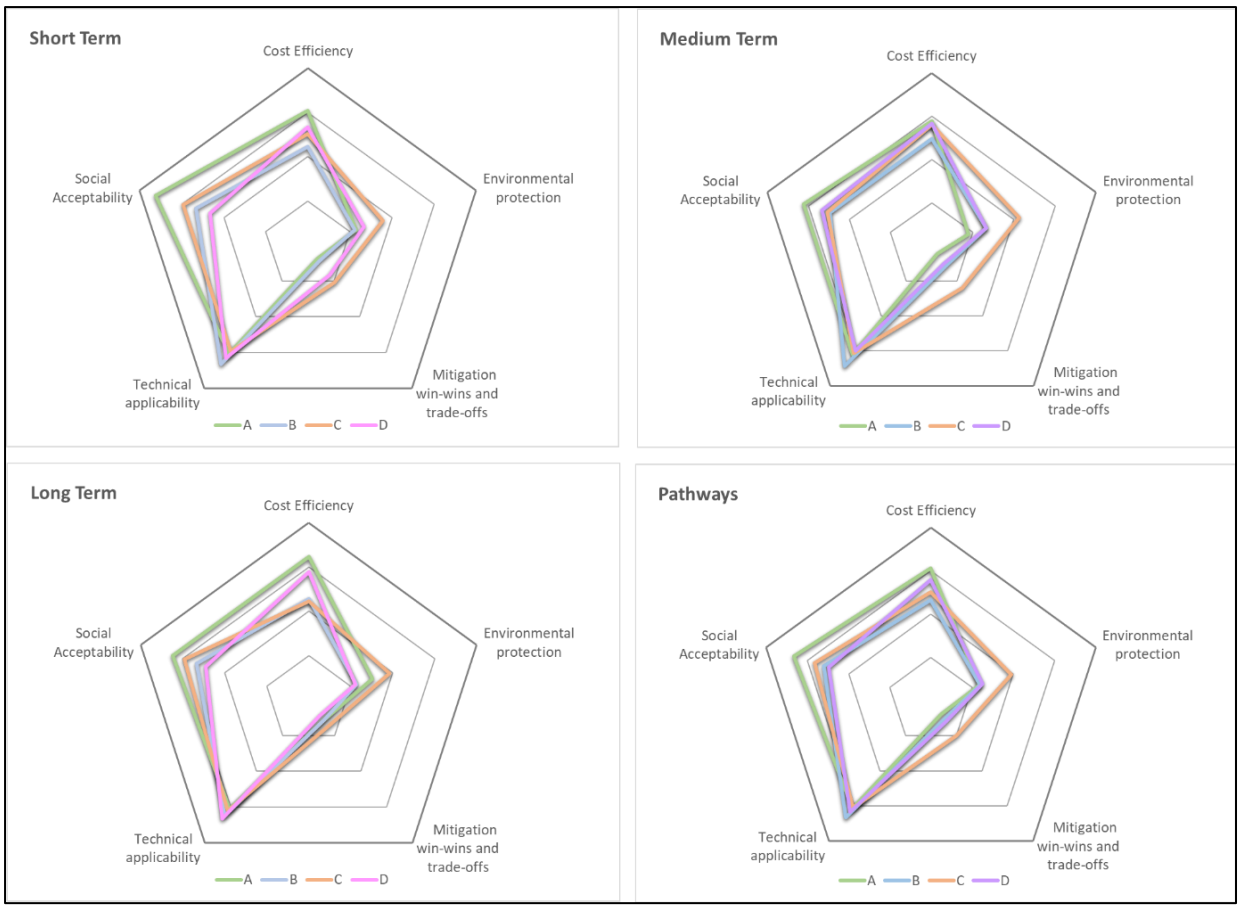

Figure 48: Pathway evaluation for the tourism sector considering: Cost Efficiency; Environmental protection; Mitigation (GHG emissions) win-wins and trade-offs; Technical applicability; and Social acceptability. The analysis was conducted for the four policy pathways scenarios: APT A - Minimum Intervention; APT B - Economic Capacity Expansion (ECE); APT C- Efficiency Enhancement (EE); APT D - System Restructuring (SR), for different timeframes: S - Short term (up to 2030), M- Medium term (up to 2050), L - Long term (until 2100)
, as well as an average analysis across all timeframes. Evaluation based on the personal assessment of Fehmarn IFP Baltic Environmental Forum Germany.

4.7.2 Further comments

General discussion on the stakeholder engagement process and climate adaptation yielded further insights on stakeholder attitudes. It was acknowledged that climate change is coming and even mitigation measures will not do much to reduce the impacts. By implementing island-wide measures the climatic changes cannot be stopped in the eyes of some stakeholders. One person said that it is therefore important to always have a plan B in case the adaptation measures will not work. It was also acknowledged that there are limits to adaptation. Certain activities can only help so much before they cannot buffer the impacts of climate change. Even if all preventive and absorbing measures are implemented, it will depend on the severity of climate change to show how effective they are. There are certain events for which adaptive measures will not help, for instance, the increased occurrence of dangerous jellyfish. In those instances, inhabitants and tourists know that nothing can be done, and other solutions have to be found.

What was pointed out is that the island communities need to have an administrative structure that will enable them to adapt to climatic changes. If the municipality of Fehmarn does not have the means to coordinate and implement adequate measures, then creating adaptation plans is of no use. A negative example for this is the planned construction of the "Fixed Fehmarn Belt" tunnel that will connect Fehmarn

and Denmark. Although the community wants to become climate neutral by 2030, the tunnel and its connected infrastructure will cause lots of car traffic across the island. Fehmarn municipality and inhabitants are against the mega-project but cannot intervene as decisions are made on a federal level.

Playing through the stakeholder tool was considered a useful activity to start thinking about climate adaptation but working through four scenario worlds was considered a lot. One stakeholder remarked that it was quite challenging and confusing to focus on the mindset of a specific world and make choices based on the APT attitudes. She said that sometimes she just picked a random option to move on to the next choice. This was potentially the case for other stakeholders as well. It was stated that focussing on one scenario world in more detail could have potentially been more productive. Regardless of the tool's complexities, it was considered valuable to end up with a plan outlining the general adaptation trajectories and a combination of measures.

4.8 Guadalupe & Martinica

Due to circumstances associated to Covid-19 context it was not possible to implement the methodology to the Island case study, although efforts were made to contact stakeholders and attain their inputs on the adaptation options available for the Adaptation Pathways.

4.9 Madeira

For these Islands two online webinars were made and spoken in Portuguese, with the presentations in English and the Online Survey Tool with the options and classes in English as well. A support word file with the measures were prepared. There were several Local knowledge options proposed by stakeholders and the IFP (AREAM), and the characterization of all adaptation options was made by the IFP.

4.9.1 Aquaculture

The identification and description of the adaptation measures for the aquaculture sector, including the local knowledge measures, are on the Annex AI.

Aquaculture pathways are based on choices made by 23 experts island stakeholders.

Selected Adaptation Pathways

ID	Name	Class number	Ratio	APT A			APT B			APT C			APT D		
				S	M	L	S	M	L	S	M	L	S	M	L
A1	Financial schemes, insurance and loans	1	55%					B						D	
A2	Tax benefits and subsidies	1	45%					B						D	
A10	Efficient feed management	2	54%		A			B			C			D	
A9	Awareness campaigns for behavioural change	2	46%		A			B			C			D	
A11	Addressing consumer and environmental concerns at the local	3	55%								C				
A12	Promote cooperation to local consumption	3	45%								C				
A13	Integrated multi-trophic aquaculture (IMTA)	4	54%								C			D	
A14	Short-cycle aquaculture	4	46%								C			D	
A16	Submersible cages	5	75%					B							
A15	Recirculation Aquaculture Systems (RAS)	5	25%					B							
A17	Climate proof aquaculture activities	6	53%		A			B			C			D	
A18	Risk-based zoning and site selection	6	47%		A			B			C			D	
A19	Disease prevention methods	7	70%								C				
A20	Environmental monitoring and Early Warning Systems (EWS)	7	30%								C				
A21	Mainstreaming Disaster Risk Management (DRM)	8	61%		A										
A22	Contingency for emergency management, early	8	39%		A										
A23	Recovery Post-Disaster plans	9	65%		A									D	
A24	Recovery Post-Disaster funds	9	35%		A									D	
A3	Feed production	10	55%		A			B			C			D	
A4	Species selection	10	45%		A			B			C			D	
A6	Best Management Practices	11	55%					B			C				
A5	Selective breeding	11	45%					B			C				
A7	Create educational visits	12	55%								C				
A8	Promote aquaculture cuisine	12	45%								C				
A29	(A29) Aquaculture as an alternative to fishing	Local	30%		A			B			C			D	
A27	(A27) Aquaculture and circular economy	Local	23%		A			B			C			D	
A28	(A28) Implement measures for increasing local industry self-	Local	22%		A			B			C			D	
A25	(A25) Long-term environmental data collection and management	Local	18%		A			B			C			D	
A26	(A26) Implementation of local sanitary programs at regional scale	Local	7%		A			B			C			D	

Figure 49 - Adaptation options for the aquaculture sector. Options are identified with an ID number, full name, and class of adaptation number. Adaptation objectives are identified in each option by colour: ***vulnerability reduction (red), Disaster Risk Reduction (blue); Social-Ecological Resilience (green); Local Knowledge adaptation options (grey).*** *Each ATP (APT A; APT B; APT C; APT D) is represented in three timeframes: S - Short term (up to 2030), M- Medium term (up to 2050), L - Long term (until 2100). Highlighted options indicate the measure was selected in each ATP and timeframe: ATP A – Minimum Intervention (light blue); ATP B – Economic Capacity Expansion (light green); ATP C – Efficiency Enhancement (Light orange) and ATP D – System Restructuring (light purple). Bold letters in each ATP indicate the option was available to be selected in the three time frames. Grey cells mean that they the options was not available in that APT.*

The measures selected for each Adaptation Pathway for the aquaculture sector can be consulted in the Annex BI. It is also possible to verify the percentage of stakeholders that selected each measure by Adaptation Pathway Trajectory and time frame.

The **human capital** (class 2) measure considered a priority to address **Vulnerability Reduction** for the APT B (capacity expansion) was "Awareness campaign and behavioural change" for all time frames, which indicates the necessity of this measure on a scenario of low political commitment. Under APT D (system restructuring) the considered priority was "Efficient feed management" for all time frames, which is coherent with a scenario of high political commitment.

Under the APT B and D, both with high level of investment, the **financial capital** measures (class 1) considered a priority for the short and long terms are the same. It indicates that regardless the level of commitment, at short term the region is more focused on "Financial schemes, insurances and loans", and on the long term the focus is "Tax benefits and subsidies".

In the scope of **social capital** (class 3) and under the APT C (efficient enhancement), "Promote cooperation to local consumption" was consider a priority for the short term. For medium and long terms, the priority considered was "Addressing consumer and environmental concerns at the local level".

The measure "Short-cycle aquaculture", **physical capital** (class 4), was considered a priority for all time frames for the APT C and on short for the APT D. Currently, "Integrated multi-trophic aquaculture (IMTA)" is not implemented in Madeira island. This measure was selected for the medium and long-time frame for APT D, being the priority consistent with a system restructuring scenario.

In opposition to "Recirculation Aquaculture Systems (RAS)", the measure "Submersible cages", **natural capital** (class 5), was a clear priority in all time frames of the scenario where the measure was available, scenario of capacity expansion. The measure enables to submerge the cages according with temperature gradient and to protect them from sea storms, being considered a good adaptation measure. Furthermore, it decreases the cages visual impact, which, currently, is one of the main regional social constraints to the development of this blue economy sector.

For **Disaster Risk Reduction**, in opposition to "Environmental monitoring and Early Warning Systems (EWS)", the measure "Disease prevention methods", **hazard preparedness** (class 7) was consider a priority in all time frames of the scenario where the measure was available, scenario of efficiency enhancement.

The measure considered a priority address **risk mitigation** (class 6) for the APT's B, C and D was "Climate proof aquaculture activities" in the majority of the time frames, in opposition to the measure "Risk-based zoning and site selection", which was the priority for the scenario of minimum intervention for all time frames and for the short term for the APT C and D.

In the scope of **disaster response** (class 8) the priority for the short term was the measure "Mainstreaming Disaster Risk Management (DRM)" and for the medium and long term the regional priority considered was "Contingency for emergency management, early harvest and/or relocation", for minimum intervention scenario.

Under the **post disaster recovery** (class 9), the region gave priority to the measure "Recovery Post-Disaster plans" for all time frames in the APT A and in the short term for the APT D, in opposition with the measure "Recovery-disaster funds", that as priority for the medium and long terms for the APT D (high investment/ high commitment).

In **Social-Ecological Resilience** adaption objective concerning **provisioning services class** (class 10), the region gave considered a priority the measure "Feed production" for all time frame in the scenarios minimum intervention (APT A) and capacity expansion (APTB), both scenarios with low commitment. This measure was a priority in the APT C and APT D at short term, being the measure "Species selection" the priority measure at medium and long term for these APTs.

The measure to address the class **regulating and maintenance services** (class 11) considered a priority by the stakeholders was "Best management practices" for the medium and long term for the APT C, in opposition with the measure "Selective breeding", which was a regional priority in all time frames for the scenario minimum intervention, and at short and medium terms for the scenario efficiency enhancement.

Under **cultural services** (class 12) the regional priority is to promote "Aquaculture cuisine" at the short term for the APT C, in order to increase the local consumption, and "Create educational visits" at medium and long terms to increase awareness on aquaculture advantages.

Local knowledge priorities where focus on "Aquaculture as an alternative to fishing" on all time frames of the lower commitment scenarios, APT A and APT B, and at short term in the efficiency enhancement scenario, APT C. It highlights the role of aquaculture in the preservation the natural resources. The following priorities are related with circular economy and self-sufficiency in aquaculture, which is important to the regional food security and decrease the region dependence from the exterior. They are strategic objectives to increase the archipelago resilience to climate change.

The measure "Long-term environmental data collection and management" at regional level was also considered a priority in the APT A, C and D, which is important to ensure the reduction of the aquaculture impacts and increase its social acceptability.

Sustainability Performance

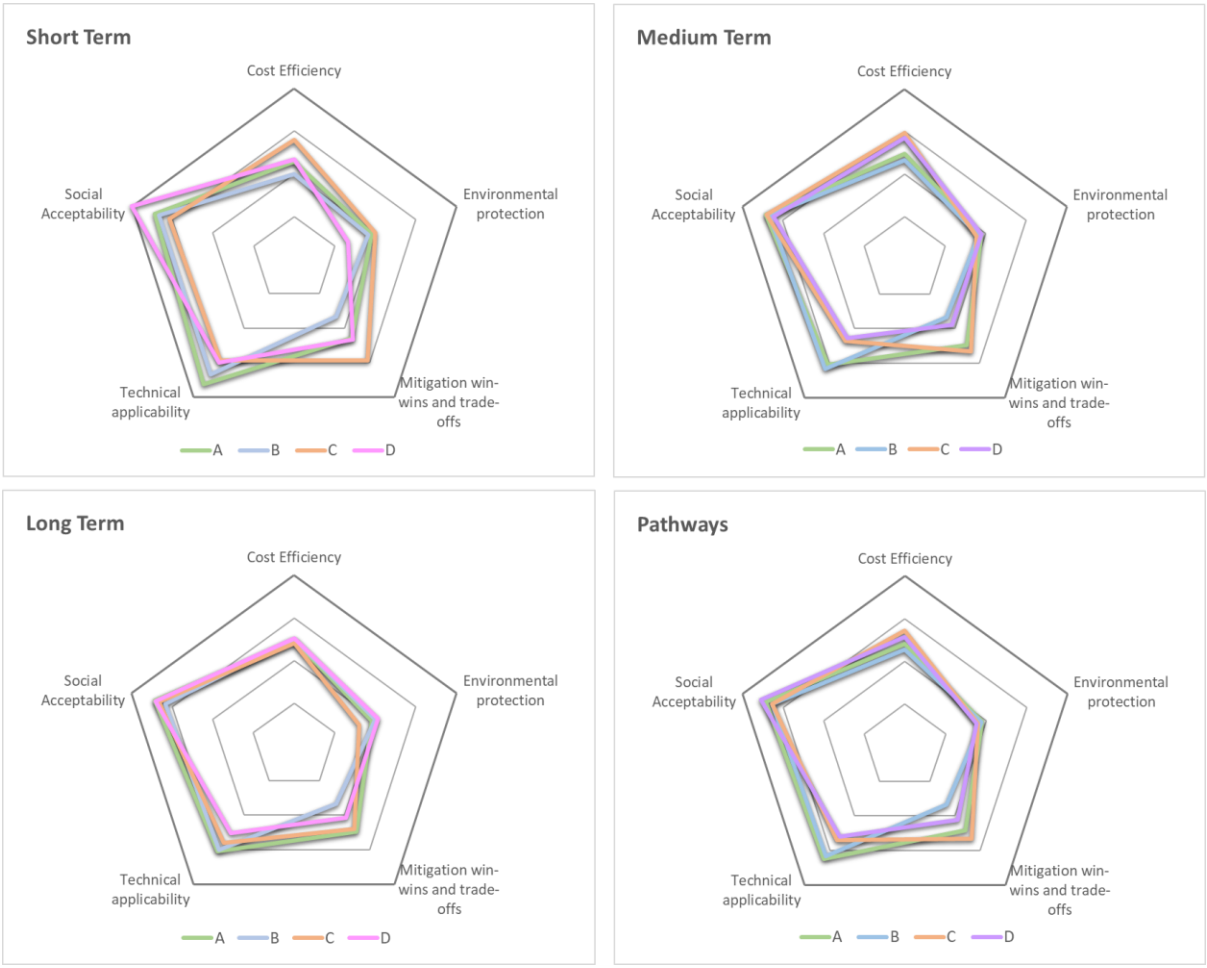

Figure 50 - Pathways evaluation for the aquaculture sector considering: Cost Efficiency; Environmental protection; Mitigation (GHG emissions) win-wins and trade-offs; Technical applicability; Social acceptability. The policy pathways scenarios: APT A - Minimum Intervention; APT B - Economic Capacity Expansion (ECE); APT C- Efficiency Enhancement (EE); APT D - System Restructuring (SR), for different timeframes: S - Short term (up to 2030), M- Medium term (up to 2050), L - Long term (until 2100)

On the short term, the measures selected for the APT A have better technical applicability performance, the measures selected for the APT D have better social acceptability performance and the measures selected for the APT C have better cost efficiency, environmental protection, and mitigation performances.

On the medium term, the measures selected for the APT B have better technical applicability performance, and the measures selected for the APT C have better the cost efficiency, social acceptability, and mitigation performances.

On the long term, all APT's have similar performance in all criteria. However, the measures selected for the APT B have lower mitigation performance, the measures selected for the APT C have lower environmental protection performance and the measures selected for the APT D have lower technical performance.

At long term, for all APTs, the technical applicability is lower, but the measures were classified for 2020 for these criteria and should be expected more maturity for this adaptation solutions after 2050.

Overall, the APT C is the one with better contribution for the regional mitigation objectives of reduce at least 40% of GHG emissions for 2030 and achieve climate resilience and carbon neutrality (85% GHG emissions reduction) by 2050, according the Sustainable Energy and Climate Action Plan under development and have highest cost efficiency performance. The APT D is the scenario with better social acceptance performance.

4.9.2 Energy

The identification and description of the adaptation measures for the energy sector, including the local knowledge measures, are on the Annex AII.

Energy pathways are based on choices made by 25 expert island stakeholders.

Selected Adaptation Pathways

ID	Name	Class number	Ratio	APT A			APT B			APT C			APT D		
				S	M	L	S	M	L	S	M	L	S	M	L
E2	Financial support for smart control of energy in houses and	1	55%					B						D	
E1	Financial support for buildings with low energy needs	1	45%					B						D	
E9	Green jobs and businesses	2	63%		A			B			C			D	
E10	Public information service on climate action	2	37%		A			B			C			D	
E11	Small scale production and consumption (prosumers)	3	63%								C				
E12	Risk reporting platform	3	37%								C				
E13	Energy storage systems	4	68%								C			D	
E14	Collection and storage of forest fuel loads	4	32%								C			D	
E16	Demand Side Mangement (DSM) of Energy	5	59%					B							
E15	SeaWater Air Conditioning (SWAC).	5	41%					B							
E17	Review building codes of the energy infrastructure	6	53%		A			B			C			D	
E18	Upgrade evaporative cooling systems	6	47%		A			B			C			D	
E20	Grid reliability	7	55%								C				
E19	Early Warning Systems (EWS)	7	45%								C				
E22	Energy-independent facilities (generators)	8	52%		A										
E21	Study and develop energy grid connections	8	48%		A										
E23	Energy recovery microgrids	9	57%		A									D	
E24	Local recovery energy outage capacity	9	43%		A									D	
E3	Energy efficiency in urban water management	10	68%		A			B			C			D	
E4	Underground tubes and piping in urban planning	10	32%		A			B			C			D	
E6	Urban green corridors	11	52%					B			C				
E5	Biomass power from household waste	11	48%					B			C				
E7	Educational garden plots	12	69%								C				
E8	Heated pools with waste heat from power plants	12	31%								C				
E25	(E25) Minimize islands energy dependence from imported fossil	Local	31%		A			B			C			D	
E26	(E26) Diversification on energy supply and electricity generation	Local	22%		A			B			C			D	
E29	(E29) Promote electric mobility integrated in smart grids with	Local	17%		A			B			C			D	
E27	(E27) Implement electricity prices for renewable energy	Local	14%		A			B			C			D	
E30	(E30) Electrification of energy demand	Local	10%		A			B			C			D	
E28	(E28) Modelling and forecasting of supply and demand	Local	6%		A			B			C			D	

Figure 51 - Adaptation options for the energy sector. Options are identified with an ID number, full name, and class of adaptation number. Adaptation objectives are identified in each option by colour: ***vulnerability reduction (red), Disaster Risk Reduction (blue); Social-Ecological Resilience (green); Local Knowledge adaptation options (grey).*** *Each ATP (APT A; APT B; APT C; APT D) is represented in three timeframes: S - Short term (up to 2030), M- Medium term (up to 2050), L - Long term (until 2100). Highlighted options indicate the measure was selected in each ATP and timeframe: ATP A – Minimum Intervention (light blue); ATP B – Economic Capacity Expansion (light green); ATP C – Efficiency Enhancement (Light orange) and ATP D – System Restructuring (light purple). Bold letters in each ATP indicate the option was available to be selected in the three time frames. Grey cells mean that they the options was not available in that APT.*

The measures selected for each Adaptation Pathway for the energy sector can be consulted in the Annex BII. It is also possible to verify the percentage of stakeholders that selected each measure by Adaptation Pathway Trajectory and time frame.

The **financial capital** (class 1) measure considered a priority to address **Vulnerability Reduction** for the APT B (capacity expansion) and APT D (system restructuring) was "Financial support for buildings with low energy needs" for the short term. At medium and long term, the regional priority was "Financial support for smart control of energy in houses and buildings", which reflects an expected maturity of these solutions.

Under the **human capital** measures (class 2) the regional priority for the APT B and D was "Green jobs and businesses" for all time frames. For the APT A (minimum intervention) and APT C (efficiency enhancement), the regional priority was "Public information service on climate action" at short term and "Green jobs and businesses" at medium term.

In the scope of **social capital** (class 3) and under the APT C, the regional priority was "Small scale production and consumption (prosumers)" for all time frames.

The measure "Energy storage systems", **physical capital** (class 4), was considered a priority for all time frames of the APT C and on short for the APT D. This measure will allow Madeira to decrease its dependency from fossil fuels, and thus increasing its resilience to climate change.

In opposition to "Seawater Air Conditioning (SWAC)", the measure "Demand Side Management (DSM) of Energy", **natural capital** (class 5), was consider a priority in all time frames of the APT B (capacity expansion), where the measure was available. This choice is compatible with sea water average temperature and the island orography that difficult the sea access.

For **Disaster Risk Reduction** the measure considered a priority to address **risk mitigation** (class 6) for the APT's A, B, C and D was "Review building codes of the energy infrastructure" in the majority of the time frames, in opposition to the measure "Upgrade evaporative cooling systems", which was the priority, at the long term, for the scenarios of capacity expansion (APT B), efficiency enhancement (APT C) and system restructuring (APT D).

Under the class **hazard preparedness** (class 7), the priority at short term was "Early Warning Systems (EWS)" and for the medium and long terms the priority was "Grid reliability" for the efficiency enhancement scenario, where the measures were available.

In the scope of **disaster response** (class 8), the priority at short term was the measure "Study and develop energy grid connections" and for the medium and long term the regional priority was "Energy-independent facilities (generators)", for minimum intervention scenario.

Under the post **disaster recovery** (class 9), the measure "Energy recovery microgrids" was considered a priority for all time frames in the APT D and for the short and medium terms in the APT A, in opposition to the measure "Local recovery energy outage capacity" that was consider a priority at long term for the APT A.

In **Social-Ecological** Resilience adaption objective concerning **provisioning services class** (class 10), the region gave clear priority to "Energy efficiency in urban water management" for all time frame in the APT A (minimum intervention), APT B (capacity expansion), APT C (efficiency enhancement) and APT D (system restructuring).

The measure considered a priority to address the class **regulating and maintenance services** (class 11) was "Urban green corridors" for all time frames for the APT B and for the medium term for the APT C, in opposition of the measure "Biomass power from household waste" that was consider a priority for the short and long terms for the APT C. The local stakeholders recognize the importance of reducing the air temperatures in the cities without increase the consumption of energy for cooling, increasing the quality of life in open spaces.

Under **cultural services** (class 12), there is a clear priority to promote "Educational garden plots" for all time frames for the APT C, which highlights the importance to reduce the food carbon footprint and food security in islands.

Local knowledge priorities were focus on minimize islands energy dependence from imported fossil fuels to increase its climate change resilience, in all time frames of the 4 scenarios. It highlights the importance to decrease imported fossil fuels as a climate change adaptation measure. The following priority is related with the diversification of energy supply and electricity generation (E26), which contributes the measure "Promote electric mobility integrated in smart grids with smart-charging and vehicle-to-grid infrastructure" and "Implement electricity prices for renewable energy generation on islands based on actual local costs to stimulate the RES generation".

During the results discussion, the stakeholders underlined the importance of the diversification on energy supply and electricity generation for energy independence of islands, as the extreme weather events, namely storms, can destroy wind farms, being important to invest in photovoltaic energy and the foreseen

precipitation reduction will affect hydropower production. Hydro energy will be affected by water scarcity and by priority uses, human consumption and irrigation in Madeira island.

It was also underlined that downscaling the climate models for Madeira and Porto Santo islands is important to better forecast the renewable resources and deal with the foreseen reduction of precipitation. Currently, the available climate data and models for these Atlantic islands do not have the necessary accuracy do support the decision-making process on RES and energy storage investments.

Sustainable Performance

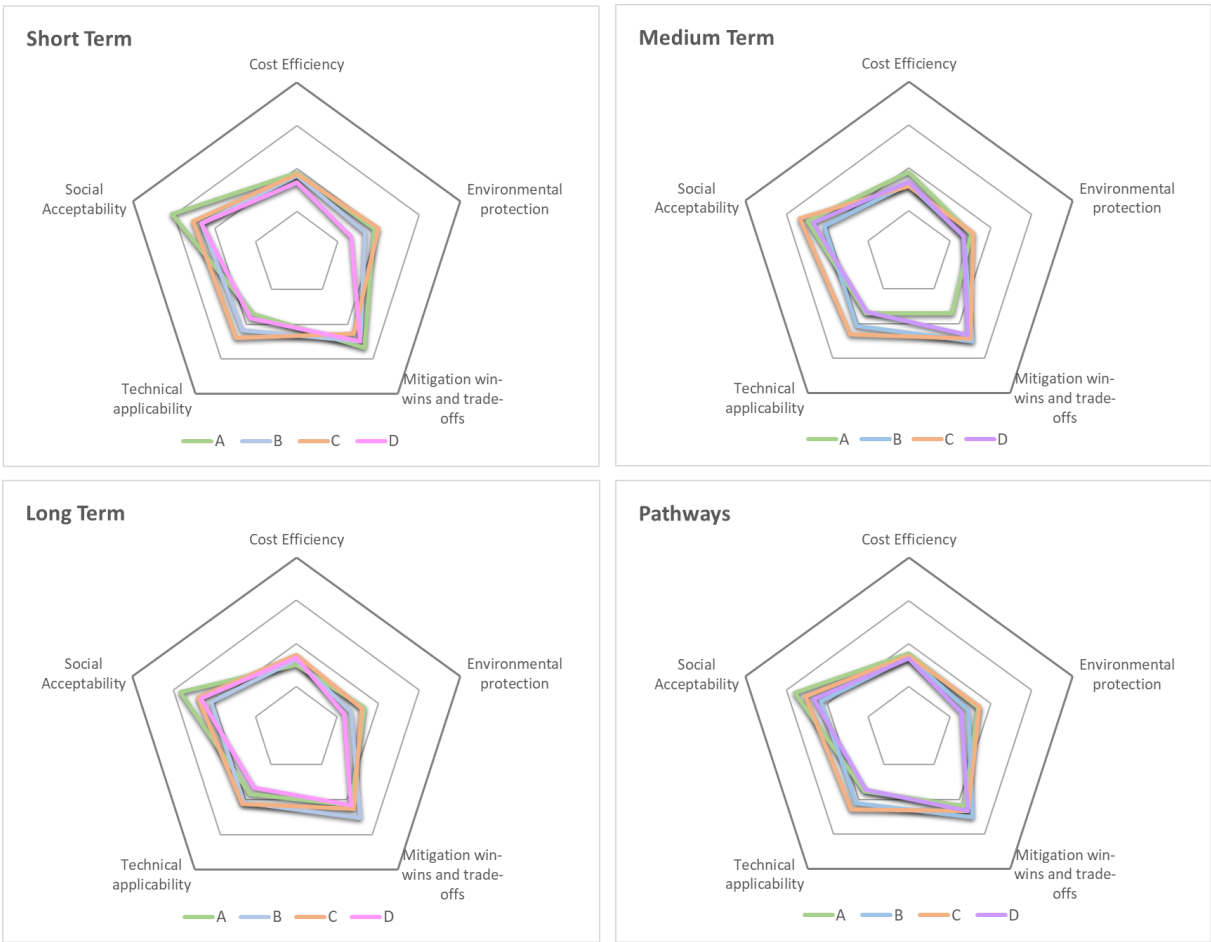

Figure 52 - Pathways evaluation for the energy sector considering: Cost Efficiency; Environmental protection; Mitigation (GHG emissions) win-wins and trade-offs; Technical applicability; Social acceptability. The policy pathways scenarios: APT A - Minimum Intervention; APT B - Economic Capacity Expansion (ECE); APT C- Efficiency Enhancement (EE); APT D - System Restructuring (SR), for different timeframes: S - Short term (up to 2030), M- Medium term (up to 2050), L - Long term (until 2100)

On the short term, the measures selected for the APT A have better social acceptability, cost efficiency and mitigation performances, and the measures selected for the APT C have better technical applicability and environmental protection performances.

On the medium term, the measures selected for the APT A have better cost efficiency performance, the measures selected for the APT B have better mitigation performance, and the measures selected for the APT C have better technical applicability, social acceptability, and environmental protection performances.

On the long term the measures selected for the APT A have better social acceptability and environmental protection, the measures selected for the APT B have better mitigation performance, and the measures selected for the APT C have better technical applicability performance.

At long term, for all APTs, the technical applicability is lower, but the measures were classified for 2020 for these criteria and should be expected more maturity for this adaptation solutions after 2050.

Overall, the APT B is the one with higher contribution for the regional mitigation objectives of reduce at least 40% of GHG emissions for 2030 and achieve climate resilience and carbon neutrality (85% GHG emissions reduction) by 2050, according the Sustainable Energy and Climate Action Plan under development. The APT A is the scenario with better social acceptability and cost efficiency performances, the APT C is the scenario with better technical applicability and environmental protection performances, and the APT D is the scenario with lower technical applicability and environmental protection performances.

4.9.3 Maritime Transport

The identification and description of the adaptation measures for the maritime transport sector, including the local knowledge measures, are on the Annex AII.

Maritime transport pathways are based on choices made by 24 expert island stakeholders.

Selected Adaptation Pathways

ID	Name	Class number	Ratio	APT A			APT B			APT C			APT D		
				S	M	L	S	M	L	S	M	L	S	M	L
MT2	Financial incentives to retreat from high-risk areas	1	57%					B						D	
MT1	Insurance mechanisms for ports	1	43%					B						D	
MT10	Social dialogue for training in the port sector	2	51%		A			B			C			D	
MT9	Awareness campaigns for behavioural change	2	49%		A			B			C			D	
MT12	Climate resilient economy and jobs	3	61%								C				
MT11	Diversification of trade using climate resilient commodities	3	39%								C				
MT14	Restrict development and settlement in low-lying areas	4	61%								C			D	
MT13	Refrigeration, cooling and ventilation systems	4	39%								C			D	
MT16	Increase operational speed and flexibility in ports	5	58%					B							
MT15	Sturdiness improvement of vessels	5	42%					B							
MT17	Climate proof ports and port activities	6	53%		A			B			C			D	
MT18	Consider expansion/retreat of ports in urban planning	6	47%		A			B			C			D	
MT20	Early Warning Systems (EWS) and climate change monitoring	7	56%								C				
MT19	Reinforcement of inspection, repair and maintenance of	7	44%								C				
MT21	Inteligent Transport Systems (ITS)	8	57%		A										
MT22	Prepare for service delays or cancellations	8	43%		A										
MT23	Backup routes and infrastructures during extreme weather	9	68%		A									D	
MT24	Post-Disaster recovery funds	9	32%		A									D	
MT4	Combined protection and wave energy infrastructures	10	55%		A			B			C			D	
MT3	Marine life friendly coastal protection structures	10	45%		A			B			C			D	
MT6	Coastal protection structures	11	53%					B			C				
MT5	Hybrid and full electric ship propulsion	11	47%					B			C				
MT7	Integrate ports in urban tissue	12	63%								C				
MT8	Ocean pools	12	38%								C				
MT27	(MT27) Increase knowledge and modelling tools on climate	Local	27%		A			B			C			D	
MT28	(MT28) City ports as coastal protection infrastructures against	Local	27%		A			B			C			D	
MT25	(MT25) Specific requirements to increase climate change	Local	23%		A			B			C			D	
MT26	(MT26) Prepare islands ports to supply alternative fuels and	Local	23%		A			B			C			D	

Figure 53 - Adaptation options for the Maritime Transport sector. Options are identified with an ID number, full name, and class of adaptation number. Adaptation objectives are identified in each option by colour: ***vulnerability reduction (red), Disaster Risk Reduction (blue); Social-Ecological Resilience (green); Local Knowledge adaptation options (grey).*** *Each ATP (APT A; APT B; APT C; APT D) is represented in three timeframes: S - Short term (up to 2030), M- Medium term (up to 2050), L - Long term (until 2100). Highlighted options indicate the measure was selected in each ATP and timeframe: ATP A – Minimum Intervention (light blue); ATP B –*

Economic Capacity Expansion (light green); ATP C – Efficiency Enhancement (Light orange) and ATP D – System Restructuring (light purple). Bold letters in each ATP indicate the option was available to be selected in the three time frames. Grey cells mean that they the options was not available in that APT.

The measures selected for each Adaptation Pathway for the maritime transport sector can be consulted in the Annex BIII. It is also possible to verify the percentage of stakeholders that selected each measure by Adaptation Pathway Trajectory and time frame.

The **financial capital** (class 1) measure considered a priority to address **Vulnerability Reduction** for the scenario capacity expansion (APT B) was "Insurance mechanisms for ports" for all time frames which is coherent with the low commitment to significant policy change. For the scenario system restructuring (APT D) the priority measure considered was "Financial incentives to retreat from high-risk areas" for all time frames, which is coherent with a scenario of high level of investment and high commitment to significant policy change.

Under the **human capital** measures (class 2) the regional priority for the APT A, B, C and D was "Awareness campaigns for behavioural change" for the short term. For the medium and long terms, in all scenarios, the regional priority was "Social dialogue for training in the port sector", underling the concerns with the foreseen sea level rise in these time frames.

In the scope of **social capital** (class 3) and under the APT C, the regional priority was "Climate resilient economy and jobs" for all time frames, which underlines the importance to reduce imported goods from the exterior.

Under the APT C and D, in all time frames, the measure "Restrict development and settlement in low-lying areas" **physical capital** (class 4), was considered a clear priority.

Under the class **natural capital** (class 5), the measure "Sturdiness improvement of vessels" was selected by 50% of the stakeholders at the short term for the APT B. The measure "Increase operational speed and flexibility in ports" was considered the priority for the medium and long term.

For **Disaster Risk Reduction**, the measure to address **risk mitigation** (class 6) "Climate proof ports and port activities" was consider a priority for the APT A for all time frames, for the APT B for the medium and long term, for the APT C for the medium term and for the APT D for the short and medium term, this underlines the island dependence from the exterior and the importance of preventing the disruption of port activities due extreme weather events.

Under the class **hazard preparedness** (class 7), the measure "Early Warning Systems (EWS) and climate change monitoring" was consider a clear priority for the medium and long terms in opposition of "Reinforcement of inspection, repair and maintenance of infrastructures". Both measures were selected to be included in adaptation pathway for the short term.

For the minimum intervention scenario, in the scope of **disaster response** (class 8) the priority at short term, was the measure "Prepare for service delays or cancellations". For the medium and long term, "Intelligent Transport Systems (ITS)" was considered a regional priority, which is coherent with the development of this technology until the end of the century.

Under the post **disaster recovery** (class 9), the measure "Backup routes and infrastructures during extreme weather" was consider a clear priority for all time frames for the APT A and APT D in opposition of "Post-Disaster recovery funds". For the long term for the scenario system restructuring, both measures were selected to be included in adaptation pathway.

In **Social-Ecological Resilience** adaption objective concerning **provisioning services class** (class 10), the measure "Marine life friendly coastal protection structures" was selected for the short term for the APTs A, B, C and D. This recognizes the potential role of coastal protection infrastructures for biodiversity preservation. For the medium and long term, the selected measure "Combined protection and wave energy infrastructures" was selected for the APTs B, C and D, which indicates the potential contribution of wave energy for islands energy independence.

The measure selected by the stakeholders to address the class **regulating and maintenance services** (class 11) was "Coastal protection structures" for all time frames for the APT B and for the short term for the APT C, in opposition of the measure "Hybrid and full electric ship propulsion", that was considered a priority for the medium and long term for the scenario efficiency enhancement.

Under **cultural services** (class 12), there is a priority to "Integrate ports in urban tissue" for short and long term for the APT C. For the medium term, the measure "Ocean pools" was consider the regional priority.

The Local Knowledge measure "Increase knowledge and modelling tools on climate change for islands" was considered a priority for the short term for all scenarios, which highlights the importance of this measure for the decision-making process. All measures were considered a priority for, at least, 3 different scenarios, which highlights the importance of all Local Knowledge measures.

During the results discussion, the stakeholders underlined the concerns related with the sea level rise that will require high investments in all ports and coastal protection infrastructures. Prepare island ports to supply alternative fuels was identified as an important contribute to reduce the island energy dependence and the emissions associated with maritime transport.

It was also underlined the importance of making available climate change projections on maximum hight waves that combined with the sea level rise will have severe impacts in ports, marines, and other coastal infrastructures.

Given the high dependence from maritime transport, it was highlighted by the stakeholders the importance of backup routes and infrastructures to overcome the islands isolation during extreme weather events which require high investment, justified by the principle of territorial continuity.

The maritime transport is very important for the transportation of goods and persons in archipelagos, being highlighted by the stakeholders that the next concession for maritime public transport services between islands should have requirements concerning alternative fuels and improved vessels sturdiness to increase climate change resilience.

The regional stakeholders mention the importance to increase the regional dry docks areas in marines and shipyards to protect recreational and maritime touristic activities boats in extreme weather events.

Sustainable performance

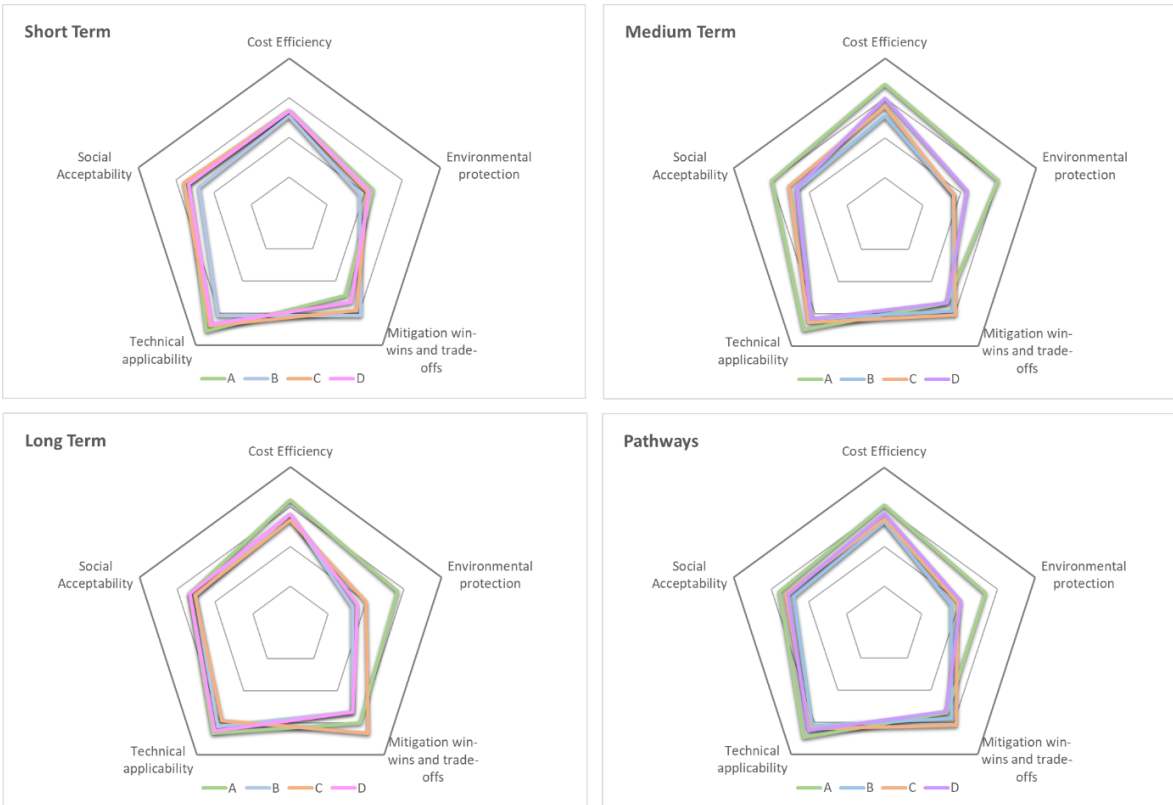

Figure 54 - Pathways evaluation for the maritime transport sector considering: Cost Efficiency; Environmental protection; Mitigation (GHG emissions) win-wins and trade-offs; Technical applicability; Social acceptability. The policy pathways scenarios: APT A - Minimum Intervention; APT B - Economic Capacity Expansion (ECE); APT C- Efficiency Enhancement (EE); APT D - System Restructuring (SR), for different timeframes: S - Short term (up to 2030), M- Medium term (up to 2050), L - Long term (until 2100)

On the short term, the measures selected for the APT A have better technical applicability and environmental protection performances, the measures selected for the APT B have better mitigation performances, the measures selected for the APT C have better social acceptance performance, and the APT D have better cost efficiency performance.

On the medium term, the measures selected for the APT A have better technical applicability, social acceptability, cost efficiency and environmental protection performances, and the measures selected for the APT C have better mitigation performance.

On the long term the measures selected for the APT A have better cost efficiency, environmental protection and technical applicability performances, and the measures selected for the APT C have better mitigation performance, and the measures selected for the APT D have better social acceptability performance.

At long term, for all APTs, the technical applicability is lower, but the measures were classified for 2020 for these criteria and should be expected more maturity for this adaptation solutions after 2050.

Overall, the APT C is the one with higher contribution for the regional mitigation objectives of reduce at least 40% of GHG emissions for 2030 and achieve climate resilience and carbon neutrality (85% GHG emissions reduction) by 2050, according the Sustainable Energy and Climate Action Plan under development. The APT A is the scenario with better technical applicability, environmental protection, social acceptability, and cost efficiency performances.

4.9.4 Tourism

The identification and description of the adaptation measures for the tourism sector, including the local knowledge measures, are on the Annex AIV.

Tourism pathways are based on choices made by 31 expert island stakeholders.

Selected Adaptation Pathways

ID	Name	Class number	Ratio	APT A			APT B			APT C			APT D		
				S	M	L	S	M	L	S	M	L	S	M	L
T2	Financial incentives to retreat from high-risk areas	1	54%					B						D	
T1	Economic Policy Instruments (EPIs)	1	46%					B						D	
T9	Activity and product diversification	2	58%		A			B			C			D	
T10	Public awareness programmes	2	42%		A			B			C			D	
T11	Local circular economy	3	68%								C				
T12	Tourist awareness campaigns	3	32%								C				
T14	Water restrictions, consumption cuts and grey-water recycling	4	63%								C			D	
T13	Local sustainable fishing	4	37%								C			D	
T16	Desalination	5	58%					B							
T15	Beach nourishment	5	42%					B							
T17	Coastal protection structures	6	52%		A			B			C			D	
T18	Drought and water conservation plans	6	48%		A			B			C			D	
T19	Mainstreaming Disaster Risk Management (DRM)	7	75%								C				
T20	Using water to cope with heat waves	7	25%								C				
T21	Fire management plans	8	57%		A										
T22	Health care delivery systems	8	43%		A										
T24	Pre-disaster early recovery planning	9	57%		A									D	
T23	Post-Disaster recovery funds	9	43%		A									D	
T4	Monitoring, modelling and forecasting systems	10	54%		A			B			C			D	
T3	Adaptation of groundwater management	10	46%		A			B			C			D	
T6	River rehabilitation and restoration	11	56%					B			C				
T5	Dune restoration and rehabilitation	11	44%					B			C				
T7	Adaptive management of natural habitats	12	72%								C				
T8	Ocean pools	12	28%								C				
T25	(T25) Rehabilitation and conservation of islands natural habitats	Local	24%		A			B			C			D	
T26	(T26) Diversification of economic activities to reduce the	Local	23%		A			B			C			D	
T28	(T28) Increase knowledge and modelling tools on climate	Local	17%		A			B			C			D	
T30	(T30) Implement waste reduction and management procedures	Local	17%		A			B			C			D	
T29	(T29) Control measures for terrestrial and maritime tourist	Local	11%		A			B			C			D	
T27	(T27) Promote islands as telework tourism destinations	Local	8%		A			B			C			D	

Figure 55 - Adaptation options for the tourism sector. Options are identified with an ID number, full name, and class of adaptation number. Adaptation objectives are identified in each option by colour: ***vulnerability reduction (red), Disaster Risk Reduction (blue); Social-Ecological Resilience (green); Local Knowledge adaptation options (grey).*** *Each ATP (APT A; APT B; APT C; APT D) is represented in three timeframes: S - Short term (up to 2030), M- Medium term (up to 2050), L - Long term (until 2100). Highlighted options indicate the measure was selected in each ATP and timeframe: ATP A – Minimum Intervention (light blue); ATP B – Economic Capacity Expansion (light green); ATP C – Efficiency Enhancement (Light orange) and ATP D – System Restructuring (light purple). Bold letters in each ATP indicate the option was available to be selected in the three time frames. Grey cells mean that they the options was not available in that APT.*

The measures selected for each Adaptation Pathway for the tourism sector can be consulted in the Annex BIV. It is also possible to verify the percentage of stakeholders that selected each measure by Adaptation Pathway Trajectory and time frame.

The **financial capital** (class 1), the regional priority to address **Vulnerability reduction** was "Financial incentives to retreat from high-risk areas" for the APT B (capacity expansion) for the medium term and for the APT D (system restructuring) for all time frames, in opposition to the measure Economic Policy Instruments (EPIs) that was considered a priority for the APT B for the short and long terms.

Under the **human capital** measures (class 2), the regional priority for the APT A for all time frames (minimum intervention) was "Public awareness programmes". For the APT B and APT C (efficiency enhancement) for the medium and long term, and for the APT D for all time frames the measure "Activity and product diversification" was consider the regional priority. This result reveals the stakeholder's perception that it is necessary invest more money and more political commitment to diversify the tourism economy instead of promoting awareness campaign.

In the scope of **social capital** (class 3) and under the APT C, the regional priority was "Local circular economy" for all time frames. This measure will allow Madeira to decrease its waste and offers a framework to reduce CO2 emissions from imports and exports.

In opposition to "Local fishing", the measure "Water restrictions, consumption cuts and grey-water recycling", **physical capital** (class 4), was considered a clear priority for all time frames of the APT C and for the APT D. This measure will allow Madeira to use hydric resource more efficiency and decrease water waste.

For the short term, the measure "Beach nourishment", **natural capital** (class 5), was consider the regional priority. For the medium and long term, the measure "Desalination" was considered the regional priority. This choice underlines the stakeholder concerns regarding the precipitation decrease projections and subsequent water scarcity.

For **Disaster Risk Reduction** the measure considers a priority to address **risk mitigation** (class 6) for the APT's A, B, and D was "Coastal protection structures" in the majority of the time frames, in opposition to the measure "Drought and water conservation plans", which was the priority for the short and medium term, for the scenario of efficiency enhancement.

Under the class **hazard preparedness** (class7), the clear regional priority for all time frames was "Mainstreaming Disaster Risk Management (DRM)" for the efficiency enhancement scenario, where the measures were available.

In the scope of **disaster response** (class 8), the priority at short and medium terms was the measure "Fire management plans", in coherence with the foreseen fire weather index that will stay in the same fire danger class (which is high). For the long term, the regional priority was "Health care delivery systems", for minimum intervention scenario, in coherence with the foreseen significant increase of heat waves.

Under the post **disaster recovery** (class 9), the measure "Pre-disaster early recovery planning" was selected for short and long terms in the APT A and for the short and medium terms in the APT D, in opposition to the measure "Post-Disaster recovery funds" that was consider a priority at medium term for the APT A, and for the long term for the APT D.

In **Social-Ecological** Resilience adaption objective concerning **provisioning services class** (class 10), the region gave priority to "Monitoring, modelling and forecasting systems" for all scenarios for the short term, which is coherent with the necessity to improve knowledge in these matters.

The measure considered a priority by the stakeholders to address the class **regulating and maintenance services** (class 11) was "River rehabilitation and restoration" for all time frames for the APT B and APT C, in opposition of the measure "Dune restoration and rehabilitation". This underlines the high risk of flash floods and its historic occurrence in Madeira island, and presence of dunes only in the small island of Porto Santo.

Under **cultural services** (class 12), for all time frames for the APT C, there is a clear priority for "Adaptive management of natural habitats", a key asset for the archipelago's touristic activities.

Local knowledge priorities where focused on habitats rehabilitation, conservation and monitoring actions, including control of non-indigenes species, that are important to increase ecosystems resilience to climate

change, in order to preserve habitats, biodiversity and landscape, key assets for tourism, agriculture, fisheries and food security.

The diversification of economic activities was also considered a regional priority to reduce the dependence from tourism activities that can be disrupted by extreme weather events. Stakeholders recognise the importance of diversify the island economy, namely by promoting the development of primary sector activities to increase food security and reduce food carbon footprint and promote digital innovative products and services. Also, fair trade, quality, certification, and differentiation can increase competitiveness of islands cash crops.

Sustainable performance

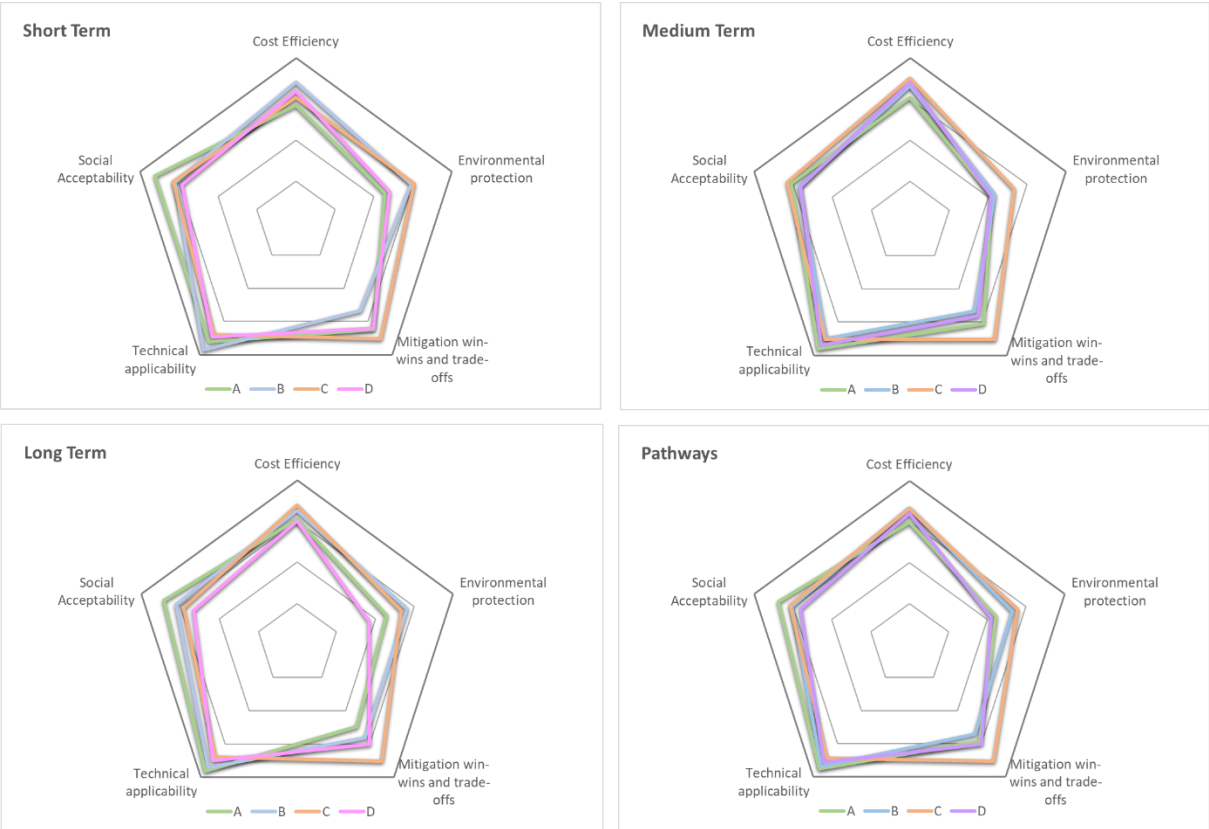

Figure 56 - Pathways evaluation for the tourism sector considering: Cost Efficiency; Environmental protection; Mitigation (GHG emissions) win-wins and trade-offs; Technical applicability; Social acceptability. The policy pathways scenarios: APT A - Minimum Intervention; APT B - Economic Capacity Expansion (ECE); APT C- Efficiency Enhancement (EE); APT D - System Restructuring (SR), for different timeframes: S - Short term (up to 2030), M- Medium term (up to 2050), L - Long term (until 2100)

On the short term, the measures selected for the APT A have better social acceptability performance, the measures selected for the APT B have better technical applicability and cost efficiency performances, and the measures selected for the APT C have better mitigation and environmental protection performance.

On the medium term, the measures selected for the APT A have better technical applicability performance, and the measures selected for the APT C have better mitigation, social acceptability, cost efficiency and environmental protection performances.

On the long term the measures selected for the APT A have better technical applicability and social acceptability performances, the measures selected for the APT B have better environmental protection

performance, and the measures selected for the APT C have better mitigation and cost efficiency performance.

The technical applicability for all APTs keeps almost the same for all time frames due the fact that these measures are not as technical as the ones from the aquaculture, energy, and maritime transport sectors.

Overall, the APT C is the one with better cost efficiency and environmental protection performance, and higher contribution for the regional mitigation objectives of reduce at least 40% of GHG emissions for 2030 and achieve climate resilience and carbon neutrality (85% GHG emissions reduction) by 2050, according the Sustainable Energy and Climate Action Plan under development. The APT A is the scenario with better technical applicability and social acceptability performances.

4.9.5 Further comments

The SOCLIMPACT project provided the opportunity to **create a multisectoral working group**, with the participation of around 65 local and regional policy makers, public and private companies, research institutions, associations, and local experts, that had the possibility to increase their knowledge on climate change and adaptation. This is important to acknowledge the adaptation challenge in the daily decision-making process and in the sectorial and holistic planning exercises, and to update the regional adaptation strategy, foreseen for 2021.

Despite the joint discussion limitations due to the **pandemic constraints**, the adaptation pathways provided **insight** into the concerns and priorities of regional stakeholders regarding climate change and adaptation measures required.

Reliable climate change projections are fundamental for the decision-making process on fund allocation for climate change adaptation. Until now, the decision-making process on climate change adaptation is highly linked with the occurrence of extreme weather events that have severe socioeconomic and environmental impacts. For example, the flash floods that occurred in Madeira Island on February 2010 obliged to large investments on post-disaster intervention and launched several initiatives on weather forecast, early warning systems and other adaptation measures that contributed to disaster risk reduction. However, the allocation of high investments on post disaster recovery, in sequence of extreme weather events, **reduces the capacity of investment** on adaptation measures to increase resilience and decrease climate change vulnerability. This fact highlights the importance of reliable downscaling climate models for the Atlantic.

The EU outermost regions, particularly Atlantic Ocean archipelagos, have small and fragmented territories located on the **margins of EU climate models**, making it difficult to have reliable climate change projections. The participation in the project also highlighted the lack of systematic data collection that is important to enable downscaling of climate models and assess climate change impacts on natural ecosystems and infrastructures, and socio-economic activities.

Adaptation policies based on scientific and technical knowledge **instead of reaction** to extreme weather events, allow to reduce socio-economic and environmental impacts of extreme weather events and other climate change impacts like water scarcity and heat waves by efficiently allocating available resources to increase resilience, decrease vulnerability and disaster risk, especially for risk mitigation, hazard preparedness and disaster response. This scientific based approach is particularly important to support adaptation policies to face climate change hazards **never experienced before**.

Even considering a scenario with increased resolution on climate change modelling and climate change impact assessment, small and fragmented island territories such as the Archipelago of Madeira, **face greater uncertainty and error in weather forecasts and projections** due to less coverage of weather observation networks (there are no fixed weather stations on the ocean, some data is collected by merchant vessels at sea).

Another conclusion of this exercise for Madeira archipelago was the evidence of the need for a **specific adaptation approach to each island** within the archipelago, as they have specificities that will determine different vulnerabilities to climate change

4.10 Malta

For these Islands two online webinars were made and spoken in English, with the presentations in English and the Online Survey Tool with the options and classes in English as well. There were no Local knowledge options proposed by the IFP (ABT) and the characterization of all adaptation options was made by the IFP.

4.10.1 Aquaculture

Aquaculture pathways are based on choices made by 5 expert island stakeholders.

Selected Adaptation Pathways

ID	Name	Class number	APT A			APT B			APT C			APT D		
			S	M	L	S	M	L	S	M	L	S	M	L
A1	Financial schemes, insurance and loans	1					B						D	
A2	Tax benefits and subsidies	1					B						D	
A10	Efficient feed management	2		A			B			C			D	
A9	Awareness campaigns for behavioural change	2		A			B			C			D	
A12	Promote cooperation to local consumption	3								C				
A11	Addressing consumer and environmental concerns at the	3								C				
A13	Integrated multi-trophic aquaculture (IMTA)	4								C			D	
A14	Short-cycle aquaculture	4								C			D	
A16	Submersible cages	5					B							
A15	Recirculation Aquaculture Systems (RAS)	5					B							
A18	Risk-based zoning and site selection	6		A			B			C			D	
A17	Climate proof aquaculture activities	6		A			B			C			D	
A20	Environmental monitoring and Early Warning Systems (EWS)	7								C				
A19	Disease prevention methods	7								C				
A21	Mainstreaming Disaster Risk Management (DRM)	8		A										
A22	Contingency for emergency management, early	8		A										
A23	Recovery Post-Disaster plans	9		A									D	
A24	Recovery Post-Disaster funds	9		A									D	
A4	Species selection	10		A			B			C			D	
A3	Feed production	10		A			B			C			D	
A6	Best Management Practices	11					B			C				
A5	Selective breeding	11					B			C				
A7	Create educational visits	12								C				
A8	Promote aquaculture cuisine	12								C				

Figure 57 - Adaptation options for the aquaculture sector. Options are identified with an ID number, full name, and class of adaptation number. Adaptation objectives are identified in each option by colour: ***vulnerability reduction (red), Disaster Risk Reduction (blue); Social-Ecological Resilience (green); Local Knowledge adaptation options (grey).*** *Each ATP (APT A; APT B; APT C; APT D) is represented in three timeframes: S - Short term (up to 2030), M- Medium term (up to 2050), L - Long term (until 2100). Highlighted options indicate the measure was selected in each ATP and timeframe: ATP A – Minimum Intervention (light blue); ATP B – Economic Capacity Expansion (light green); ATP C – Efficiency Enhancement (Light orange) and ATP D – System Restructuring (light purple). Bold letters in each ATP indicate the option was available to be selected in the three time frames. Grey cells mean that they the options was not available in that APT.*

Overall, the adaptation pathways for the Aquaculture sector in Malta is characterized by a significant heterogeneity across the four potential adaptation policy trajectories (APTs) and across adaptation objectives.

Under **APT A: Minimum intervention** (low investment, low commitment to policy change) for the human capital class, for all terms, efficient feed management was preferred over awareness campaigns for behavioural change. To reduce disaster risk, in class 6, risk mitigation, risk bases zoning and site selection was preferred over climate proof aquaculture (strengthening infrastructure) while in the disaster response class, disaster Risk management (prevention, protection, preparedness, response, recovery) was preferred over Contingency for emergency management. In class 8, post disaster recovery, recovery plans (good practices) were preferred over recovery funds (makes sense since this is the low investment trajectory). Finally, to improve socio-Ecological resistance, class of provisioning services, species selection was

preferred over feed production (alternative feed ingredients). Species selection is more optimal and efficient than the feed production.

For **APT B: Economic Capacity Expansion** (high investment, low commitment to policy change), in the financial capital in vulnerability reduction for short term, tax benefits were selected over financial schemes, insurance, and loans, while for the medium- and long-term financial schemes insurance and loans is preferred. Classes 2 and 6 had the same results as under APT A. For natural capital, RAS was preferred for the short term, while for mid and long-term submersible cages was selected more frequently. To improve socio-Ecological resistance, class of provisioning services, for the short term more sustainable feed production is preferred while for mid and long term, species selection was most selected. However, for APT A species selection was chosen for the short term as well. This can be explained because this can also be a strategy, to diversify species in the short-term to choose species that are most efficient for aquaculture. Inn regulating and maintenance services, for all terms Best Management Practices was preferred over selective breeding.

In **APT C: Efficiency Enhancement** (medium investment, medium commitment to policy change), again, efficient feed management was selected for short and long term. However, we see a change of selected measure for the mid-term where awareness campaigns were preferred. There is no clear explanation for this. In the social capital class, for short and mid-term Promotion of local consumption (reduce transport costs, create value addition) was preferred over promotion of economy and jobs to address CC to address consumer and environmental concerns. For the long term it was the other way around. For physical capital, for the short term, short cycle aquaculture (stock larger fish in cages) was preferred over IMTA, while for the mid and long term IMTA was selected more frequently. In the risk mitigation class, we see the same results as for APT A&B. For hazard preparedness, environmental monitoring and Early Warning Systems were preferred for all terms over disease prevention (vaccines, probiotics, strict hygiene procedures). Classes provisioning, and regulating and maintenance services, we have the same results as for APT B. In the third class in social-ecological resilience, cultural services, in the short-term promoting aquaculture cuisine was preferred while for the mid and long-term, educational visits were selected as the most suitable adaptation measure.

APT D: System Restructuring (high investment, high commitment to policy change) has some similar results as other APTs. For financial capital, the same results were obtained as in APT B, and for physical capital the same as APT C. For provisioning services, the same results were found as in APT A. For the human capital, again, efficient feed management was selected for short and mid-term. However, we see a change of selected measure for the long term where awareness campaigns were preferred. Efficient feed management was chosen for most the different time periods for all APTs. In the risk mitigation class, for APT A, B, C risk-based zoning and site selection was always preferred. In APT D too for the short and mid-terms, however for the long term, climate proof aquaculture activities (strengthening infrastructure) was selected. Climate proof aquaculture activities was chosen for the long term in APT D because this measure requires high investment and high commitment. On the long term, when we could run out of other options this can be a suitable measure. In the post disaster recovery class, for the short and long terms, plans were preferred while for the mid-term funds were selected more often.

This project has received funding from the European Union's Horizon 2020 research and innovation programme under Grant Agreement No776661

ID	Name	Class number	Ratio	APT A			APT B			APT C			APT D		
				S	M	L	S	M	L	S	M	L	S	M	L
A1	Financial schemes, insurance and loans	1	60%		A			B			C			D	
A2	Tax benefits and subsidies	1	40%		A			B			C			D	
A10	Efficient feed management	2	73%		A			B			C			D	
A9	Awareness campaigns for behavioural change	2	27%		A			B			C			D	
A12	Promote cooperation to local consumption	3	60%		A			B			C			D	
A11	Addressing consumer and environmental concerns at the local	3	40%		A			B			C			D	
A13	Integrated multi-trophic aquaculture (IMTA)	4	60%		A			B			C			D	
A14	Short-cycle aquaculture	4	40%		A			B			C			D	
A16	Submersible cages	5	60%		A			B			C			D	
A15	Recirculation Aquaculture Systems (RAS)	5	40%		A			B			C			D	
A18	Risk-based zoning and site selection	6	65%		A			B			C			D	
A17	Climate proof aquaculture activities	6	35%		A			B			C			D	
A20	Environmental monitoring and Early Warning Systems (EWS)	7	67%		A			B			C			D	
A19	Disease prevention methods	7	33%		A			B			C			D	
A21	Mainstreaming Disaster Risk Management (DRM)	8	67%		A			B			C			D	
A22	Contingency for emergency management, early	8	33%		A			B			C			D	
A23	Recovery Post-Disaster plans	9	60%		A			B			C			D	
A24	Recovery Post-Disaster funds	9	40%		A			B			C			D	
A4	Species selection	10	68%		A			B			C			D	
A3	Feed production	10	32%		A			B			C			D	
A6	Best Management Practices	11	77%		A			B			C			D	
A5	Selective breeding	11	23%		A			B			C			D	
A7	Create educational visits	12	60%		A			B			C			D	
A8	Promote aquaculture cuisine	12	40%		A			B			C			D	

Figure 58 : Ranking of adaptation measures selected by experts for aquaculture from high to low.

The 24 measures were all selected at least once. The top 3 measures selected were Best Management Practices, efficient feed management and species selection.

The least preferred measures, logically from the same classes, were the use of alternative ingredients in feed production, awareness campaigns and selective breeding.

Sustainability Performance

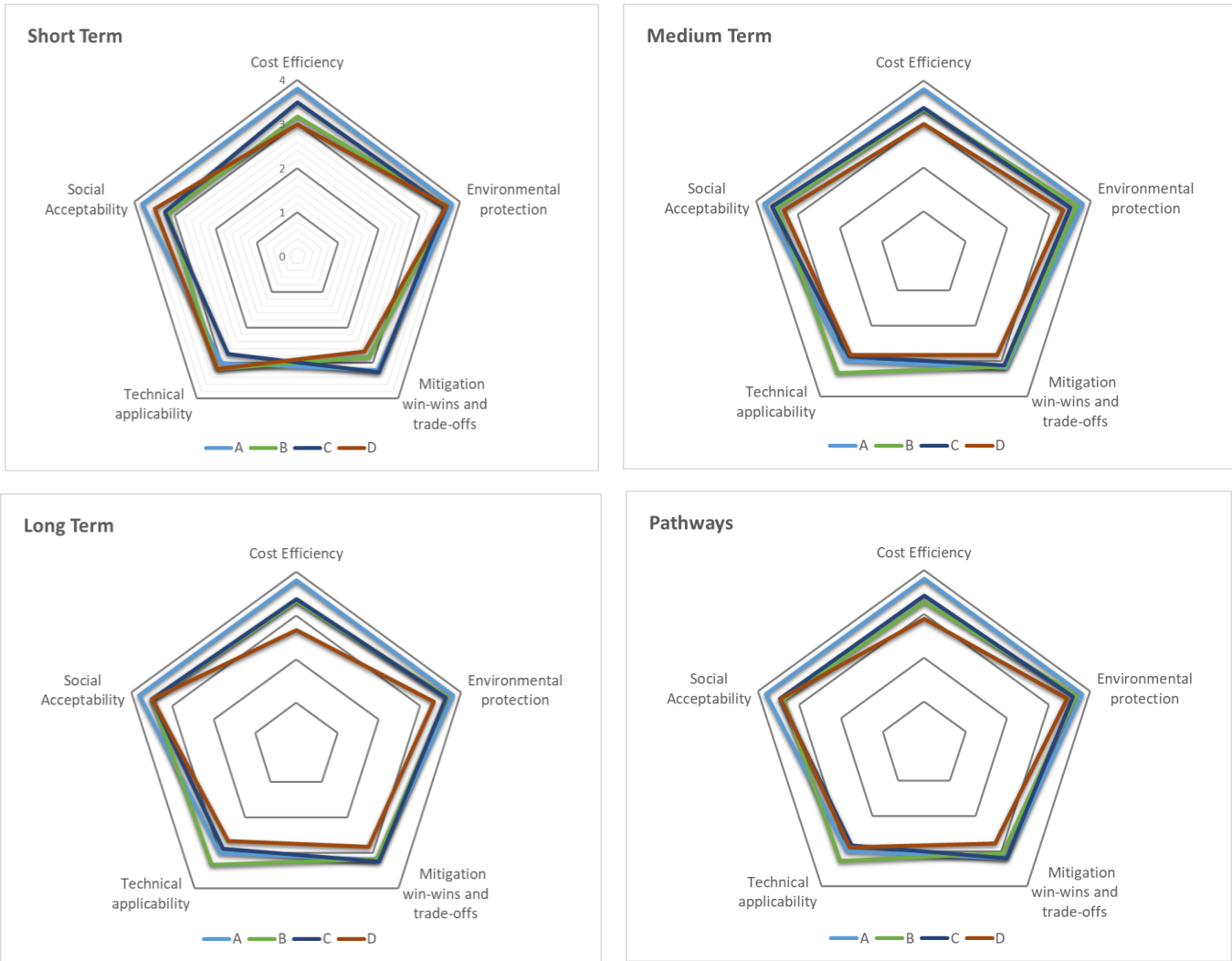

Figure 59 - Pathways evaluation for the aquaculture sector considering: Cost Efficiency; Environmental protection; Mitigation (GHG emissions) win-wins and trade-offs; Technical applicability; Social acceptability. The policy pathways scenarios: APT A - Minimum Intervention; APT B - Economic Capacity Expansion (ECE); APT C- Efficiency Enhancement (EE); APT D - System Restructuring (SR), for different timeframes: S - Short term (up to 2030), M- Medium term (up to 2050), L - Long term (until 2100)

All four pathways in the Aquaculture sector have a similar evaluation across all timeframes. The analysis showed little differences in the scoring of criteria as a reflection of the different ATP narratives. In general, all scenarios show high levels of cost efficiency, environmental protection, mitigation trade-offs, technical applicability, and social acceptability. The cost efficiency of APT D for the long term is slightly lower. Environmental protection has an overall high value but with differences in APT D (lower value), APT C (intermediate value) and APT A and B (highest value). Mitigation performance shows a small range of values, APT D (minimal intervention) has the lowest value and APT C (capacity expansion) the highest, leaving A and B in the middle. APT A scores highest for all performance indicators apart from technical ability, which is highest in APT B for all terms.

Social acceptability has the highest values with APT A having more and APT D less. It can be expected that APT D would have the most challenging options in terms of social acceptability because it is the scenario with the highest commitment to policy change. It is assumed that a higher commitment could better cope with options which have a lower social acceptance. Using the same principal, in APT A (Minimum Intervention) could have had a higher (than D) social acceptability result.

APTs B and C have intermediate results, which are within what can be expected from them, especially for C. In APT B this is because there are is also low commitment, which limits the available options, and APT C because it is an intermediate policy scenario (medium commitment with medium investment).

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4.11 Sardinia

For these Islands two online webinars were made and spoken in Italian, with the presentations in Italian and the Online Survey Tool with the options and classes in Italian as well. There were no Local knowledge options proposed by the IFP (ANCI) and the characterization of all adaptation options was made by the IFP.

4.11.1 Tourism

Tourism pathways are based on choices made by 5 expert island stakeholders.

Selected Adaptation Pathways

In the following figures have been reported the Adaptation options for the tourism sector analysed by class and by symmetry.

Options are identified with an ID number, full name, and class of adaptation number.

Adaptation objectives are identified in each option by colour: **vulnerability reduction (red),** Disaster **Risk Reduction (blue); Social-Ecological Resilience (green);** Local Knowledge adaptation options (grey). Each ATP (APT A; APT B; APT C; APT D) is represented in three timeframes: S - Short term (up to 2030), M- Medium term (up to 2050), L - Long term (until 2100). Bold letters in each ATP indicate the option was available to be selected in the three time frames. Highlighted options indicate the measure was selected in each ATP and timeframe: ATP A (light blue); ATP B (light green); ATP C (Light orange) and ATP D (light purple). Space with colour: option was selected for the timeframe: Short term, Medium term, or Long term. Bold letter: option is available in the APT.

ID	Name	Class number	Ratio	APT A			APT B			APT C			APT D		
				S	M	L	S	M	L	S	M	L	S	M	L
T1	Economic Policy Instruments (EPIs)	1	83%					**B**						**D**	
T2	Financial incentives to retreat from high-risk areas	1	17%					**B**						**D**	
T9	Activity and product diversification	2	55%		**A**			**B**			**C**			**D**	
T10	Public awareness programmes	2	45%		**A**			**B**			**C**			**D**	
T12	Tourist awareness campaigns	3	53%								**C**				
T11	Local circular economy	3	47%								**C**				
T14	Water restrictions, consumption cuts and grey-water recycling	4	63%								**C**			**D**	
T13	Local sustainable fishing	4	37%								**C**			**D**	
T15	Beach nourishment	5	53%					**B**							
T16	Desalination	5	47%					**B**							
T18	Drought and water conservation plans	6	75%		**A**			**B**			**C**			**D**	
T17	Coastal protection structures	6	25%		**A**			**B**			**C**			**D**	
T19	Mainstreaming Disaster Risk Management (DRM)	7	80%								**C**				
T20	Using water to cope with heat waves	7	20%								**C**				
T21	Fire management plans	8	73%		**A**										
T22	Health care delivery systems	8	27%		**A**										
T24	Pre-disaster early recovery planning	9	67%		**A**									**D**	
T23	Post-Disaster recovery funds	9	33%		**A**									**D**	
T4	Monitoring, modelling and forecasting systems	10	72%		**A**			**B**			**C**			**D**	
T3	Adaptation of groundwater management	10	28%		**A**			**B**			**C**			**D**	
T6	River rehabilitation and restoration	11	53%					**B**			**C**				
T5	Dune restoration and rehabilitation	11	47%					**B**			**C**				
T7	Adaptive management of natural habitats	12	53%								**C**				
T8	Ocean pools	12	47%								**C**				

ID	Name	Class number	Ratio	APT A			APT B			APT C			APT D		
				S	M	L	S	M	L	S	M	L	S	M	L
T1	Economic Policy Instruments (EPIs)	1	83%					B						D	
T19	Mainstreaming Disaster Risk Management (DRM)	7	80%								C				
T18	Drought and water conservation plans	6	75%		A			B			C			D	
T21	Fire management plans	8	73%		A										
T4	Monitoring, modelling and forecasting systems	10	72%		A			B			C			D	
T24	Pre-disaster early recovery planning	9	67%		A									D	
T14	Water restrictions, consumption cuts and grey-water recycling	4	63%								C			D	
T9	Activity and product diversification	2	55%		A			B			C			D	
T7	Adaptive management of natural habitats	12	53%								C				
T6	River rehabilitation and restoration	11	53%					B			C				
T15	Beach nourishment	5	53%					B							
T12	Tourist awareness campaigns	3	53%								C				
T11	Local circular economy	3	47%								C				
T16	Desalination	5	47%					B			C				
T5	Dune restoration and rehabilitation	11	47%					B							
T8	Ocean pools	12	47%								C				
T10	Public awareness programmes	2	45%		A			B			C			D	
T13	Local sustainable fishing	4	37%								C			D	
T23	Post-Disaster recovery funds	9	33%		A									D	
T3	Adaptation of groundwater management	10	28%		A			B			C			D	
T22	Health care delivery systems	8	27%		A										
T17	Coastal protection structures	6	25%		A			B			C			D	
T20	Using water to cope with heat waves	7	20%								C				
T2	Financial incentives to retreat from high-risk areas	1	17%					B						D	

Figure 60 - Adaptation options for the tourism sector analysed by class (top) and by symmetry in stakeholder preference (bottom). Options are identified with an ID number, full name, and class of adaptation number. Adaptation objectives are identified in each option by colour: ***vulnerability reduction (red), Disaster Risk Reduction (blue); Social-Ecological Resilience (green).*** *Each ATP (APT A; APT B; APT C; APT D) is represented in three timeframes: S - Short term (up to 2030), M- Medium term (up to 2050), L - Long term (until 2100). Highlighted options indicate the measure was selected in each ATP and timeframe: ATP A – Minimum Intervention (light blue); ATP B – Economic Capacity Expansion (light green); ATP C – Efficiency Enhancement (Light orange) and ATP D – System Restructuring (light purple). Bold letters in each ATP indicate the option was available to be selected in the three time frames. Grey cells mean that they the options was not available in that APT.*

Sustainability Performance

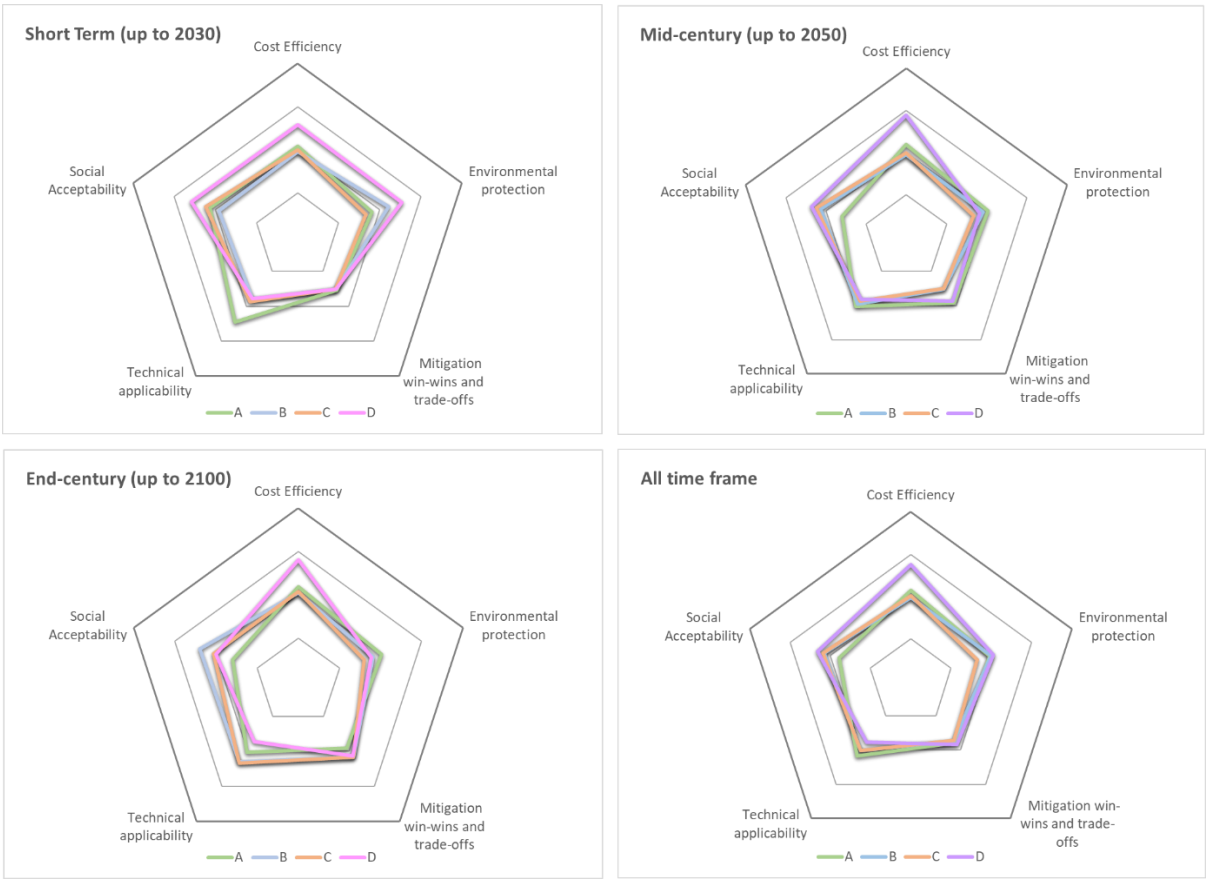

Figure 61 - Pathways evaluation for the tourism sector considering: Cost Efficiency; Environmental protection; Mitigation (GHG emissions) win-wins and trade-offs; Technical applicability; Social acceptability. The policy pathways scenarios: APT A - Minimum Intervention; APT B - Economic Capacity Expansion (ECE); APT C- Efficiency Enhancement (EE); APT D - System Restructuring (SR), for different timeframes: S - Short term (up to 2030), M- Medium term (up to 2050), L - Long term (until 2100)

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4.11.2 Maritime Transport

Maritime transport pathways are based on choices made by 6 expert island stakeholders.

Selected Adaptation Pathways

In the following figures have been reported the Adaptation options for the Maritime Transport sector analysed by class and by symmetry.

Options are identified with an ID number, full name, and class of adaptation number.

Adaptation objectives are identified in each option by colour: **vulnerability reduction (red),** Disaster **Risk Reduction (blue); Social-Ecological Resilience (green);** Local Knowledge adaptation options (grey). Each ATP (APT A; APT B; APT C; APT D) is represented in three timeframes: S - Short term (up to 2030), M- Medium term (up to 2050), L - Long term (until 2100). Bold letters in each ATP indicate the option was available to be selected in the three time frames. Highlighted options indicate the measure was selected in each ATP and timeframe: ATP A (light blue); ATP B (light green); ATP C (Light orange) and ATP D (light purple). Space with colour: option was selected for the timeframe: Short term, Medium term, or Long term. Bold letter: option is available in the APT.

ID	Name	Class number	Ratio	APT A			APT B			APT C			APT D		
				S	M	L	S	M	L	S	M	L	S	M	L
MT2	Financial incentives to retreat from high-risk areas	1	64%					**B**						**D**	
MT1	Insurance mechanisms for ports	1	36%					**B**						**D**	
MT10	Social dialogue for training in the port sector	2	64%		**A**			**B**			**C**			**D**	
MT9	Awareness campaigns for behavioural change	2	36%		**A**			**B**			**C**			**D**	
MT12	Climate resilient economy and jobs	3	83%								**C**				
MT11	Diversification of trade using climate resilient commodities	3	17%								**C**				
MT14	Restrict development and settlement in low-lying areas	4	67%								**C**			**D**	
MT13	Refrigeration, cooling and ventilation systems	4	33%								**C**			**D**	
MT16	Increase operational speed and flexibility in ports	5	94%					**B**							
MT15	Sturdiness improvement of vessels	5	6%					**B**							
MT17	Climate proof ports and port activities	6	61%		**A**			**B**			**C**			**D**	
MT18	Consider expansion/retreat of ports in urban planning	6	39%		**A**			**B**			**C**			**D**	
MT20	Early Warning Systems (EWS) and climate change monitoring	7	61%								**C**				
MT19	Reinforcement of inspection, repair and maintenance of	7	39%								**C**				
MT21	Inteligent Transport Systems (ITS)	8	94%		**A**										
MT22	Prepare for service delays or cancellations	8	6%		**A**										
MT23	Backup routes and infrastructures during extreme weather	9	69%		**A**									**D**	
MT24	Post-Disaster recovery funds	9	31%		**A**									**D**	
MT4	Combined protection and wave energy infrastructures	10	60%		**A**			**B**			**C**			**D**	
MT3	Marine life friendly coastal protection structures	10	40%		**A**			**B**			**C**			**D**	
MT6	Coastal protection structures	11	53%					**B**			**C**				
MT5	Hybrid and full electric ship propulsion	11	47%					**B**			**C**				
MT7	Integrate ports in urban tissue	12	72%								**C**				
MT8	Ocean pools	12	28%								**C**				

Figure 62 - Adaptation options for the Maritime Transport sector analysed by class (top) and by symmetry in stakeholder preference (bottom). Options are identified with an ID number, full name, and class of adaptation number. Adaptation objectives are identified in each option by colour: ***vulnerability reduction (red), Disaster Risk Reduction (blue); Social-Ecological Resilience (green).*** *Each ATP (APT A; APT B; APT C; APT D) is represented in three timeframes: S - Short term (up to 2030), M- Medium term (up to 2050), L - Long term (until 2100). Highlighted options indicate the measure was selected in each ATP and timeframe: ATP A – Minimum Intervention (light blue); ATP B – Economic Capacity Expansion (light green); ATP C – Efficiency Enhancement (Light orange) and ATP D – System Restructuring (light purple). Bold letters in each ATP indicate the option was available to be selected in the three time frames. Grey cells mean that they the options was not available in that APT.*

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ID	Name	Class number	Ratio	APT A			APT B			APT C			APT D		
				S	M	L	S	M	L	S	M	L	S	M	L
MT21	Inteligent Transport Systems (ITS)	8	94%		A										
MT16	Increase operational speed and flexibility in ports	5	94%					B							
MT12	Climate resilient economy and jobs	3	83%								C				
MT7	Integrate ports in urban tissue	12	72%								C				
MT23	Backup routes and infrastructures during extreme weather	9	69%		A									D	
MT14	Restrict development and settlement in low-lying areas	4	67%								C			D	
MT10	Social dialogue for training in the port sector	2	64%		A			B			C			D	
MT2	Financial incentives to retreat from high-risk areas	1	64%					B						D	
MT20	Early Warning Systems (EWS) and climate change monitoring	7	61%								C				
MT17	Climate proof ports and port activities	6	61%		A			B			C			D	
MT4	Combined protection and wave energy infrastructures	10	60%		A			B			C			D	
MT6	Coastal protection structures	11	53%					B			C				
MT5	Hybrid and full electric ship propulsion	11	47%					B			C				
MT3	Marine life friendly coastal protection structures	10	40%		A			B			C			D	
MT18	Consider expansion/retreat of ports in urban planning	6	39%								C				
MT19	Reinforcement of inspection, repair and maintenance of infrastructures	7	39%		A			B			C			D	
MT1	Insurance mechanisms for ports	1	36%		A			B			C			D	
MT9	Awareness campaigns for behavioural change	2	36%					B						D	
MT13	Refrigeration, cooling and ventilation systems	4	33%								C			D	
MT24	Post-Disaster recovery funds	9	31%		A									D	
MT8	Ocean pools	12	28%								C				
MT11	Diversification of trade using climate resilient commodities	3	17%								C				
MT15	Sturdiness improvement of vessels	5	6%		A										
MT22	Prepare for service delays or cancellations	8	6%					B							

Figure 63 - Adaptation options for the Maritime Transport sector analysed by symmetry (adaptation objectives are identified in each option by colour: ***vulnerability reduction (red),*** *Disaster* ***Risk Reduction (blue); Social-Ecological Resilience (green);*** *Local Knowledge adaptation options (grey). Each ATP (APT A; APT B; APT C; APT D) is represented in three timeframes: S - Short term (up to 2030), M- Medium term (up to 2050), L - Long term (until 2100). Bold letters in each ATP indicate the option was available to be selected in the three time frames. Highlighted options indicate the measure was selected in each ATP and timeframe: ATP A (light blue); ATP B (light green); ATP C (Light orange) and ATP D (light purple). Space with colour: option was selected for the timeframe: Short term, Medium term, or Long term. Bold letter: option is available in the APT.*

Sustainability Performance

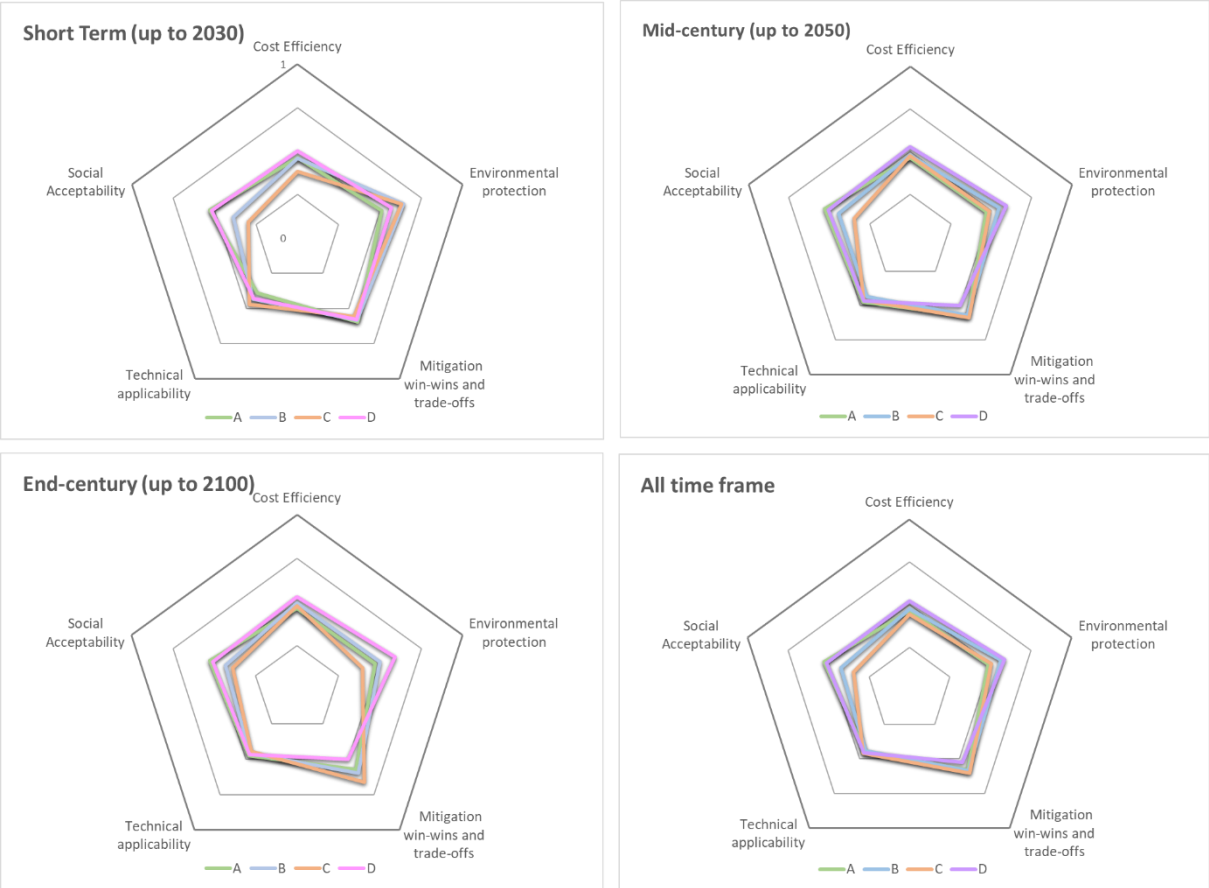

Figure 64 - Pathways evaluation for the maritime transport sector considering: Cost Efficiency; Environmental protection; Mitigation (GHG emissions) win-wins and trade-offs; Technical applicability; Social acceptability. The policy pathways scenarios: APT A - Minimum Intervention; APT B - Economic Capacity Expansion (ECE); APT C- Efficiency Enhancement (EE); APT D - System Restructuring (SR), for different timeframes: S - Short term (up to 2030), M- Medium term (up to 2050), L - Long term (until 2100)

This project has received funding from the European Union's Horizon 2020 research and innovation programme under Grant Agreement No776661

4.11.3 Energy

Energy pathways are based on choices made by 7 expert island stakeholders.

Selected Adaptation Pathways

In the following figures have been reported the Adaptation options for the Energy analysed by class and by symmetry.

Options are identified with an ID number, full name, and class of adaptation number.

Adaptation objectives are identified in each option by colour: **vulnerability reduction (red),** Disaster **Risk Reduction (blue); Social-Ecological Resilience (green);** Local Knowledge adaptation options (grey). Each ATP (APT A; APT B; APT C; APT D) is represented in three timeframes: S - Short term (up to 2030), M- Medium term (up to 2050), L - Long term (until 2100). Bold letters in each ATP indicate the option was available to be selected in the three time frames. Highlighted options indicate the measure was selected in each ATP and timeframe: ATP A (light blue); ATP B (light green); ATP C (Light orange) and ATP D (light purple). Space with colour: option was selected for the timeframe: Short term, Medium term, or Long term. Bold letter: option is available in the APT.

ID	Name	Class number	Ratio	APT A			APT B			APT C			APT D		
				S	M	L	S	M	L	S	M	L	S	M	L
E1	Financial support for buildings with low energy needs	1	71%					**B**						**D**	
E2	Financial support for smart control of energy in houses and	1	29%					**B**						**D**	
E9	Green jobs and businesses	2	69%		**A**			**B**			**C**			**D**	
E10	Public information service on climate action	2	31%		**A**			**B**			**C**			**D**	
E11	Small scale production and consumption (prosumers)	3	62%								**C**				
E12	Risk reporting platform	3	38%								**C**				
E13	Energy storage systems	4	64%								**C**			**D**	
E14	Collection and storage of forest fuel loads	4	36%								**C**			**D**	
E16	Demand Side Mangement (DSM) of Energy	5	67%					**B**							
E15	SeaWater Air Conditioning (SWAC).	5	33%					**B**							
E17	Review building codes of the energy infrastructure	6	51%		**A**			**B**			**C**			**D**	
E18	Upgrade evaporative cooling systems	6	49%		**A**			**B**			**C**			**D**	
E20	Grid reliability	7	67%								**C**				
E19	Early Warning Systems (EWS)	7	33%								**C**				
E21	Study and develop energy grid connections	8	71%		**A**										
E22	Energy-independent facilities (generators)	8	29%		**A**										
E23	Energy recovery microgrids	9	57%		**A**									**D**	
E24	Local recovery energy outage capacity	9	43%		**A**									**D**	
E3	Energy efficiency in urban water management	10	50%		**A**			**B**			**C**			**D**	
E4	Underground tubes and piping in urban planning	10	50%		**A**			**B**			**C**			**D**	
E6	Urban green corridors	11	55%					**B**			**C**				
E5	Biomass power from household waste	11	45%					**B**			**C**				
E7	Educational garden plots	12	52%								**C**				
E8	Heated pools with waste heat from power plants	12	48%								**C**				

ID	Name	Class number	Ratio	APT A			APT B			APT C			APT D		
				S	M	L	S	M	L	S	M	L	S	M	L
E21	Study and develop energy grid connections	8	71%		A										
E1	Financial support for buildings with low energy needs	1	71%					B						D	
E9	Green jobs and businesses	2	69%		A			B			C			D	
E20	Grid reliability	7	67%								C				
E16	Demand Side Mangement (DSM) of Energy	5	67%					B							
E13	Energy storage systems	4	64%								C			D	
E11	Small scale production and consumption (prosumers)	3	62%								C				
E23	Energy recovery microgrids	9	57%		A									D	
E6	Urban green corridors	11	55%					B			C				
E7	Educational garden plots	12	52%								C				
E17	Review building codes of the energy infrastructure	6	51%		A			B			C			D	
E3	Energy efficiency in urban water management	10	50%		A			B			C			D	
E4	Underground tubes and piping in urban planning	10	50%		A			B			C			D	
E18	Upgrade evaporative cooling systems	6	49%		A			B			C			D	
E8	Heated pools with waste heat from power plants	12	48%								C				
E5	Biomass power from household waste	11	45%					B			C				
E24	Local recovery energy outage capacity	9	43%		A									D	
E12	Risk reporting platform	3	38%								C				
E14	Collection and storage of forest fuel loads	4	36%								C			D	
E15	SeaWater Air Conditioning (SWAC).	5	33%					B							
E19	Early Warning Systems (EWS)	7	33%								C				
E10	Public information service on climate action	2	31%		A			B			C			D	
E2	Financial support for smart control of energy in houses and	1	29%					B						D	
E22	Energy-independent facilities (generators)	8	29%		A										

Figure 65 - Adaptation options for the energy sector analysed by class (top) and by symmetry in stakeholder preference (bottom). Options are identified with an ID number, full name, and class of adaptation number. Adaptation objectives are identified in each option by colour: ***vulnerability reduction (red), Disaster Risk Reduction (blue); Social-Ecological Resilience (green).*** *Each ATP (APT A; APT B; APT C; APT D) is represented in three timeframes: S - Short term (up to 2030), M- Medium term (up to 2050), L - Long term (until 2100). Highlighted options indicate the measure was selected in each ATP and timeframe: ATP A – Minimum Intervention (light blue); ATP B – Economic Capacity Expansion (light green); ATP C – Efficiency Enhancement (Light orange) and ATP D – System Restructuring (light purple). Bold letters in each ATP indicate the option was available to be selected in the three time frames. Grey cells mean that they the options was not available in that APT.*

Sustainability Performance

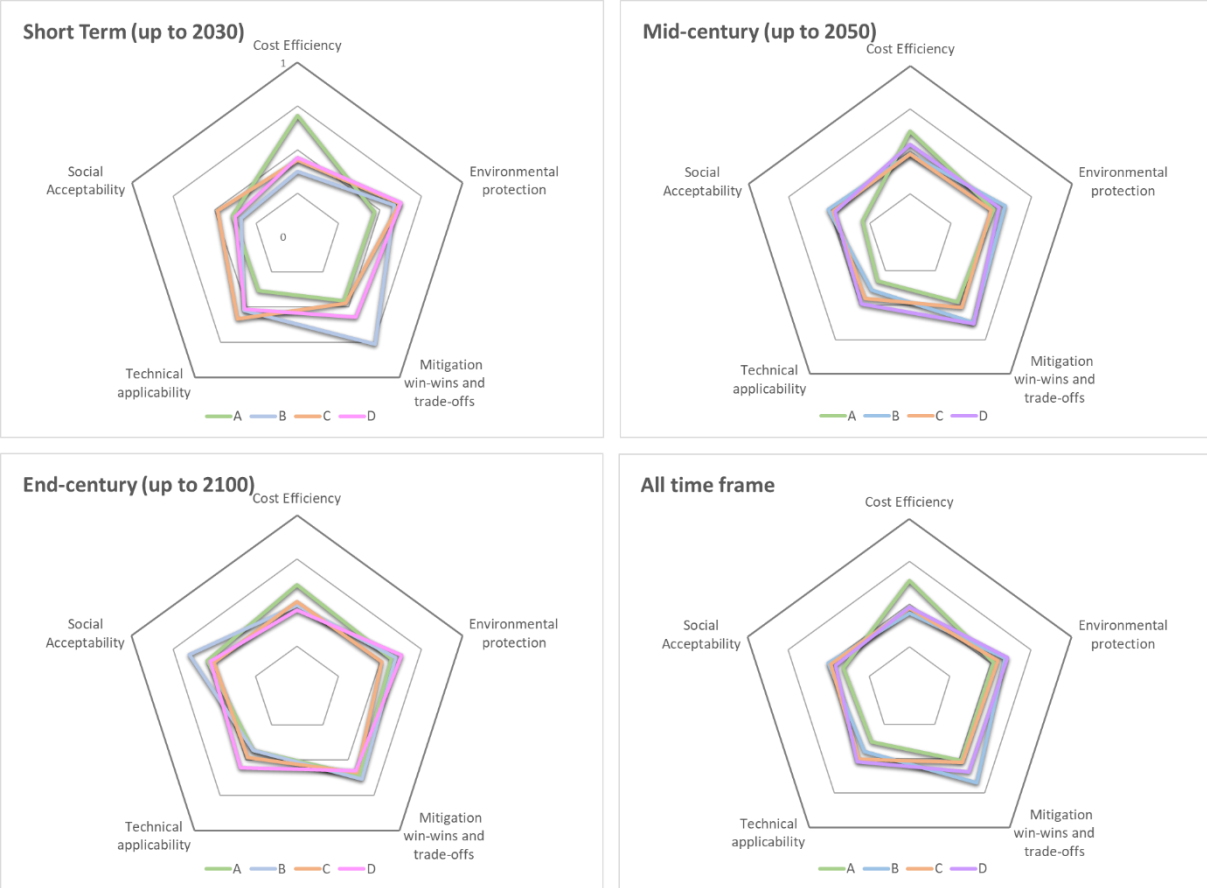

Figure 66 - Pathways evaluation for the energy sector considering: Cost Efficiency; Environmental protection; Mitigation (GHG emissions) win-wins and trade-offs; Technical applicability; Social acceptability. The policy pathways scenarios: APT A - Minimum Intervention; APT B - Economic Capacity Expansion (ECE); APT C- Efficiency Enhancement (EE); APT D - System Restructuring (SR), for different timeframes: S - Short term (up to 2030), M- Medium term (up to 2050), L - Long term (until 2100)

4.11.4 Aquaculture

Aquaculture pathways are based on choices made by 6 expert island stakeholders.

Selected Adaptation Pathways

ID	Name	Class number	Ratio	APT A			APT B			APT C			APT D		
				S	M	L	S	M	L	S	M	L	S	M	L
A2	Tax benefits and subsidies	1	67%					B						D	
A1	Financial schemes, insurance and loans	1	33%					B						D	
A9	Awareness campaigns for behavioural change	2	57%		A			B			C			D	
A10	Efficient feed management	2	43%		A			B			C			D	
A11	Addressing consumer and environmental concerns at the local	3	72%								C				
A12	Promote cooperation to local consumption	3	28%								C				
A13	Integrated multi-trophic aquaculture (IMTA)	4	89%								C			D	
A14	Short-cycle aquaculture	4	11%								C			D	
A15	Recirculation Aquaculture Systems (RAS)	5	67%					B							
A16	Submersible cages	5	33%					B							
A17	Climate proof aquaculture activities	6	51%		A			B			C			D	
A18	Risk-based zoning and site selection	6	49%		A			B			C			D	
A20	Environmental monitoring and Early Warning Systems (EWS)	7	89%								C				
A19	Disease prevention methods	7	11%								C				
A21	Mainstreaming Disaster Risk Management (DRM)	8	61%		A										
A22	Contingency for emergency management, early	8	39%		A										
A23	Recovery Post-Disaster plans	9	53%		A									D	
A24	Recovery Post-Disaster funds	9	47%		A									D	
A4	Species selection	10	65%		A			B			C			D	
A3	Feed production	10	35%		A			B			C			D	
A6	Best Management Practices	11	75%					B			C				
A5	Selective breeding	11	25%					B			C				
A7	Create educational visits	12	56%								C				
A8	Promote aquaculture cuisine	12	44%								C				

ID	Name	Class number	Ratio	APT A			APT B			APT C			APT D		
				S	M	L	S	M	L	S	M	L	S	M	L
A20	Environmental monitoring and Early Warning Systems (EWS)	7	89%					B						D	
A13	Integrated multi-trophic aquaculture (IMTA)	4	89%					B						D	
A6	Best Management Practices	11	75%		A			B			C			D	
A11	Addressing consumer and environmental concerns at the local	3	72%		A			B			C			D	
A15	Recirculation Aquaculture Systems (RAS)	5	67%								C				
A2	Tax benefits and subsidies	1	67%								C				
A4	Species selection	10	65%								C			D	
A21	Mainstreaming Disaster Risk Management (DRM)	8	61%								C			D	
A9	Awareness campaigns for behavioural change	2	57%					B							
A7	Create educational visits	12	56%					B							
A23	Recovery Post-Disaster plans	9	53%		A			B			C			D	
A17	Climate proof aquaculture activities	6	51%		A			B			C			D	
A18	Risk-based zoning and site selection	6	49%								C				
A24	Recovery Post-Disaster funds	9	47%								C				
A8	Promote aquaculture cuisine	12	44%		A										
A10	Efficient feed management	2	43%		A										
A22	Contingency for emergency management, early	8	39%		A									D	
A3	Feed production	10	35%		A									D	
A1	Financial schemes, insurance and loans	1	33%		A			B			C			D	
A16	Submersible cages	5	33%		A			B			C			D	
A12	Promote cooperation to local consumption	3	28%					B			C				
A5	Selective breeding	11	25%					B			C				
A14	Short-cycle aquaculture	4	11%								C				
A19	Disease prevention methods	7	11%								C				

Figure 67 - Adaptation options for the aquaculture sector analysed by class (top) and by symmetry in stakeholder preference (bottom). Options are identified with an ID number, full name, and class of adaptation number. Adaptation objectives are identified in each option by colour: ***vulnerability reduction (red), Disaster Risk Reduction (blue); Social-Ecological Resilience (green).*** *Each ATP (APT A; APT B; APT C; APT D) is represented in three timeframes: S - Short term (up to 2030), M- Medium term (up to 2050), L - Long term (until 2100). Highlighted options indicate the measure was selected in each ATP and timeframe: ATP A – Minimum Intervention (light blue); ATP B – Economic Capacity Expansion (light green); ATP C – Efficiency Enhancement (Light orange) and ATP D – System Restructuring (light purple). Bold letters in each ATP indicate the option was available to be selected in the three time frames. Grey cells mean that they the options was not available in that APT.*

Sustainability Performance

Figure 68 - Pathways evaluation for the aquaculture sector considering: Cost Efficiency; Environmental protection; Mitigation (GHG emissions) win-wins and trade-offs; Technical applicability; Social acceptability. The policy pathways scenarios: APT A - Minimum Intervention; APT B - Economic Capacity Expansion (ECE); APT C- Efficiency Enhancement (EE); APT D - System Restructuring (SR), for different timeframes: S - Short term (up to 2030), M- Medium term (up to 2050), L - Long term (until 2100)

4.12 Sicily

For these Islands two online webinars were made and spoken in Italian, with the presentations in Italian and the Online Survey Tool with the options and classes in Italian as well. There were no Local knowledge options proposed by the IFP (OTIE) and the characterization of all adaptation options was made by the IFP.

4.12.1 Tourism

Tourism pathways are based on choices made by 6 expert island stakeholders.

Selected Adaptation Pathways

ID	Name	Class number	Ratio	APT A			APT B			APT C			APT D		
				S	M	L	S	M	L	S	M	L	S	M	L
T1	Economic Policy Instruments (EPIs)	1	56%					B						D	
T2	Financial incentives to retreat from high-risk areas	1	44%					B						D	
T9	Activity and product diversification	2	58%		A			B			C			D	
T10	Public awareness programmes	2	42%		A			B			C			D	
T11	Local circular economy	3	61%								C				
T12	Tourist awareness campaigns	3	39%								C				
T13	Local sustainable fishing	4	58%								C			D	
T14	Water restrictions, consumption cuts and grey-water recycling	4	42%								C			D	
T15	Beach nourishment	5	61%					B							
T16	Desalination	5	39%					B							
T18	Drought and water conservation plans	6	53%		A			B			C			D	
T17	Coastal protection structures	6	47%		A			B			C			D	
T19	Mainstreaming Disaster Risk Management (DRM)	7	56%								C				
T20	Using water to cope with heat waves	7	44%								C				
T22	Health care delivery systems	8	67%		A										
T21	Fire management plans	8	33%		A										
T24	Pre-disaster early recovery planning	9	67%		A									D	
T23	Post-Disaster recovery funds	9	33%		A									D	
T4	Monitoring, modelling and forecasting systems	10	61%		A			B			C			D	
T3	Adaptation of groundwater management	10	39%		A			B			C			D	
T6	River rehabilitation and restoration	11	64%					B			C				
T5	Dune restoration and rehabilitation	11	36%					B			C				
T7	Adaptive management of natural habitats	12	72%								C				
T8	Ocean pools	12	28%								C				

ID	Name	Class number	Ratio	APT A			APT B			APT C			APT D		
				S	M	L	S	M	L	S	M	L	S	M	L
T7	Adaptive management of natural habitats	12	72%								C				
T24	Pre-disaster early recovery planning	9	67%		A									D	
T22	Health care delivery systems	8	67%		A										
T6	River rehabilitation and restoration	11	64%					B			C				
T4	Monitoring, modelling and forecasting systems	10	61%		A			B			C			D	
T15	Beach nourishment	5	61%					B							
T11	Local circular economy	3	61%								C				
T13	Local sustainable fishing	4	58%								C			D	
T9	Activity and product diversification	2	58%		A			B			C			D	
T19	Mainstreaming Disaster Risk Management (DRM)	7	56%								C				
T1	Economic Policy Instruments (EPIs)	1	56%					B						D	
T18	Drought and water conservation plans	6	53%		A			B			C			D	
T17	Coastal protection structures	6	47%		A			B			C			D	
T2	Financial incentives to retreat from high-risk areas	1	44%								C				
T20	Using water to cope with heat waves	7	44%					B						D	
T10	Public awareness programmes	2	42%								C			D	
T14	Water restrictions, consumption cuts and grey-water recycling	4	42%		A			B			C			D	
T12	Tourist awareness campaigns	3	39%		A			B			C			D	
T16	Desalination	5	39%					B							
T3	Adaptation of groundwater management	10	39%								C				
T5	Dune restoration and rehabilitation	11	36%					B			C				
T21	Fire management plans	8	33%		A									D	
T23	Post-Disaster recovery funds	9	33%		A										
T8	Ocean pools	12	28%								C				

Figure 69 - Adaptation options for the tourism sector by class (on top) and by order of stakeholder preference (bottom). Options are identified with an ID number, full name, and class of adaptation number. Adaptation objectives are identified in each option by colour: ***vulnerability reduction (red), Disaster Risk Reduction (blue); Social-Ecological Resilience (green).*** *Each ATP (APT A; APT B; APT C; APT D) is represented in three timeframes: S - Short term (up to 2030), M- Medium term (up to 2050), L - Long term (until 2100). Highlighted options indicate the measure was selected in each ATP and timeframe: ATP A – Minimum Intervention (light blue); ATP B – Economic Capacity Expansion (light green); ATP C – Efficiency Enhancement (Light orange) and ATP D – System Restructuring (light purple). Bold letters in each ATP indicate the option was available to be selected in the three time frames. Grey cells mean that they the options was not available in that APT.*

Overall, the adaptation pathways for the Tourism sector in Sicily are characterized by a significant heterogeneity across the four potential adaptation policy trajectories (APTs) and across adaptation objectives.

The main measures selected to address **vulnerability reduction**, indicate that the region is initially centred on the development of sustainable approach both in short, medium, and long term. Indeed, especially in APT C the goal is address a circular economy system and sustainable economic activities. But the priority is for the Natural, Social, Physical and Human Capital rather than the Financial one. This last one is considered residual in this class and mainly for the short and long term in APT B and D. The selection of the Financial incentives to retreat in the end of the century is related with the perception that the risks will continue or increase over time. To adapt via Human Capital (class 2), diversification of the activities and products in opposition to awareness campaigns should be implemented. Products and activities diversification are the desired option for all the time and all the APTs. It is the only option with this consideration.

For **Disaster Risk Reduction**, and to manage long term risk, the decisions need to be sensible to the level of investment and reflect the climate change risk identified for the region. Pre-disaster early recovery planning is a priority for the region in the opposite scenarios, that is APT A and D, for the medium and long term. In general, for this class the options are selected for the medium or long term and with a preference for the planning tools. This result highlights a great attention towards a better management with a long-term planning. In the other case a different combination of investment and commitment is considered in respect of the first two options.

In **Social-Ecological Resilience** is the most selected option, that is Adaptive management of natural habitats, included in the Cultural Services. This measure is in APT C for all the times, then is considered a priority, now and in the future, but only with low investments and a medium level of commitment in this direction. All the measures of this class are mainly selected for the medium and long term and with a certain combination of investment and commitment, then often for APT B and C. The actions concerning the rivers represent a priority in respect of those ones on the sea and there is a special attention to the planning and monitoring activities. This indicates that the need to prevent negative effects is considered as urgent.

Sustainability Performance

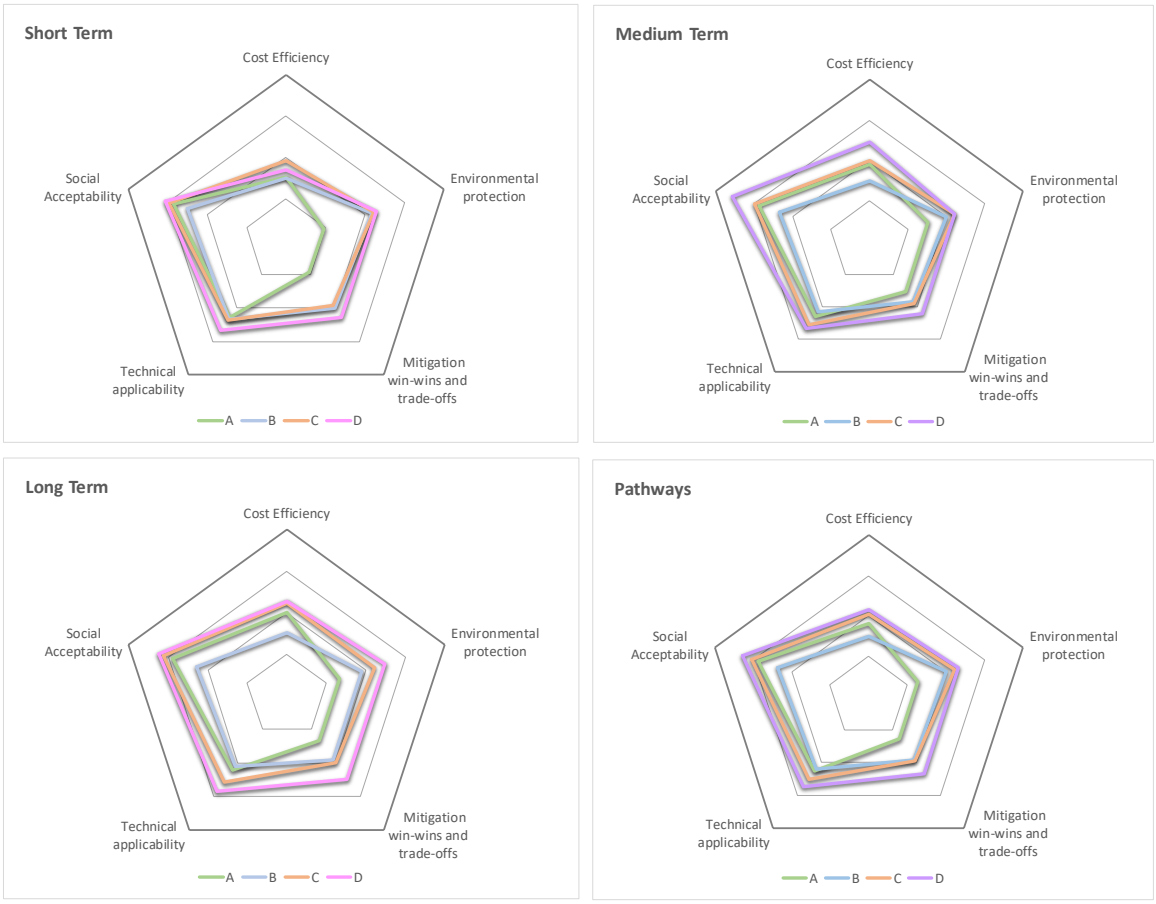

Figure 70 - Pathways evaluation for the tourism sector considering: Cost Efficiency; Environmental protection; Mitigation (GHG emissions) win-wins and trade-offs; Technical applicability; Social acceptability. The policy pathways scenarios: APT A - Minimum Intervention; APT B - Economic Capacity Expansion (ECE); APT C- Efficiency Enhancement (EE); APT D - System Restructuring (SR), for different timeframes: S - Short term (up to 2030), M- Medium term (up to 2050), L - Long term (until 2100)

The performances of the four ATP scenarios for tourism sector are quite similar for the mid and long timeframes. In general, scenarios show a high level of social acceptability and technical applicability and a medium performance for the other variables, that is mitigation win-wins and trade-offs, cost efficiency and environmental protection.

In the short term, APT C has the best cost efficiency, APT D the best results in terms of environmental protection and mitigation as well as for social acceptability and technical applicability. In the medium and long timeframes, APT D (System Restructuring scenario) has the best combination for all the dimensions.

For all the timeframes, the social acceptability and technical applicability record the best results in all the APTs.

The minimum intervention scenario (APT A) tends to have socially acceptable options and adaptation solutions with technical applicability. However, in this scenario the pathway has a low performance on mitigation, environmental protection, and cost efficiency. The scenarios B and C show balanced results for all the dimension in all the timeframes.

4.12.2 Maritime Transport

Maritime transport pathways are based on choices made by 4 expert island stakeholders.

Selected Adaptation Pathways

ID	Name	Class number	Ratio	APT A			APT B			APT C			APT D		
				S	M	L	S	M	L	S	M	L	S	M	L
MT1	Insurance mechanisms for ports	1	50%					**B**						**D**	
MT2	Financial incentives to retreat from high-risk areas	1	50%					**B**						**D**	
MT10	Social dialogue for training in the port sector	2	67%		**A**			**B**			**C**			**D**	
MT9	Awareness campaigns for behavioural change	2	33%		**A**			**B**			**C**			**D**	
MT11	Diversification of trade using climate resilient commodities	3	67%								**C**				
MT12	Climate resilient economy and jobs	3	33%								**C**				
MT13	Refrigeration, cooling and ventilation systems	4	75%								**C**			**D**	
MT14	Restrict development and settlement in low-lying areas	4	25%								**C**			**D**	
MT16	Increase operational speed and flexibility in ports	5	58%					**B**							
MT15	Sturdiness improvement of vessels	5	42%					**B**							
MT17	Climate proof ports and port activities	6	50%		**A**			**B**			**C**			**D**	
MT18	Consider expansion/retreat of ports in urban planning	6	50%		**A**			**B**			**C**			**D**	
MT20	Early Warning Systems (EWS) and climate change monitoring	7	58%								**C**				
MT19	Reinforcement of inspection, repair and maintenance of	7	42%								**C**				
MT21	Inteligent Transport Systems (ITS)	8	75%		**A**										
MT22	Prepare for service delays or cancellations	8	25%		**A**										
MT24	Post-Disaster recovery funds	9	58%		**A**									**D**	
MT23	Backup routes and infrastructures during extreme weather	9	42%		**A**									**D**	
MT4	Combined protection and wave energy infrastructures	10	56%		**A**			**B**			**C**			**D**	
MT3	Marine life friendly coastal protection structures	10	44%		**A**			**B**			**C**			**D**	
MT6	Coastal protection structures	11	54%					**B**			**C**				
MT5	Hybrid and full electric ship propulsion	11	46%					**B**			**C**				
MT7	Integrate ports in urban tissue	12	83%								**C**				
MT8	Ocean pools	12	17%								**C**				

ID	Name	Class number	Ratio	APT A			APT B			APT C			APT D		
				S	M	L	S	M	L	S	M	L	S	M	L
MT7	Integrate ports in urban tissue	12	83%								**C**				
MT21	Inteligent Transport Systems (ITS)	8	75%		**A**										
MT13	Refrigeration, cooling and ventilation systems	4	75%								**C**			**D**	
MT11	Diversification of trade using climate resilient commodities	3	67%								**C**				
MT10	Social dialogue for training in the port sector	2	67%		**A**			**B**			**C**			**D**	
MT24	Post-Disaster recovery funds	9	58%		**A**									**D**	
MT20	Early Warning Systems (EWS) and climate change monitoring	7	58%								**C**				
MT16	Increase operational speed and flexibility in ports	5	58%					**B**							
MT4	Combined protection and wave energy infrastructures	10	56%		**A**			**B**			**C**			**D**	
MT6	Coastal protection structures	11	54%					**B**			**C**				
MT17	Climate proof ports and port activities	6	50%		**A**			**B**			**C**			**D**	
MT18	Consider expansion/retreat of ports in urban planning	6	50%		**A**			**B**			**C**			**D**	
MT1	Insurance mechanisms for ports	1	50%					**B**						**D**	
MT2	Financial incentives to retreat from high-risk areas	1	50%					**B**						**D**	
MT5	Hybrid and full electric ship propulsion	11	46%					**B**			**C**				
MT3	Marine life friendly coastal protection structures	10	44%		**A**			**B**			**C**			**D**	
MT15	Sturdiness improvement of vessels	5	42%		**A**									**D**	
MT19	Reinforcement of inspection, repair and maintenance of	7	42%								**C**				
MT23	Backup routes and infrastructures during extreme weather	9	42%					**B**							
MT9	Awareness campaigns for behavioural change	2	33%								**C**				
MT12	Climate resilient economy and jobs	3	33%		**A**			**B**			**C**			**D**	
MT14	Restrict development and settlement in low-lying areas	4	25%		**A**										
MT22	Prepare for service delays or cancellations	8	25%								**C**			**D**	
MT8	Ocean pools	12	17%								**C**				

Figure 71 - Adaptation options for the maritime transport sector analysed by class (top) and by symmetry in stakeholder preference (bottom). Options are identified with an ID number, full name, and class of adaptation number. Adaptation objectives are identified in each option by colour: ***vulnerability reduction (red), Disaster Risk Reduction (blue); Social-Ecological Resilience (green).*** *Each ATP (APT A; APT B; APT C; APT D) is represented in three timeframes: S - Short term (up to 2030), M- Medium term (up to 2050), L - Long term (until 2100). Highlighted options indicate the measure was selected in each ATP and timeframe: ATP A – Minimum Intervention (light blue); ATP B – Economic Capacity Expansion (light green); ATP C – Efficiency Enhancement (Light orange) and ATP D – System Restructuring (light purple). Bold letters in each ATP indicate the option was available to be selected in the three time frames. Grey cells mean that they the options was not available in that APT.*

The Sicilian maritime transport sector adaptation pathways are characterized by a significant heterogeneity across the four potential adaptation policy trajectories (APTs). In general, a certain combination of investment and commitment, then a certain level of concrete involvement emerge for this sector.

As in the Tourism sector, the most selected option for Maritime Transport is in the class of the **Social-Ecological Resilience** and it is considered the best for all the timeframes and with a combination of medium investment and commitment (APT B and C). For this class there is a certain availability in investment for the medium and long term, mainly concerning the coastal protection, which represent a priority also in respect of alternative and sustainable propulsions for ships. These ones are selected as long-term option in APT B and C. Ocean pools are not considered a measure to implement in Sicily. The orientation is toward the improvement of the infrastructures with medium long-term strategies and investments.

In the context of **Risk Reduction** class of adaptation, the selection of the different measures is different both in terms of timeframes and in terms of combination among investments and commitment. The most selected measures concern the creation of an Intelligent Transport System but in APT A, then with low investment and low commitment. The other options are the post disaster recovery (APT A low investment and commitment) to react to the impacts and the prevention systems to avoid negative effects (APT C – low investments and medium commitment). The two risk mitigation options are considered equally desired. Prepare for service delays or cancellations, instead, is not considered as a priority and could be a strategy only in the short time under APT C and D.

For the **vulnerability reduction** the Physical, Social and Human capital represent a priority option in the mid-long term for APT C and D. Particularly, all these three options are considered in APT C, then with a low level of investment and medium commitment, at least for the mid and long term. The financial instruments are equally preferred. Specifically, the insurance mechanisms fit well in the mid and long term, while the financial incentives are useful in the short term, in APT B and D. For almost all the measure included in this class of adaptation, the orientation is towards a certain combination of investment and commitment, then a certain level of involvement. Only for the Human Capital option the choice is for APT A.

Sustainability Performance

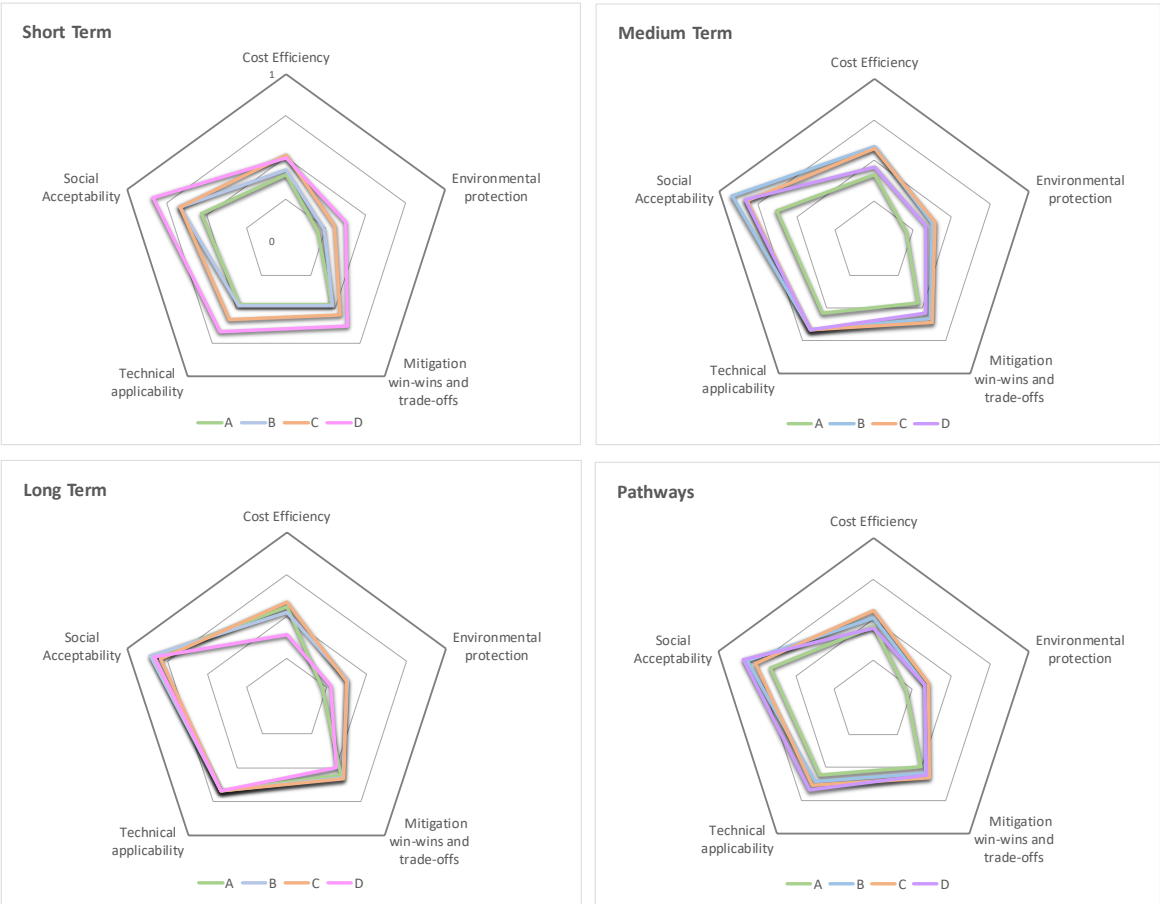

Figure 72 - Pathways evaluation for the maritime transport sector considering: Cost Efficiency; Environmental protection; Mitigation (GHG emissions) win-wins and trade-offs; Technical applicability; Social acceptability. The policy pathways scenarios: APT A - Minimum Intervention; APT B - Economic Capacity Expansion (ECE); APT C- Efficiency Enhancement (EE); APT D - System Restructuring (SR), for different timeframes: S - Short term (up to 2030), M- Medium term (up to 2050), L - Long term (until 2100)

All four adaptation pathways for the maritime transport sector reveal a similar structure in terms of their sustainability performance, especially from 2050 up to 2100. These pathways are comprised of measures that have a relatively high social acceptability and technical acceptability, medium level for mitigation objectives and cost-efficiency. These sector pathways will not perform in terms of future environmental protection.

More specifically, APT C has the best general performances in terms of cost efficiency, environmental protection, and mitigation. APT D has the best results for social acceptability and technical applicability. Considering the different timeframes, in the short term, APT D has the best combination except than for the cost efficiency aspect. In the medium and long timeframes, the APT B shows the better mix for all the dimensions.

All the pathways are characterised by a high degree of social acceptability, especially in the mid-long time.

4.12.3 Energy

Energy pathways are based on choices made by 3 expert island stakeholders.

Selected Adaptation Pathways

ID	Name	Class number	Ratio	APT A			APT B			APT C			APT D		
				S	M	L	S	M	L	S	M	L	S	M	L
E2	Financial support for smart control of energy in houses and	1	56%					B						D	
E1	Financial support for buildings with low energy needs	1	44%					B						D	
E9	Green jobs and businesses	2	69%		A			B			C			D	
E10	Public information service on climate action	2	31%		A			B			C			D	
E11	Small scale production and consumption (prosumers)	3	67%								C				
E12	Risk reporting platform	3	33%								C				
E13	Energy storage systems	4	78%								C			D	
E14	Collection and storage of forest fuel loads	4	22%								C			D	
E16	Demand Side Mangement (DSM) of Energy	5	56%					B							
E15	SeaWater Air Conditioning (SWAC).	5	44%					B							
E17	Review building codes of the energy infrastructure	6	56%		A			B			C			D	
E18	Upgrade evaporative cooling systems	6	44%		A			B			C			D	
E20	Grid reliability	7	67%								C				
E19	Early Warning Systems (EWS)	7	33%								C				
E21	Study and develop energy grid connections	8	56%		A										
E22	Energy-independent facilities (generators)	8	44%		A										
E23	Energy recovery microgrids	9	56%		A									D	
E24	Local recovery energy outage capacity	9	44%		A									D	
E4	Underground tubes and piping in urban planning	10	56%		A			B			C			D	
E3	Energy efficiency in urban water management	10	44%		A			B			C			D	
E5	Biomass power from household waste	11	50%					B			C				
E6	Urban green corridors	11	50%					B			C				
E8	Heated pools with waste heat from power plants	12	67%								C				
E7	Educational garden plots	12	33%								C				

ID	Name	Class number	Ratio	APT A			APT B			APT C			APT D		
				S	M	L	S	M	L	S	M	L	S	M	L
E13	Energy storage systems	4	78%								C			D	
E9	Green jobs and businesses	2	69%		A			B			C			D	
E8	Heated pools with waste heat from power plants	12	67%								C				
E20	Grid reliability	7	67%								C				
E11	Small scale production and consumption (prosumers)	3	67%								C				
E4	Underground tubes and piping in urban planning	10	56%		A			B			C			D	
E23	Energy recovery microgrids	9	56%		A									D	
E21	Study and develop energy grid connections	8	56%		A										
E17	Review building codes of the energy infrastructure	6	56%		A			B			C			D	
E16	Demand Side Mangement (DSM) of Energy	5	56%					B							
E2	Financial support for smart control of energy in houses and	1	56%					B						D	
E5	Biomass power from household waste	11	50%					B			C				
E6	Urban green corridors	11	50%					B			C				
E1	Financial support for buildings with low energy needs	1	44%		A			B			C			D	
E15	SeaWater Air Conditioning (SWAC).	5	44%		A									D	
E18	Upgrade evaporative cooling systems	6	44%		A										
E22	Energy-independent facilities (generators)	8	44%		A			B			C			D	
E24	Local recovery energy outage capacity	9	44%					B							
E3	Energy efficiency in urban water management	10	44%					B						D	
E12	Risk reporting platform	3	33%								C				
E19	Early Warning Systems (EWS)	7	33%								C				
E7	Educational garden plots	12	33%								C				
E10	Public information service on climate action	2	31%		A			B			C			D	
E14	Collection and storage of forest fuel loads	4	22%								C			D	

Figure 73 - Adaptation options for the energy sector analysed by class (top) and by symmetry in stakeholder preference (bottom). Options are identified with an ID number, full name, and class of adaptation number. Adaptation objectives are identified in each option by colour: ***vulnerability reduction (red), Disaster Risk Reduction (blue); Social-Ecological Resilience (green).*** *Each ATP (APT A; APT B; APT C; APT D) is represented in three timeframes: S - Short term (up to 2030), M- Medium term (up to 2050), L - Long term (until 2100). Highlighted options indicate the measure was selected in each ATP and timeframe: ATP A – Minimum Intervention (light blue); ATP B – Economic Capacity Expansion (light green); ATP C – Efficiency Enhancement (Light orange) and ATP D – System Restructuring (light purple). Bold letters in each ATP indicate the option was available to be selected in the three time frames. Grey cells mean that they the options was not available in that APT.*

In general, the energy sector in Sicily is characterized by heterogeneity concerning the selection of adaptation options in all adaptation policy trajectories (APTs). APT C is the prevailing combination of investment and commitment, highlighting as there is a wide awareness about the need to do something concretely improving the medium- and long-term scenarios.

Across all ATPs, for **vulnerability reduction**, pathways mainly rely on energy storage systems (Physical capital; ATP C and D) and green jobs (Human capital; all ATPs). Both the options are considered at least for the mid and long time. In contrast, public information on climate action (also Human capital; APT B and C) is not a priority since it is assumed that there is and will be a sufficient level public information in the island for it to pursue climate action. At the same way, the collection of forest fuel loads is part of pathways D for the short term, but it relies as last option. The Natural capital and the Financial one are considered always of equal importance in the context of vulnerability reduction. Moreover, the Financial capital is considered necessary, almost with equal intensity, and with a certain combination of investment and commitment, in APT B and D.

For **Disaster Risk Reduction**, the Grid reliability is the most selected option in APT C, for the mid and long term. On the opposite, the Early Warning System is not a priority, chosen only in APT C as a short-term measure. The options within the classes Risk mitigation, Disaster response and Post disaster recovery have the same distribution of preference. Particularly, the options with the higher percentage (56%) are valid for the short and the long term, instead the remaining ones are chosen for the medium timeframe. Moreover, Review building codes and Generators are present in all the APTs for all the timeframes.

Regarding **Social-Ecological Resilience**, Heated pools with waste heat from power plants is considered a priority in all the timeframes of APT C. Except that for underground tubes and piping in urban planning, chosen for all the APTs, the other measures are characterized by a certain degree of investment and commitment (APT B and C). The options in the Regulating and Maintenance Services class are considered equally relevant and with the same degree of priority. The educational gardens are not a priority, then it seems that there is enough awareness and knowledge about climate implication in Energy Sector.

Sustainability Performance

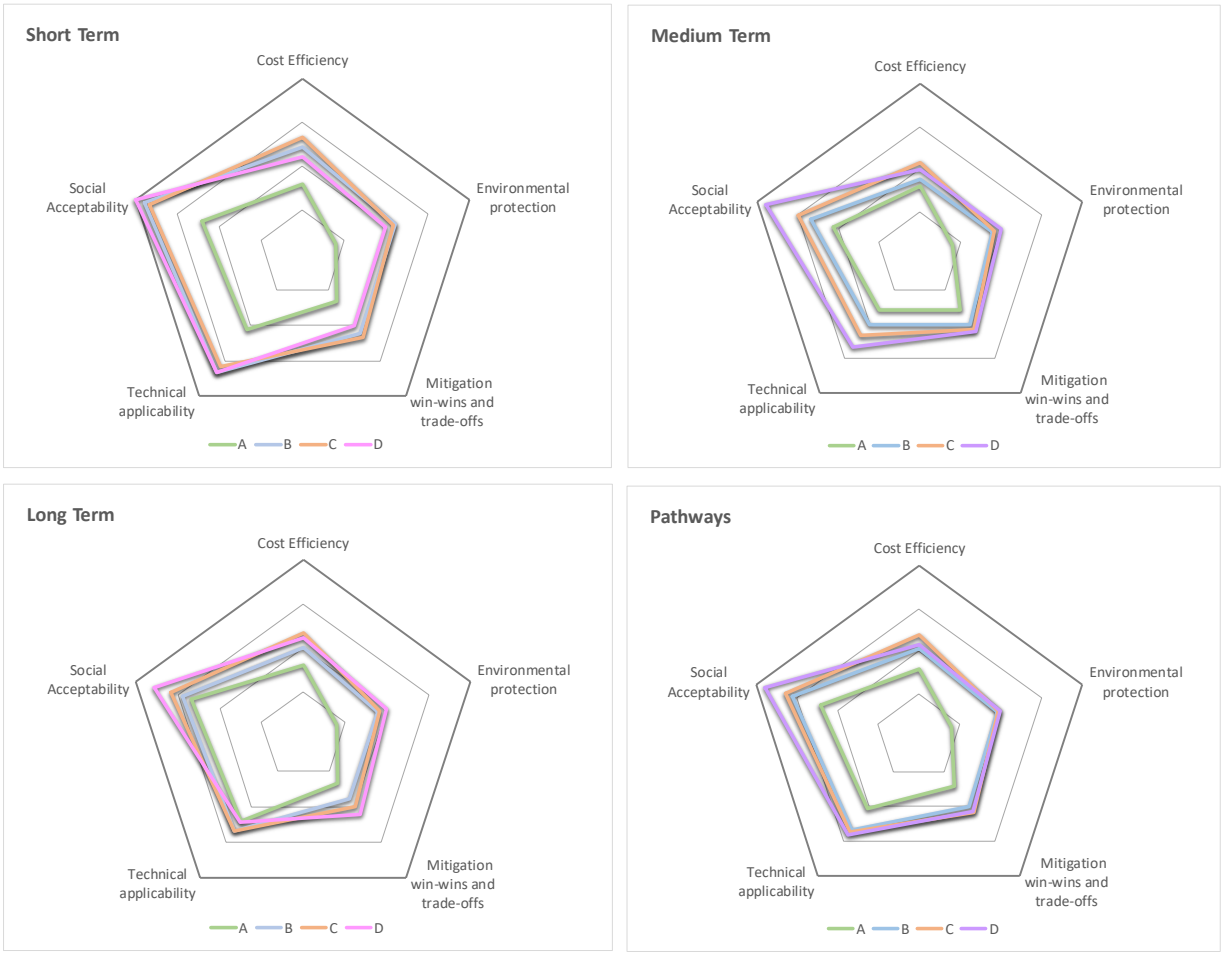

Figure 74 - Pathways evaluation for the energy sector considering: Cost Efficiency; Environmental protection; Mitigation (GHG emissions) win-wins and trade-offs; Technical applicability; Social acceptability. The policy pathways scenarios: APT A - Minimum Intervention; APT B - Economic Capacity Expansion (ECE); APT C- Efficiency Enhancement (EE); APT D - System Restructuring (SR), for different timeframes: S - Short term (up to 2030), M- Medium term (up to 2050), L - Long term (until 2100)

In general, the best performance in term of cost efficiency is in APT C, while the APT D has the higher results for the other dimensions. APT A shows the worst results in all the dimensions, especially in cost efficiency, mitigation and environ mental protection.

In the short timeframe, APT B provides the best environmental protection, the APT C the best combination of cost efficiency and mitigation, the APT D the best performances in terms of technical applicability and social acceptability. In the medium time, cost efficiency has the best results in APT C, instead APT D prevails in the other dimensions. In the long term, APT C has the best combination for cost efficiency and technical applicability, while APT D in the other dimensions.

Also, in this case social acceptability shows the higher results in all the APTs and all the timeframes.

This project has received funding from the European Union's Horizon 2020 research and innovation programme under Grant Agreement No776661

4.12.4 Aquaculture

Aquaculture pathways are based on choices made by 4 expert island stakeholders.

Selected Adaptation Pathways

ID	Name	Class number	Ratio	APT A			APT B			APT C			APT D		
				S	M	L	S	M	L	S	M	L	S	M	L
A15	Recirculation Aquaculture Systems (RAS)	5	75%		A			B							
A13	Integrated multi-trophic aquaculture (IMTA)	4	71%		A			B			C			D	
A8	Promote aquaculture cuisine	12	67%		A			B			C			D	
A6	Best Management Practices	11	67%		A			B			C			D	
A3	Feed production	10	60%		A			B			C			D	
A20	Environmental monitoring and Early Warning Systems (EWS)	7	58%		A			B			C			D	
A18	Risk-based zoning and site selection	6	58%		A			B			C			D	
A12	Promote cooperation to local consumption	3	58%		A			B			C			D	
A10	Efficient feed management	2	58%		A			B			C			D	
A23	Recovery Post-Disaster plans	9	54%		A			B			C			D	
A21	Mainstreaming Disaster Risk Management (DRM)	8	50%		A			B			C			D	
A22	Contingency for emergency management, early	8	50%		A			B			C			D	
A1	Financial schemes, insurance and loans	1	50%		A			B			C			D	
A2	Tax benefits and subsidies	1	50%		A			B			C			D	
A24	Recovery Post-Disaster funds	9	46%		A			B			C			D	
A19	Disease prevention methods	7	42%		A			B			C			D	
A17	Climate proof aquaculture activities	6	42%		A			B			C			D	
A11	Addressing consumer and environmental concerns at the	3	42%		A			B			C			D	
A9	Awareness campaigns for behavioural change	2	42%		A			B			C			D	
A4	Species selection	10	40%		A			B			C			D	
A7	Create educational visits	12	33%		A			B			C			D	
A5	Selective breeding	11	33%		A			B			C			D	
A14	Short-cycle aquaculture	4	29%		A			B			C			D	
A16	Submersible cages	5	25%		A			B			C			D	

ID	Name	Class number	Ratio	APT A			APT B			APT C			APT D		
				S	M	L	S	M	L	S	M	L	S	M	L
A1	Financial schemes, insurance and loans	1	50%		A			B			C			D	
A2	Tax benefits and subsidies	1	50%		A			B			C			D	
A10	Efficient feed management	2	58%		A			B			C			D	
A9	Awareness campaigns for behavioural change	2	42%		A			B			C			D	
A12	Promote cooperation to local consumption	3	58%		A			B			C			D	
A11	Addressing consumer and environmental concerns at the	3	42%		A			B			C			D	
A13	Integrated multi-trophic aquaculture (IMTA)	4	71%		A			B			C			D	
A14	Short-cycle aquaculture	4	29%		A			B			C			D	
A15	Recirculation Aquaculture Systems (RAS)	5	75%		A			B			C			D	
A16	Submersible cages	5	25%		A			B			C			D	
A18	Risk-based zoning and site selection	6	58%		A			B			C			D	
A17	Climate proof aquaculture activities	6	42%		A			B			C			D	
A20	Environmental monitoring and Early Warning Systems (EWS)	7	58%		A			B			C			D	
A19	Disease prevention methods	7	42%		A			B			C			D	
A21	Mainstreaming Disaster Risk Management (DRM)	8	50%		A			B			C			D	
A22	Contingency for emergency management, early	8	50%		A			B			C			D	
A23	Recovery Post-Disaster plans	9	54%		A			B			C			D	
A24	Recovery Post-Disaster funds	9	46%		A			B			C			D	
A3	Feed production	10	60%		A			B			C			D	
A4	Species selection	10	40%		A			B			C			D	
A6	Best Management Practices	11	67%		A			B			C			D	
A5	Selective breeding	11	33%		A			B			C			D	
A8	Promote aquaculture cuisine	12	67%		A			B			C			D	
A7	Create educational visits	12	33%		A			B			C			D	

Figure 75 - Adaptation options for the aquaculture sector analysed by class (top) and by symmetry in stakeholder preference (bottom). Options are identified with an ID number, full name, and class of adaptation number. Adaptation objectives are identified in each option by colour: ***vulnerability reduction (red), Disaster Risk Reduction (blue); Social-Ecological Resilience (green).*** *Each ATP (APT A; APT B; APT C; APT D) is represented in three timeframes: S - Short term (up to 2030), M- Medium term (up to 2050), L - Long term (until 2100). Highlighted options indicate the measure was selected in each ATP and timeframe: ATP A – Minimum Intervention (light blue); ATP B – Economic Capacity Expansion (light green); ATP C – Efficiency Enhancement (Light orange) and ATP D – System Restructuring (light purple). Bold letters in each ATP indicate the option was available to be selected in the three time frames. Grey cells mean that they the options was not available in that APT.*

In general, the Aquaculture sector in Sicily is characterized by a heterogeneous selection of adaptation options in all adaptation policy trajectories (APTs). APT A prevails in Disaster Risk Reduction class of adaptation, APT B and C are the prevalent choice in Social Ecological Resilience measures, while the vulnerability reduction is characterized by a certain combination of APT B, C and D. This shows the degree of commitment and investment associated to each class.

The most selected measures concern **vulnerability reduction**, that is Recirculation Aquaculture Systems and Integrated multi-trophic aquaculture. These options are selected for all the timeframes respectively in APT B for the first one and APT C and D for the other one. Since they are perceived as urgent, a priority, there is a certain degree of investment and commitment towards them. The measures concerning Human and Social Capital are selected for all the ATPs and different timeframes and show the same share of preference within each class. The instruments within the Financial capital measures are considered of equal importance, so the choice among the two options is indifferent. Short cycle aquaculture and Submersible cages are the less selected than they do not represent a priority.

For **Disaster Risk Reduction**, the Disaster response measures are considered of equal relevance, then the choice among the two options is indifferent. The monitoring and the implementation of a warning plan are considered a priority option, showing that the prevention measures and tools are fundamental. All the measures included in this category of class of adaptation have a certain level of relevance for local experts, indeed they are in all the APTs and in all the timeframes.

Regarding **Social-Ecological Resilience**, the measures with the higher score are considered for all the timeframes within the single ATP in which they are selected. Promote aquaculture and Best management practices consider a different combination of investment and commitment (ATP B and C) but they are considered valid in the short, medium, and long term. The feed production is the option universally selected for all the ATPs and the times. In this field the need for measure addressing different aspect emerges.

Sustainability Performance

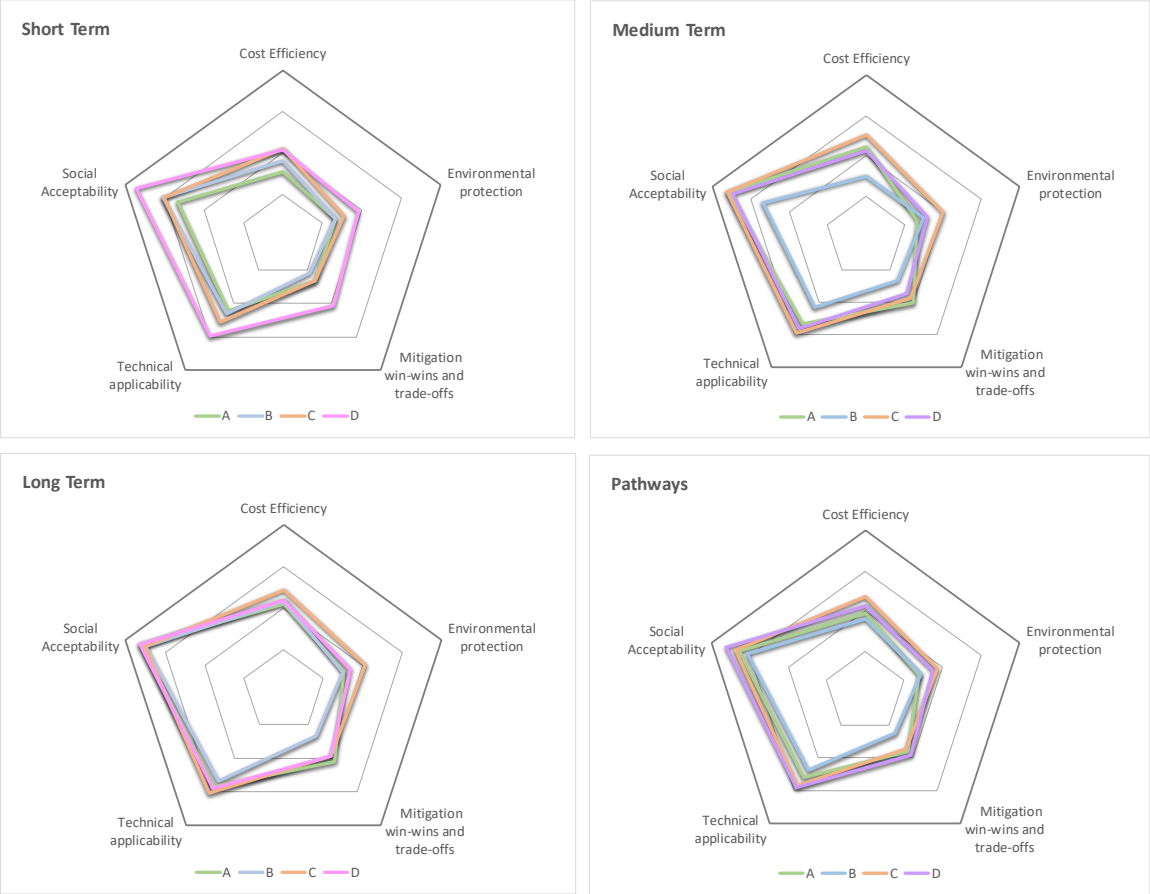

Figure 76 - Pathways evaluation for the aquaculture sector considering: Cost Efficiency; Environmental protection; Mitigation (GHG emissions) win-wins and trade-offs; Technical applicability; Social acceptability. The policy pathways scenarios: APT A - Minimum Intervention; APT B - Economic Capacity Expansion (ECE); APT C- Efficiency Enhancement (EE); APT D - System Restructuring (SR), for different timeframes: S - Short term (up to 2030), M- Medium term (up to 2050), L - Long term (until 2100)

All the pathways in the Energy sector have a similar evaluation across all timeframes, in general terms.

The APT B has the worst results in terms of cost efficiency, mitigation, and environmental protection. APT D the best mix in all the dimensions except for the environmental protection for which the APT C has a higher score.

More specifically, APT D has the best performances in the short period, the APT C in the medium and long timeframe.

In general, the dimension with the best results are the social and technical ones, especially in mid-long time. Environmental protection and mitigation record the worst results in all the timeframes and almost in all the APTs.

5 SOCLIMPACT Sector Adaptation Pathways

These results regard a main set of islands as they do not include Canary and Baleares data, as well as Guadalupe and Martinica who were not able to attain feedback from stakeholders on time for this task.

The tables for all Islands are presented bellow but the final analysis of results will only be made in D7.5.

5.1 Aquaculture

ID	Name	Class number	Ratio	APT A			APT B			APT C			APT D		
				S	M	L	S	M	L	S	M	L	S	M	L
A1	Financial schemes, insurance and loans	1	52%					B						D	
A2	Tax benefits and subsidies	1	48%					B						D	
A10	Efficient feed management	2	54%		A			B			C			D	
A9	Awareness campaigns for behavioural change	2	46%		A			B			C			D	
A11	Addressing consumer and environmental concerns at the local	3	52%								C				
A12	Promote cooperation to local consumption	3	48%								C				
A13	Integrated multi-trophic aquaculture (IMTA)	4	63%								C			D	
A14	Short-cycle aquaculture	4	37%								C			D	
A16	Submersible cages	5	62%					B							
A15	Recirculation Aquaculture Systems (RAS)	5	38%					B							
A18	Risk-based zoning and site selection	6	50%		A			B			C			D	
A17	Climate proof aquaculture activities	6	50%		A			B			C			D	
A19	Disease prevention methods	7	53%								C				
A20	Environmental monitoring and Early Warning Systems (EWS)	7	47%								C				
A21	Mainstreaming Disaster Risk Management (DRM)	8	60%		A										
A22	Contingency for emergency management, early	8	40%		A										
A23	Recovery Post-Disaster plans	9	60%		A									D	
A24	Recovery Post-Disaster funds	9	40%		A									D	
A4	Species selection	10	52%		A			B			C			D	
A3	Feed production	10	48%		A			B			C			D	
A6	Best Management Practices	11	61%					B			C				
A5	Selective breeding	11	39%					B			C				
A7	Create educational visits	12	52%								C				
A8	Promote aquaculture cuisine	12	48%								C				

Figure 77 - Adaptation options for the aquaculture sector in the main set of Islands. Options are identified with an ID number, full name, and class of adaptation number. Adaptation objectives are identified in each option by colour: ***vulnerability reduction (red), Disaster Risk Reduction (blue); Social-Ecological Resilience (green).*** *Each ATP (APT A; APT B; APT C; APT D) is represented in three timeframes: S - Short term (up to 2030), M- Medium term (up to 2050), L - Long term (until 2100). Highlighted options indicate the measure was selected in each ATP and timeframe: ATP A – Minimum Intervention (light blue); ATP B – Economic Capacity Expansion (light green); ATP C – Efficiency Enhancement (Light orange) and ATP D – System Restructuring (light purple). Bold letters in each ATP indicate the option was available to be selected in the three time frames. Grey cells mean that they the options was not available in that APT.*

ID	Name	Class number	Ratio
A13	Integrated multi-trophic aquaculture (IMTA)	4	63%
A16	Submersible cages	5	62%
A6	Best Management Practices	11	61%
A21	Mainstreaming Disaster Risk Management (DRM)	8	60%
A23	Recovery Post-Disaster plans	9	60%
A10	Efficient feed management	2	54%
A19	Disease prevention methods	7	53%
A11	Addressing consumer and environmental concerns at the	3	52%
A4	Species selection	10	52%
A7	Create educational visits	12	52%
A1	Financial schemes, insurance and loans	1	52%
A18	Risk-based zoning and site selection	6	50%
A17	Climate proof aquaculture activities	6	50%
A2	Tax benefits and subsidies	1	48%
A8	Promote aquaculture cuisine	12	48%
A3	Feed production	10	48%
A12	Promote cooperation to local consumption	3	48%
A20	Environmental monitoring and Early Warning Systems (EWS)	7	47%
A9	Awareness campaigns for behavioural change	2	45%
A24	Recovery Post-Disaster funds	9	40%
A22	Contingency for emergency management, early	8	40%
A5	Selective breeding	11	39%
A15	Recirculation Aquaculture Systems (RAS)	5	38%
A14	Short-cycle aquaculture	4	37%

Figure 78 - Adaptation options for the aquaculture sector in the main set of Islands organised by Ratio (Selections/possible selections). Options are identified with an ID number, full name, and class of adaptation number. Adaptation objectives are identified in each option by colour: ***vulnerability reduction (red), Disaster Risk Reduction (blue); Social-Ecological Resilience (green).***

Figure 79 - Pathways evaluation for the aquaculture sector considering: Cost Efficiency; Environmental protection; Mitigation (GHG emissions) win-wins and trade-offs; Technical applicability; Social acceptability. The policy pathways scenarios: APT A - Minimum Intervention; APT B - Economic Capacity Expansion (ECE); APT C- Efficiency Enhancement (EE); APT D - System Restructuring (SR), for different timeframes: S - Short term (up to 2030), M- Medium term (up to 2050), L - Long term (until 2100)

This project has received funding from the European Union's Horizon 2020 research and innovation programme under Grant Agreement No776661

5.2 Energy

ID	Name	Class number	Ratio	APT A			APT B			APT C			APT D		
				S	M	L	S	M	L	S	M	L	S	M	L
E1	Financial support for buildings with low energy needs	1	47%					**B**						**D**	
E2	Financial support for smart control of energy in houses and	1	53%					**B**						**D**	
E10	Public information service on climate action	2	32%		**A**			**B**			**C**			**D**	
E9	Green jobs and businesses	2	68%		**A**			**B**			**C**			**D**	
E12	Risk reporting platform	3	36%								**C**				
E11	Small scale production and consumption (prosumers)	3	64%								**C**				
E14	Collection and storage of forest fuel loads	4	29%								**C**			**D**	
E13	Energy storage systems	4	71%								**C**			**D**	
E15	Seawater Air Conditioning (SWAC)	5	37%					**B**							
E16	Demand Side Management (DSM) of Energy	5	63%					**B**							
E18	Upgrade evaporative cooling systems	6	43%		**A**			**B**			**C**			**D**	
E17	Review building codes of the energy infrastructure	6	57%		**A**			**B**			**C**			**D**	
E19	Early Warning Systems (EWS)	7	44%								**C**				
E20	Grid reliability	7	56%								**C**				
E21	Study and develop energy grid connections	8	49%		**A**										
E22	Energy-independent facilities (generators)	8	51%		**A**										
E24	Local recovery energy outage capacity	9	47%		**A**									**D**	
E23	Energy recovery microgrids	9	53%		**A**									**D**	
E4	Underground tubes and piping in urban planning	10	37%		**A**			**B**			**C**			**D**	
E3	Energy efficiency in urban water management	10	63%		**A**			**B**			**C**			**D**	
E6	Urban green corridors	11	48%					**B**			**C**				
E5	Biomass power from household waste	11	52%					**B**			**C**				
E8	Heated pools with waste heat from power plants	12	39%								**C**				
E7	Educational garden plots	12	61%								**C**				

Figure 80 - Adaptation options for the energy sector in the main set of Islands. Options are identified with an ID number, full name, and class of adaptation number. Adaptation objectives are identified in each option by colour: ***vulnerability reduction (red), Disaster Risk Reduction (blue); Social-Ecological Resilience (green).*** *Each ATP (APT A; APT B; APT C; APT D) is represented in three timeframes: S - Short term (up to 2030), M- Medium term (up to 2050), L - Long term (until 2100). Highlighted options indicate the measure was selected in each ATP and timeframe: ATP A – Minimum Intervention (light blue); ATP B – Economic Capacity Expansion (light green); ATP C – Efficiency Enhancement (Light orange) and ATP D – System Restructuring (light purple). Bold letters in each ATP indicate the option was available to be selected in the three time frames. Grey cells mean that they the options was not available in that APT.*

ID	Name	Class number	Ratio
E13	Energy storage systems	4	71%
E9	Green jobs and businesses	2	68%
E11	Small scale production and consumption (prosumers)	3	64%
E3	Energy efficiency in urban water management	10	63%
E16	Demand Side Management (DSM) of Energy	5	63%
E7	Educational garden plots	12	61%
E17	Review building codes of the energy infrastructure	6	57%
E20	Grid reliability	7	56%
E23	Energy recovery microgrids	9	53%
E2	Financial support for smart control of energy in houses and	1	53%
E5	Biomass power from household waste	11	52%
E22	Energy-independent facilities (generators)	8	51%
E21	Study and develop energy grid connections	8	49%
E6	Urban green corridors	11	48%
E1	Financial support for buildings with low energy needs	1	47%
E24	Local recovery energy outage capacity	9	47%
E19	Early Warning Systems (EWS)	7	44%
E18	Upgrade evaporative cooling systems	6	43%
E8	Heated pools with waste heat from power plants	12	39%
E15	Seawater Air Conditioning (SWAC)	5	37%
E4	Underground tubes and piping in urban planning	10	37%
E12	Risk reporting platform	3	36%
E10	Public information service on climate action	2	32%
E14	Collection and storage of forest fuel loads	4	29%

Figure 81 - Adaptation options for the energy sector in the main set of Islands organised by Ratio (Selections/possible selections). Options are identified with an ID number, full name, and class of adaptation number. Adaptation objectives are identified in each option by colour: ***vulnerability reduction (red), Disaster Risk Reduction (blue); Social-Ecological Resilience (green).***

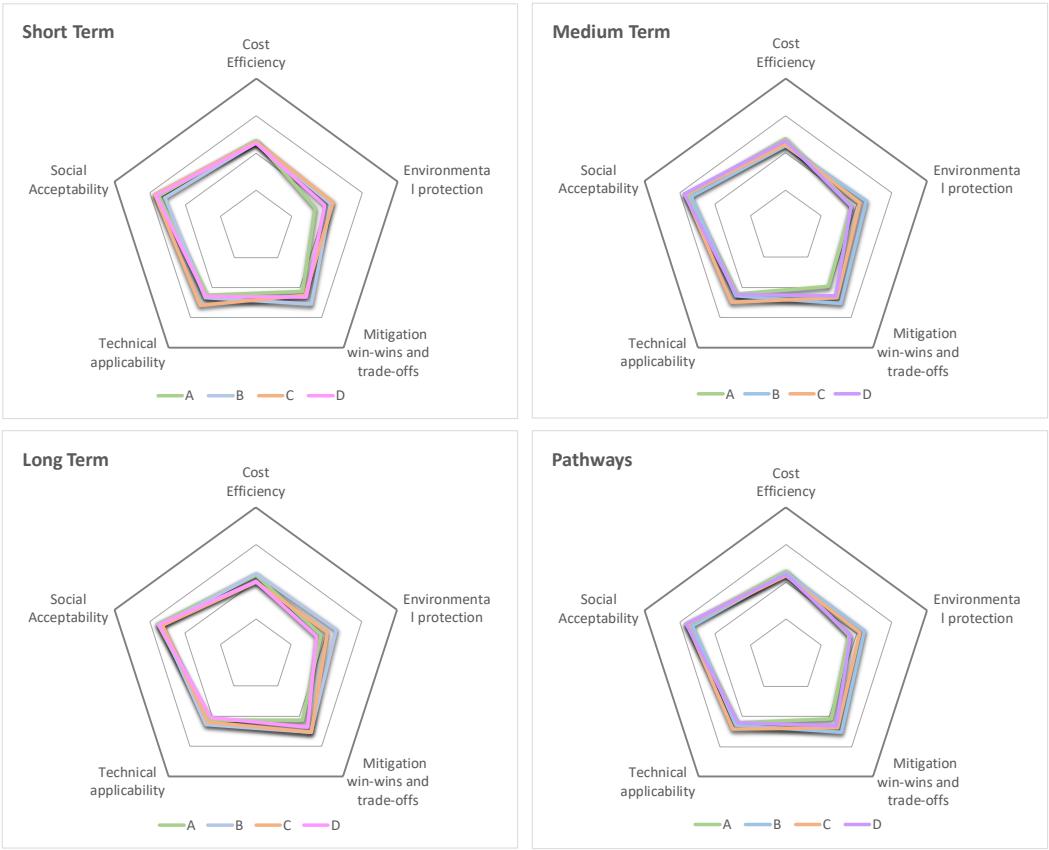

Figure 82 - Pathways evaluation for the energy sector considering: Cost Efficiency; Environmental protection; Mitigation (GHG emissions) win-wins and trade-offs; Technical applicability; Social acceptability. The policy pathways scenarios: APT A - Minimum Intervention; APT B - Economic Capacity Expansion (ECE); APT C- Efficiency Enhancement (EE); APT D - System Restructuring (SR), for different timeframes: S - Short term (up to 2030), M- Medium term (up to 2050), L - Long term (until 2100)

5.3 Maritime Transport

ID	Name	Class number	Ratio	APT A			APT B			APT C			APT D		
				S	M	L	S	M	L	S	M	L	S	M	L
MT2	Financial incentives to retreat from high-risk areas	1	57%					B						D	
MT1	Insurance mechanisms for ports	1	43%					B						D	
MT10	Social dialogue for training in the port sector	2	57%		A			B			C			D	
MT9	Awareness campaigns for behavioural change	2	43%		A			B			C			D	
MT12	Climate resilient economy and jobs	3	61%								C				
MT11	Diversification of trade using climate resilient commodities	3	39%								C				
MT14	Restrict development and settlement in low-lying areas	4	56%								C			D	
MT13	Refrigeration, cooling and ventilation systems	4	44%								C			D	
MT16	Increase operational speed and flexibility in ports	5	65%					B							
MT15	Sturdiness improvement of vessels	5	35%					B							
MT17	Climate proof ports and port activities	6	57%		A			B			C			D	
MT18	Consider expansion/retreat of ports in urban planning	6	43%		A			B			C			D	
MT20	Early Warning Systems (EWS) and climate change monitoring	7	56%								C				
MT19	Reinforcement of inspection, repair and maintenance of	7	44%								C				
MT21	Intelligent Transport Systems (ITS)	8	61%		A										
MT22	Prepare for service delays or cancellations	8	39%		A										
MT23	Backup routes and infrastructures during extreme weather	9	65%		A									D	
MT24	Post-Disaster recovery funds	9	35%		A									D	
MT4	Combined protection and wave energy infrastructures	10	56%		A			B			C			D	
MT3	Marine life friendly coastal protection structures	10	44%		A			B			C			D	
MT6	Coastal protection structures	11	54%					B			C				
MT5	Hybrid and full electric ship propulsion	11	46%					B			C				
MT7	Integrate ports in urban tissue	12	67%								C				
MT8	Ocean pools	12	33%								C				

Figure 83 - Adaptation options for the maritime transport sector in the main set of Islands. Options are identified with an ID number, full name, and class of adaptation number. Adaptation objectives are identified in each option by colour: ***vulnerability reduction (red), Disaster Risk Reduction (blue); Social-Ecological Resilience (green).*** *Each ATP (APT A; APT B; APT C; APT D) is represented in three timeframes: S - Short term (up to 2030), M- Medium term (up to 2050), L - Long term (until 2100). Highlighted options indicate the measure was selected in each ATP and timeframe: ATP A – Minimum Intervention (light blue); ATP B – Economic Capacity Expansion (light green); ATP C – Efficiency Enhancement (Light orange) and ATP D – System Restructuring (light purple). Bold letters in each ATP indicate the option was available to be selected in the three time frames. Grey cells mean that they the options was not available in that APT.*

ID	Name	Class number	Ratio
MT7	Integrate ports in urban tissue	12	67%
MT23	Backup routes and infrastructures during extreme weather	9	65%
MT16	Increase operational speed and flexibility in ports	5	65%
MT21	Intelligent Transport Systems (ITS)	8	61%
MT12	Climate resilient economy and jobs	3	61%
MT2	Financial incentives to retreat from high-risk areas	1	57%
MT17	Climate proof ports and port activities	6	57%
MT10	Social dialogue for training in the port sector	2	57%
MT4	Combined protection and wave energy infrastructures	10	56%
MT14	Restrict development and settlement in low-lying areas	4	56%
MT20	Early Warning Systems (EWS) and climate change monitoring	7	56%
MT6	Coastal protection structures	11	54%
MT5	Hybrid and full electric ship propulsion	11	46%
MT19	Reinforcement of inspection, repair and maintenance of infrastructures	7	44%
MT13	Refrigeration, cooling and ventilation systems	4	44%
MT3	Marine life friendly coastal protection structures	10	44%
MT9	Awareness campaigns for behavioural change	2	43%
MT18	Consider expansion/retreat of ports in urban planning	6	43%
MT1	Insurance mechanisms for ports	1	43%
MT11	Diversification of trade using climate resilient commodities	3	39%
MT22	Prepare for service delays or cancellations	8	39%
MT15	Sturdiness improvement of vessels	5	35%
MT24	Post-Disaster recovery funds	9	35%
MT8	Ocean pools	12	33%

Figure 84 - Adaptation options for the maritime transport sector in the main set of Islands organised by Ratio (Selections/possible selections). Options are identified with an ID number, full name, and class of adaptation number. Adaptation objectives are identified in each option by colour: ***vulnerability reduction (red), Disaster Risk Reduction (blue); Social-Ecological Resilience (green).***

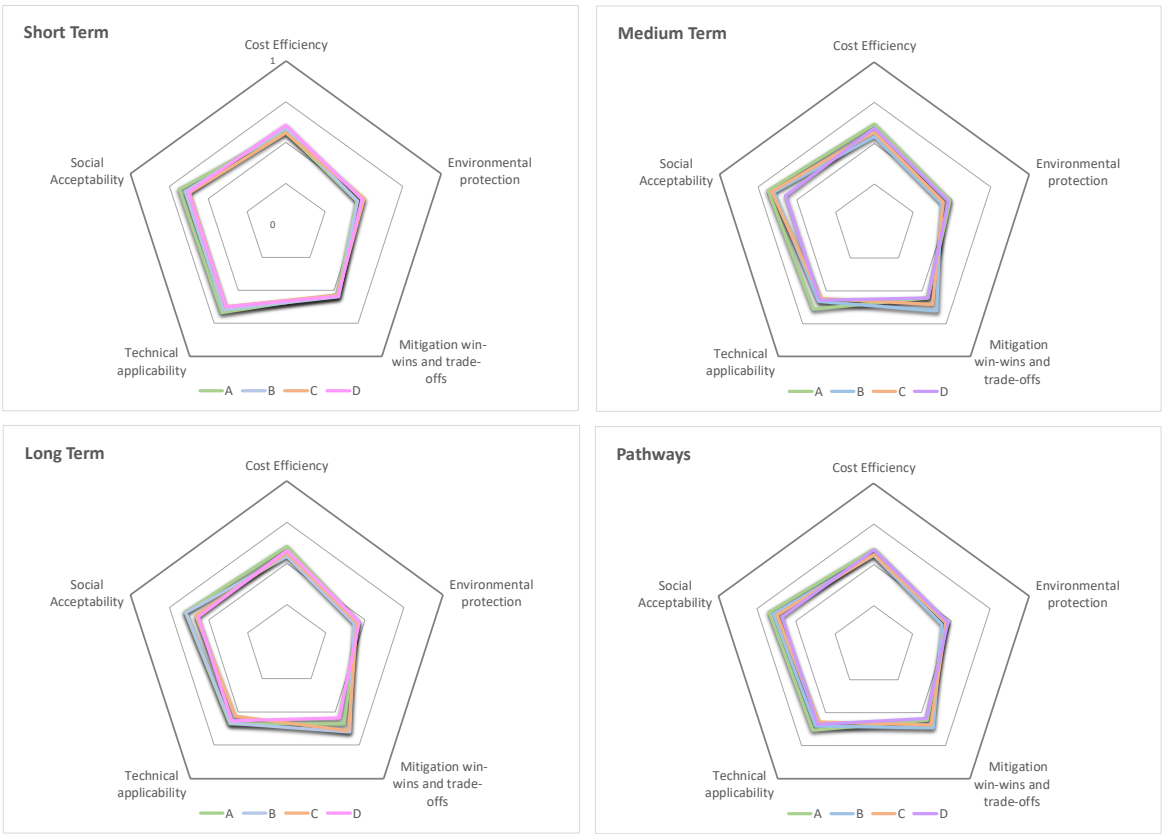

Figure 85 - Pathways evaluation for the maritime transport sector considering: Cost Efficiency; Environmental protection; Mitigation (GHG emissions) win-wins and trade-offs; Technical applicability; Social acceptability. The policy pathways scenarios: APT A - Minimum Intervention; APT B - Economic Capacity Expansion (ECE); APT C- Efficiency Enhancement (EE); APT D - System Restructuring (SR), for different timeframes: S - Short term (up to 2030), M- Medium term (up to 2050), L - Long term (until 2100)

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5.4 Tourism

ID	Name	Class number	Ratio	APT A			APT B			APT C			APT D		
				S	M	L	S	M	L	S	M	L	S	M	L
T1	Economic Policy Instruments (EPIs)	1	56%		A			**B**			C			D	
T2	Financial incentives to retreat from high-risk areas	1	44%		A			B			C			**D**	
T9	Activity and product diversification	2	62%		**A**			**B**			**C**			**D**	
T10	Public awareness programmes	2	38%		A			B			C			D	
T11	Local circular economy	3	66%		A			B			**C**			D	
T12	Tourist awareness campaigns	3	34%		A			B			C			D	
T14	Water restrictions, consumption cuts and grey-water recycling	4	59%		A			B			**C**			**D**	
T13	Local sustainable fishing	4	41%		A			B			C			D	
T15	Beach nourishment	5	54%		A			**B**			C			D	
T16	Desalination	5	46%		A			B			C			D	
T17	Coastal protection structures	6	50%		A			**B**			**C**			**D**	
T18	Drought and water conservation plans	6	50%		**A**			B			C			D	
T19	Mainstreaming Disaster Risk Management (DRM)	7	69%		A			B			**C**			D	
T20	Using water to cope with heat waves	7	31%		A			B			C			D	
T22	Health care delivery systems	8	51%		**A**			B			C			D	
T21	Fire management plans	8	49%		A			B			C			D	
T24	Pre-disaster early recovery planning	9	62%		**A**			B			C			**D**	
T23	Post-Disaster recovery funds	9	38%		A			B			C			D	
T4	Monitoring, modelling and forecasting systems	10	56%		**A**			**B**			**C**			**D**	
T3	Adaptation of groundwater management	10	44%		A			B			C			D	
T6	River rehabilitation and restoration	11	52%		A			**B**			C			D	
T5	Dune restoration and rehabilitation	11	48%		A			B			**C**			D	
T7	Adaptive management of natural habitats	12	68%		A			B			**C**			D	
T8	Ocean pools	12	32%		A			B			C			D	

Figure 86 - Adaptation options for the tourism sector in the main set of Islands. Options are identified with an ID number, full name, and class of adaptation number. Adaptation objectives are identified in each option by colour: ***vulnerability reduction (red), Disaster Risk Reduction (blue); Social-Ecological Resilience (green).*** *Each ATP (APT A; APT B; APT C; APT D) is represented in three timeframes: S - Short term (up to 2030), M- Medium term (up to 2050), L - Long term (until 2100). Highlighted options indicate the measure was selected in each ATP and timeframe: ATP A – Minimum Intervention (light blue); ATP B – Economic Capacity Expansion (light green); ATP C – Efficiency Enhancement (Light orange) and ATP D – System Restructuring (light purple). Bold letters in each ATP indicate the option was available to be selected in the three time frames. Grey cells mean that they the options was not available in that APT.*

This project has received funding from the European Union's Horizon 2020 research and innovation programme under Grant Agreement No776661

ID	Name	Class number	Ratio
T19	Mainstreaming Disaster Risk Management (DRM)	7	69%
T7	Adaptive management of natural habitats	12	68%
T11	Local circular economy	3	66%
T24	Pre-disaster early recovery planning	9	62%
T9	Activity and product diversification	2	62%
T14	Water restrictions, consumption cuts and grey-water recycling	4	59%
T1	Economic Policy Instruments (EPIs)	1	56%
T4	Monitoring, modelling and forecasting systems	10	56%
T15	Beach nourishment	5	54%
T6	River rehabilitation and restoration	11	52%
T22	Health care delivery systems	8	51%
T17	Coastal protection structures	6	50%
T18	Drought and water conservation plans	6	50%
T21	Fire management plans	8	49%
T5	Dune restoration and rehabilitation	11	48%
T16	Desalination	5	46%
T3	Adaptation of groundwater management	10	44%
T2	Financial incentives to retreat from high-risk areas	1	44%
T13	Local sustainable fishing	4	41%
T10	Public awareness programmes	2	38%
T23	Post-Disaster recovery funds	9	38%
T12	Tourist awareness campaigns	3	34%
T8	Ocean pools	12	32%
T20	Using water to cope with heat waves	7	31%

Figure 87 - Adaptation options for the tourism sector in the main set of Islands organised by Ratio (Selections/possible selections). Options are identified with an ID number, full name, and class of adaptation number. Adaptation objectives are identified in each option by colour: ***vulnerability reduction (red), Disaster Risk Reduction (blue); Social-Ecological Resilience (green).***

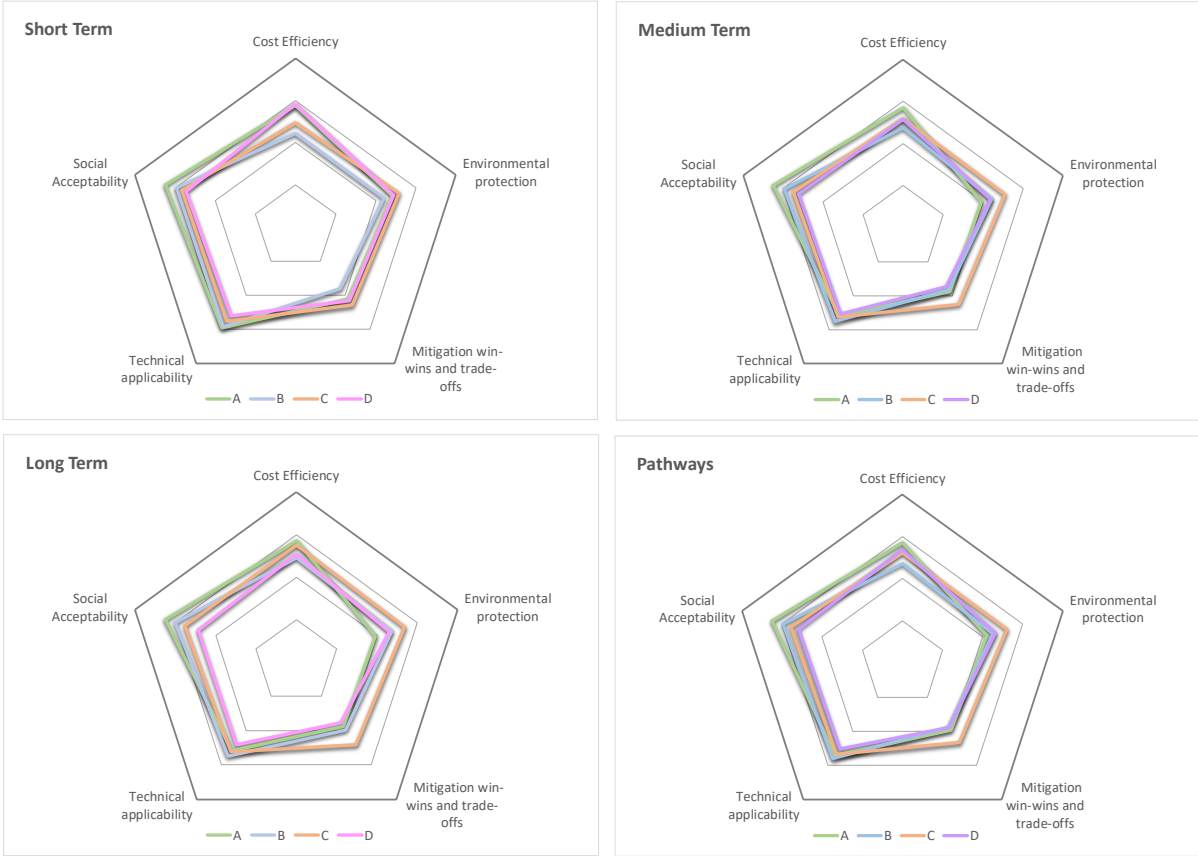

Figure 88 - Pathways evaluation for the tourism sector considering: Cost Efficiency; Environmental protection; Mitigation (GHG emissions) win-wins and trade-offs; Technical applicability; Social acceptability. The policy pathways scenarios: APT A - Minimum Intervention; APT B - Economic Capacity Expansion (ECE); APT C- Efficiency Enhancement (EE); APT D - System Restructuring (SR), for different timeframes: S - Short term (up to 2030), M- Medium term (up to 2050), L - Long term (until 2100)

6 Conclusions and Discussion

6.1 Challenges of implementation for the Methodological Framework

SOCLIMPACT completed a methodological framework which was presented to partners in March 11th, but due to the Covid-19 pandemic it had to be reshaped to a non-presential format. The Covid-19 contingent Plan (chapter 2.2) was set and in three months an online format participatory process was created throughout two webinars and using an online survey tool in between them. The proposed method was a pragmatic compromise between simplicity and scientific relevance that proved to be demanding to implement, because of three main challenges: 1) the APT concept was difficult to grasp, nevertheless most of IFPs were able to explore it considering uncertainty related with climate change; 2a) the choice between pairs of adaptation options inside a *class of adaptation* proved challenging as some options were referenced as not applicable to some Islands; 2b) the characterization/evaluation of the adaptation options proved to raise difficulties among IFPs 3) the tool was referenced to be challenging to explore considering the amount of factors that could be considered for decisions.

Regarding challenge #1, the APTs were used as a way to address uncertainty, which can be driven by socio-economical changes. With the goal of better engaging stakeholders some IFPs made their variations on the original method, giving their own insight about APTs and creating their own revisions of the materials (changed or added support documents). From IFP experience seems to be potential benefits in having shorter descriptions of the APTs and with real-world examples.

Regarding challenge #2, the objective to make results comparable between different islands lead to transversal approach something which is not site (island) specific but rather a generic approach for all islands[9] (2a). This methodological approach may have had the drawback of having stakeholders choosing options that are not completely in line with what is preconized for the island context. Evaluating Adaptation Options (2b) per island was a necessary step to create insight regarding each island context given by how the criteria would apply in.

Regarding challenge #3, there was a need to use a simple, flexible, and robust format for the online survey tool, which in one package could contain sector and regionalized background information, the available options and the results of individual stakeholders. In practice it proved complex for some participants to make a choice, in a given class, within a given APT, considering the climate risks in the background information and the time frames for each measure.

6.2 Methodological Framework overview

The method proposed in WP7 was structured and designed to come across with results for each island and for the Islands as a whole, creating a robust tool, adapted to the circumstances and which face the pragmatic objective of producing results. In this context, we were able to reflect with local stakeholders on the implications of adaptation policy choices for the Islands, considering the uncertainty of the future socio-economic, climate pathways and within the risks assessed and precepted by the stakeholders in each region.

In this context, it was created a set of adaptation options (see Annex) that were developed for different regions across European or which are present in sector-specific literature, mainly in Climate-Adapt database. The adaptation options were grouped in three main objectives: (a) actions to reduce socio-economic vulnerability; (b) actions that address disaster risk reduction; and (c) actions that affect social-ecological resilience. In this analysis, we do not reflect on the measures that are occurring in the Islands, for this purpose the IFP create an additional list of options (*Local Knowledge*). The main questions to be address were related with which policy direction for adaptation policy should be implemented in the future (near future or far future) in the islands. Some stakeholder remarked that it was quite challenging and confusing to focus on the mindset of a specific world and make choices based on the APT. It was mentioned that focussing in

[9] Something which in itself is a novelty

one scenario world in more detail could have potentially been more productive. Regardless of the tool's complexities, it was considered valuable to end up with a plan outlining general adaptation trajectory and a combination of options.

The framework implemented proved to be challenging to follow but resulted in an exercise that stakeholders recognised as useful. For some island stakeholders addressing the subject of adaptation policy under the context of the blue economy decarbonization was a first, something which in itself is already valuable. Doing this while considering adaptation policy uncertainty was in fact challenging but it may have paved the way for future working groups that need to consider it.

We consider that this methodological framework had ambitious goals that lead to valuable results regarding adaptation for the blue economy in the European Islands. We consider this implementation to be a success bearing in mind that this was a first online implementation of such a decision process dealing with uncertainty, the pandemic context and the described challenges. The IFPs did considerable efforts to use the proposed method and, were able to provide these results, as well as insights on the implementation process itself.

Future developments on the adaptation options should be focus on the establishment of a list that addresses solutions for all Islands in a more iterative and participative involvement of the local experts. Due to limitations regarding the context of the project and time availability this objective wasn't pursued.

The use of non-presential format and individual answers throughout an excel file was referred to have the advantage of having an effective participation of all stakeholders. Without an active and experience facilitation, often the round-table workshops or interviewers' formats are dominated by individuals that easily express publicly their opinions. When this happens, the final decisions could reflex more the individual or part of the group perspective and less the group of people participating.

The transdisciplinary approach to understand the climate related risk in Islands captured by the framework it was necessary to ensure the relevancy, and credibility for stakeholders. The *Pathways* co-development with stakeholders and considering climate change risk (even without as absolute structure perspective) is key to ensure that scientific questions asked can provide useful responses. The decisions provided throughout the framework should be considered as a focal point for future discussion between scientists, practitioners, and citizens in EU-Islands context.

6.3 Implementation result of the methodological framework

The results for the core group of Islands that developed the methodology proposed (see Chapter 4) are presented in SOCLIMPACT Sector Adaptation Pathways. In this chapter is presented a selection of the top five most selected Adaptation Options (AO) per sector, across all APTs. These results may benefit from a data clustering involving different island groups, in order for them to be more meaningful for Island Adaptation policy. These clusters may be set for Atlantic Islands, South Mediterranean, North Mediterranean and Baltic, but further study is necessary to find out if this such a clustering is beneficial or if another approach is necessary.

ID	Name	Class number	Ratio	APT A			APT B			APT C			APT D		
				S	M	L	S	M	L	S	M	L	S	M	L
A13	Integrated multi-trophic aquaculture (IMTA)	4	63%								C			D	
A16	Submersible cages	5	62%					B							
A6	Best Management Practices	11	61%					B			C				
A21	Mainstreaming Disaster Risk Management (DRM)	8	60%		A										
A23	Recovery Post-Disaster plans	9	60%		A									D	

Figure 89 - Averaged adaptation options and pathways for the ***aquaculture*** *sector in 5 islands (Corsica, Madeira, Malta, Sardinia and Sicily). Options are identified with an ID number, full name, and class of adaptation number. Adaptation objectives are identified in each option by colour: vulnerability reduction (red), Disaster Risk Reduction (blue); Social-Ecological Resilience (green). Each ATP (APT A; APT B; APT C; APT D) is represented in three timeframes: S - Short term (up to 2030), M- Medium term (up to 2050), L - Long term (until 2100). Bold letters in each ATP indicate the option was available to be selected in the three time frames. Highlighted options indicate the measure was selected in each ATP and timeframe: ATP A (light blue); ATP B (light green); ATP C (Light orange) and ATP D (light purple).*

ID	Name	Class number	Ratio	APT A			APT B			APT C			APT D		
				S	M	L	S	M	L	S	M	L	S	M	L
E13	Energy storage systems	4	71%								C			D	
E9	Green jobs and businesses	2	68%		A			B			C			D	
E11	Small scale production and consumption (prosumers)	3	64%								C				
E3	Energy efficiency in urban water management	10	63%		A			B			C			D	
E16	Demand Side Management (DSM) of Energy	5	63%					B							

Figure 90 - Averaged adaptation options and pathways for the ***energy*** *sector in 5 islands (Azores, Cyprus, Madeira, Sardinia and Sicily). Options are identified with an ID number, full name, and class of adaptation number. Adaptation objectives are identified in each option by colour: vulnerability reduction (red), Disaster Risk Reduction (blue); Social-Ecological Resilience (green). Each ATP (APT A; APT B; APT C; APT D) is represented in three timeframes: S - Short term (up to 2030), M- Medium term (up to 2050), L - Long term (until 2100). Bold letters in each ATP indicate the option was available to be selected in the three time frames. Highlighted options indicate the measure was selected in each ATP and timeframe: ATP A (light blue); ATP B (light green); ATP C (Light orange) and ATP D (light purple).*

ID	Name	Class number	Ratio	APT A			APT B			APT C			APT D		
				S	M	L	S	M	L	S	M	L	S	M	L
MT7	Integrate ports in urban tissue	12	67%								C				
MT23	Backup routes and infrastructures during extreme	9	65%		A									D	
MT16	Increase operational speed and flexibility in ports	5	65%					B							
MT21	Intelligent Transport Systems (ITS)	8	61%		A										
MT12	Climate resilient economy and jobs	3	61%								C				

Figure 91 - Averaged adaptation options and pathways for the ***maritime transport*** *sector in 5 islands (Azores, Crete, Madeira, Sardinia and Sicily). Options are identified with an ID number, full name, and class of adaptation number. Adaptation objectives are identified in each option by colour: vulnerability reduction (red), Disaster Risk Reduction (blue); Social-Ecological Resilience (green). Each ATP (APT A; APT B; APT C; APT D) is represented in three timeframes: S - Short term (up to 2030), M- Medium term (up to 2050), L - Long term (until 2100). Bold letters in each ATP indicate the option was available to be selected in the three time frames. Highlighted options indicate the measure was selected in each ATP and timeframe: ATP A (light blue); ATP B (light green); ATP C (Light orange) and ATP D (light purple).*

ID	Name	Class number	Ratio	APT A			APT B			APT C			APT D		
				S	M	L	S	M	L	S	M	L	S	M	L
T19	Mainstreaming Disaster Risk Management (DRM)	7	69%								C				
T7	Adaptive management of natural habitats	12	68%								C				
T11	Local circular economy	3	66%								C				
T24	Pre-disaster early recovery planning	9	62%		A									D	
T9	Activity and product diversification	2	62%		A			B			C			D	

Figure 92 - Averaged adaptation options and pathways for the ***tourism*** *sector in 9 islands (Azores, Corsica, Crete, Cyprus, Fehmarn, Madeira, Sardinia and Sicily). Options are identified with an ID number, full name, and class of adaptation number. Adaptation objectives are identified in each option by colour: vulnerability reduction (red), Disaster Risk Reduction (blue); Social-Ecological Resilience (green). Each ATP (APT A; APT B; APT C; APT D) is represented in three timeframes: S - Short term (up to 2030), M- Medium term (up to 2050), L - Long term (until 2100). Bold letters in each ATP indicate the option was available to be selected in the three time frames. Highlighted options indicate the measure was selected in each ATP and timeframe: ATP A (light blue); ATP B (light green); ATP C (Light orange) and ATP D (light purple).*

Regarding the sustainability performance across the APT some differences can be referenced, although they will later be revised. This performance is measured regarding the results of the five characterization criteria of AO. For each sector there is generally a similar performance of the pathways across all APT contexts, although for the Tourism sector there is a slightly more pronounced difference, as presented below:

Aquaculture sector:

- Cost Efficiency in APT A and C;
- Environmental protection in APT C
- Mitigation win-wins and trade-offs in APT C;
- Technical applicability in APT A;
- Social Acceptability in APT A (performed better).

Energy sector:

- Cost Efficiency in APT A and B;
- Environmental protection in APT B
- Mitigation win-wins and trade-offs in APT B;
- Technical applicability in APT C;
- Social Acceptability in APT C and D.

Maritime sector:

- Cost Efficiency in APT A and D;
- Environmental protection in APT A and D;
- Mitigation win-wins and trade-offs in APT B;
- Technical applicability in APT A;
- Social Acceptability in APT A.

Tourism sector (here the pathways in the APT contexts performed better).:

- Cost Efficiency in APT A (in APT B the performance was worst)
- Environmental protection in APT C;
- Mitigation win-wins and trade-offs in APT B (in APT D was worst);
- Technical applicability in APT B (in APT D was worst);
- Social Acceptability in APT A (in APT D was worst);

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8 ANNEX - ISLANDS WORKSHOP REPORTS

The reports for each island, except Guadalupe & Martinica (West Indies), is presented below.

This project has received funding from the European Union's Horizon 2020 research and innovation programme under Grant Agreement No776661

SOCLIMPACT

Downscaling climate impacts and decarbonisation pathways in EU islands, and enhancing socioeconomic and non-market evaluation of Climate Change for Europe, for 2050 and beyond

SOCLIMPACT

This project has received funding from the European Union's Horizon 2020 research and innovation programme under Grant Agreement No776661

Work Package 7:

This is a result of Tasks 7.3. This deliverable will include the agendas, the list of participants, and the workshops outputs including the decisions taken.

Deliverable 7.3.

Workshop Report - Azores

Island Focal Point coordinated by FC.ID.

Hugo P. Costa, Ricardo Coelho, Andreia Sousa, Tiago Capela Lourenço

Final version - 15/12/2020

1 Introduction

This document presents the results of the stakeholders' consultation process to design the **SOCLIMPACT Adaptation Pathways Workshops in Azores region**. This process is included in SOCLIMPACT Task 7.3 - Engage islands' stakeholders in the design of alternative pathways. According to the project Description of Action is expected that these online workshops use the background material prepared in Task 7.2/D7.2 and include the main results from previous WPs.

In the consultation process, the following objectives are expected to be covered:

1. **Identify and present the characterized packages of adaptation and risk management options** available for each archipelago/island.
2. **Develop detailed archipelago/island integrated adaptation pathways**, in three timeframes: Short term (up to 2030), Mid-century (up to 2050) and End-century (up to 2100).
3. **Evaluate** and rank pathways for Blue Economy sectors.

In Azores, the consultation process was split into two online webinars. The original plan was to hold physical workshops in each archipelago. However, health and travel limitations due to Covid-19 forced changes to the original plan and partners decided to develop two shorter online sessions mixed with an online survey. The rationale was to make it as easier as possible for both **Island Focal Points** (IFP) and **Local Working Group** (LWG) to carry out the proposed work, without compromising the **scientific quality** of the projects' outcomes.

The Azores LWG webinars were performed on the 15th of September 2020 and on the 14th of October 2020.

In the first stages the webinar included all the sectors involved in SOCLIMPACT project. During the process and following the recommended minimum number of stakeholders per sector (between 4 and 6), the aquaculture sector was excluded. Due to the importance of the sector for the Region, the IFP-Azores team decide to maintain the Maritime Transport sector with no more than 3 valid answers considered.

The workshop was performed taking into consideration the specific requirements of the region and the resources available. For the Azores region significant gaps in data were and substantially complemented with external sources (mostly local information). Data gaps are related with the specific geographic context of the region and are explain in the correspondent deliverables. Oceanic islands face diverse development challenges, mainly due to their distance from the mainland and limited land space, and where standardized mainland-based strategies cannot be directly implemented, as the complexity of the local context needs to be accounted for (SOCLIMPACT - D4.5).

The 24 options/measures available per sector were characterized by the IFP using the five criteria defined. In addition, up to six additional adaptation options per island and per sector could be added by the LWG (class of adaptation "Local Knowledge"). The "Local Knowledge" options for Azores were developed considering the climate change local program and assessment: PRAC-Açores (Governo dos Açores, 2018).

The report follows what was defined in the proposal by presenting the online workshop materials, namely: (1) decisions taken; (2) agendas and (3) list of participants.

The **Adaptation Pathways methodology applied in SOCPLIMPACT was based in the framework developed by Suckall et al. (2018a) and considered the three main strategic vectors for climate resilience: (1) vulnerability reduction -** Five capitals of Sustainable Livelihoods Approach (SLA)**; (2) Disaster Risk Reduction –** developed throughout Hyogo and Sendai Frameworks**; (3) Social-Ecological Resilience** – that emerge from the Millennium Ecosystem Assessment (MEA) and Common International Classification of Ecosystem Services (CICES).

The **Adaptation Pathways** aim to capture the policy preferences in time and the relevancy of the context traduced in investment and commitment (Suckall et al., 2018). These Adaptation Pathways Trajectories (APT) were delineated as a set of adaptation classes each one with two options/measures to choose from. Each individual stakeholder choices contribute to create a policy pathway together with the other choices made by different stakeholders. If most of the stakeholders chose one option, then that measure was incorporated in the island adaptation pathway for that specific class in each APT, per sector. The result of the series of choices in the three timeframes defines the pathway. If there is a tie between two options, then they will both be included and become part of the adaptation pathway in each time frame. The options were included in the pathway when they were selected more than 50% in each time frame in each APT. Local Knowledge measures were included if they were chosen by at least 20% of all stakeholders.

Pathway options are grouped around three objectives: (1) actions to reduce socio-economic vulnerability; (2) actions that address disaster risk reduction; and (3) actions that affect social-ecological resilience. Adaptation policy under **vulnerability reduction**, **disaster risk reduction**, and **social-ecological resilience** were developed considering classes of adaptation (Figure 2) under which the participants decide which are the most relevant options for the Azores region.

For **vulnerability reduction** five classes were considered: (1) Financial capital; (2) Human capital; (3) Social capital; (4) Natural capital; and (5) Physical capital. For **Disaster Risk Reduction** four classes were considered: (6) managing long term risk; (7) preparedness; (8) response; (9) post disaster recovery and rehabilitation. For **Social-Ecological Resilience** three classes were considered: (10) Post disaster recovery and rehabilitation; (11) Provisioning services; and (12) Regulating and Maintenance Services (

Figure 93).

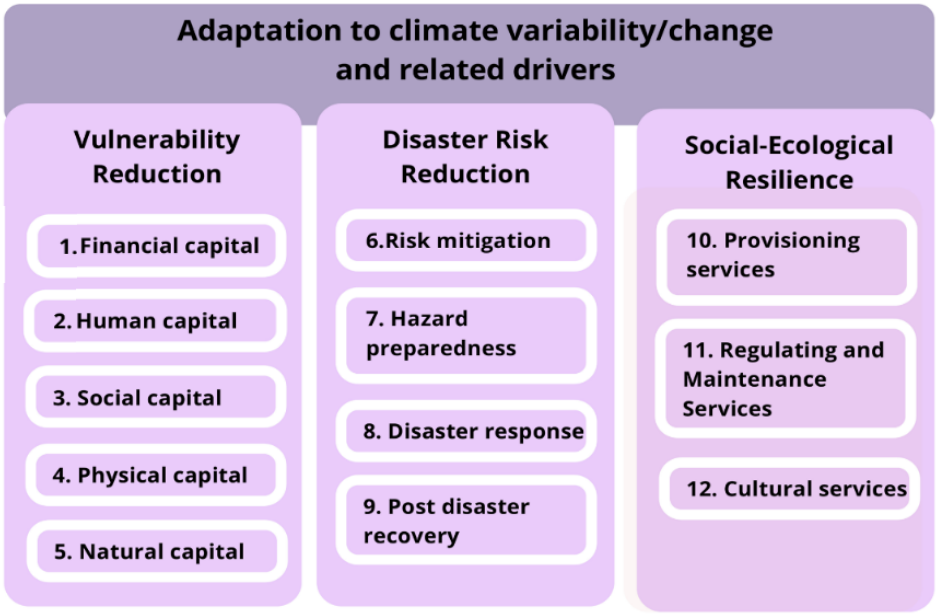

Figure 93 - The 12 classes of adaptation are structured in three broader objectives (Vulnerability reduction, Disaster Risk reduction and Ecosystem and social resilience).

The results of the Adaptation Pathways are presented in this report in two different outputs per sector: **(1) Selected Adaptation Pathways; and (2) Sustainability Performance.**

The (**1) Selected Adaptation Pathways** outputs aim to capture the acceptance of each adaptation option by calculating the options (number of times) selected within the maximum number of times they can be selected (Ratio – Selected/Maximum). This considers the number of times the option was selected by all stakeholders in all four APTs and three timeframes.

The **(2) Sustainability performance** outputs aim to characterize each pathway through the evaluation of the options chosen in each APT. The options selected in each APTs are evaluated considering a set of criteria: Cost Efficiency; Environmental protection; Mitigation (GHG emissions) win-wins and trade-offs; Technical applicability; Social acceptability (Table 3).

Table 4 – Description of the criteria used to evaluate the adaptation pathways performance.

Criteria	Description	
Cost Efficiency	Ability to efficiently address current or future climate hazards/risks in the most economical way	Higher score = higher cost efficiency
Environmental protection	Ability to protect the environment, now and in the future	Higher score = higher environmental protection
Mitigation (GHG emissions) win-wins and trade-offs	Current ability to meet (win-win) or not (trade-off) the island/archipelago's mitigation objectives	Higher score = higher mitigation win-wins and lower trade-offs
Technical applicability	Current ability to technically implement the option/measure in the island/archipelago	Higher score = higher technical applicability
Social acceptability	Current social acceptability of the option/measure in the island/archipelago	Higher score = higher social acceptability

The results are presented in a spider diagram and is the average of all options chosen for the participants in each APT pathway.

2 Summary of Background Material

To support the decisions within the Online Survey Tool and to define the Adaptation Pathways, relevant information related with climate, socio-economy and adaptation were presented to stakeholders. The deliverable 7.2 (Background Materials) were the preferential source information but additional and tailored information was developed.

Table 5 – Summary of the information used support the decisions within the Online Survey Tool. All relevant information related with climate, socio-economy and adaptation is included.

Variable	Description
Sea level rise (SLR)	Mean sea level rise (in cm) with respect to the reference period (1986-2005). Ensembles mean of CMIP 5 simulations and scaling approximation for RCP2.6
Sea level - Historical data	Sea level analyses between 1978 and 2007 indicated a statistically significant rising trend (2.5 ± 0.4 mm yr− 1; p = 0.000), while between 1996 and 2007 it was 3.3 ± 1.5 mm yr− 1 (p = 0.025), agreeing with other global sea level studies (Ng et al., 2019).
Sea level rise – Estimations of increased cost in Ports	Estimations of increased costs of keeping ports' operability under different scenarios of SLR caused by climate change until 2100. By experts' recommendation, we have assumed that 1 m increase in port height is required to cope with the SLR under RCP 8.5 scenario of emissions. Extrapolation for other RCP scenarios is then conducted based on proportionality. Produced by SOCLIMPACT: more information
Waves - 99th percentile of significant wave height averaged	99th percentile of significant wave height averaged for the reference period and the relative change for the RCP8.5. Global simulations produced by Hemer et al. (Hemer et al., 2013) (Collins et al., 2019).
Waves - Annual Mean Significant Wave Height (AMSH)	Significant wave height (m) under present climate and under RCP8.5 Produced by SOCLIMPACT: More information
Waves - Extreme Wave Return Time	Extreme waves return under present climate and under RCP8.5. Wind low resolution. Local Statistics are not homogeneous. Produced by SOCLIMPACT: More information
Hurricanes tracks	Model tracks for all storms that eventually reached category 4 or 5 intensity, for the control and the warmed 18-model ensemble conditions, as obtained using the GFDL/NWS hurricane model (Bender et al., 2010).
Waves - Regional wave statistics using 1998 to 2011 wind record	Regional wave statistics using 1998 to 2011 wind record showed: periods ranging from 7 to 13 s (circa 83%); wave heights between 1 and 3 m (circa 60%); and increasing trends in westerly (p = 0.473), easterly (p = 0.632) and south-easterly (p = 0.932) waves (Ng et al., 2019).
Waves – wind/wave conditions	Projected changes in wind-wave conditions 2075-2100 (compared 1980-2009): wave height, wave direction and wave period (Hemer et al., 2013)
Wind - Wind Extremity Index (NWIX98)	Number of days per year exceeding the 98th percentile of mean daily wind speed. Produced by SOCLIMPACT: More information
Extreme temperatures	The T98p is defined as the percentage of time where the mean daily temperature T is above the 98th percentile of mean daily temperature calculated for the reference period. Percentage of days per year when T > 98th percentile - T98p Hazard developed in SOCLIMPACT
Temperature – Downscaled mean temperature	Mean temperature Downscaled for 2080-100 Produced by Regional Program for Climate Change (Governo dos Açores, 2018)
Cooling Degree Days	Cooling Degree Days (CDD) are a measure of how much (in degrees), and for how long (in days), outdoor air temperature is higher than 18°C or 65° Farenheit. It is found that the CDD values triple according to the A1B scenario, while are more than double for the B1. Produced by SOCLIMPACT: More information
Humidex - human health, the humidity index	Number of Days with Humidex greater than 35°C was selected. Above 35°C describes conditions from discomfort to humans. The ESCENA Project model runs (Jiménez-Guerrero et al. 2013) were employed that have been produced under the AR4 IPCC Produced by SOCLIMPACT: More information
Beach flooding and related losses	Projected extreme flood level (in the vertical, in cml) at beach locations with respect to the present (1986-2005) mean sea level values averaged for the islands under scenario RCP2.6 (left) and RCP8.5 (right). Ensemble of models using Global simulations produced by Hemer et al. (2013). Hazard developed in SOCLIMPACT: More information
Reduction in overall distribution of species	Reduction in overall distribution of terrestrial species: bryophytes, vascular plants and arthropods. Compare 1961-1990 distribution with 2080-2100 potential distribution considering climate change scenarios (Ferreira et al., 2019).
Vulnerability of cetacean species	Most vulnerable cetacean species were identified. Produced by Regional Program for Climate Change (Governo dos Açores, 2018)
Fire Weather Index (FWI)	FWI results include temperature, precipitation, relative humidity, and wind. The index was calculated for the fire season (defined from May to October) for all models, scenarios, and periods. For scenarios B1 and A1B. Hazard developed in SOCLIMPACT: More information
Copernicus EMSN018-Hazard risk	Risk assessment products such as exposure, vulnerability and risk maps in order support the mitigation and preparedness efforts needed to minimize casualties and economic impact by setting up an effective preparedness and response mechanism concerning the following hazards: Seismic hazard, Flash Flood hazard, Tsunami and Storm Surges hazard, Landslide and Erosion hazard, Lava Flow and Coastal Erosion hazard. Produced for Copernicus: More information

The information presented during the webinar was imbedded into the Online Survey Tool (OST) to complement the presentations.

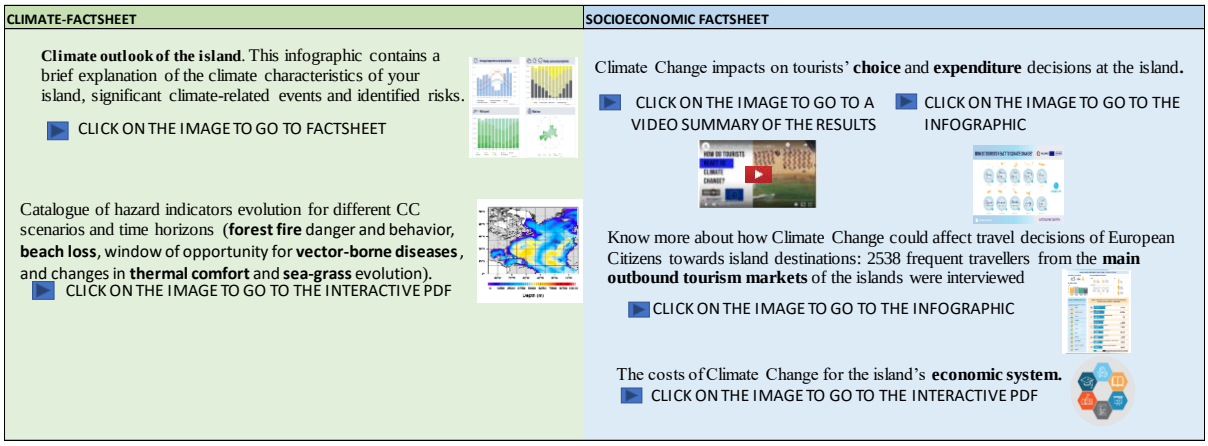

Figure 94 - Visual representation of how the background material was presented and delivered in the Online Tool Survey for Azores

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3 Sector Adaptation Pathways

3.1 Tourism

Tourism pathways are based on choices made by 8 expert island stakeholders.

3.1.1 Selected Adaptation Pathways

ID	Name	Class number	APT A			APT B			APT C			APT D		
			S	M	L	S	M	L	S	M	L	S	M	L
T1	Economic Policy Instruments (EPIs)	1					**B**						**D**	
T2	Financial incentives to retreat from high-risk areas	1					**B**						**D**	
T9	Activity and product diversification	2		**A**			**B**			**C**			**D**	
T10	Public awareness programmes	2		**A**			**B**			**C**			**D**	
T11	Local circular economy	3								**C**				
T12	Tourist awareness campaigns	3								**C**				
T13	Local sustainable fishing	4								**C**			**D**	
T14	Water restrictions, consumption cuts and grey-water recycling	4								**C**			**D**	
T15	Beach nourishment	5					**B**							
T16	Desalination	5					**B**							
T17	Coastal protection structures	6		**A**			**B**			**C**			**D**	
T18	Drought and water conservation plans	6		**A**			**B**			**C**			**D**	
T19	Mainstreaming Disaster Risk Management (DRM)	7								**C**				
T20	Using water to cope with heat waves	7								**C**				
T22	Health care delivery systems	8		**A**										
T21	Fire management plans	8		**A**										
T24	Pre-disaster early recovery planning	9		**A**									**D**	
T23	Post-Disaster recovery funds	9		**A**									**D**	
T4	Monitoring, modelling and forecasting systems	10		**A**			**B**			**C**			**D**	
T3	Adaptation of groundwater management	10		**A**			**B**			**C**			**D**	
T6	River rehabilitation and restoration	11					**B**			**C**				
T5	Dune restoration and rehabilitation	11					**B**			**C**				
T7	Adaptive management of natural habitats	12								**C**				
T8	Ocean pools	12								**C**				
T25	Adapt tourism promotion to Climate Change risks	Local		**A**			**B**			**C**			**D**	
T26	Improve Natura 2000 habitats - terrestrial, coastal and marine	Local		**A**			**B**			**C**			**D**	
T30	Define protection regime for "Maximum Infiltration Zones", within	Local		**A**			**B**			**C**			**D**	
T28	Create water storage reservoirs to ensure water availability	Local		**A**			**B**			**C**			**D**	
T27	Adapt agroforestry systems to drought conditions	Local		**A**			**B**			**C**			**D**	
T29	Create a mosquito detection information system	Local		**A**			**B**			**C**			**D**	

Figure 95 - Adaptation options for the tourism sector. Options are identified with an ID number, full name, and class of adaptation number. Adaptation objectives are identified in each option by colour: ***vulnerability reduction (red),*** *Disaster* ***Risk Reduction (blue); Social-Ecological Resilience (green);*** *Local Knowledge adaptation options (grey). Each ATP (APT A; APT B; APT C; APT D) is represented in three timeframes: S - Short term (up to 2030), M- Medium term (up to 2050), L - Long term (until 2100). Bold letters in each ATP indicate the option was available to be selected in the three time frames. Highlighted options indicate the measure was selected in each ATP and timeframe: ATP A (light blue); ATP B (light green); ATP C (Light orange) and ATP D (light purple). Space with colour: option was selected for the timeframe: Short term, Medium term, or Long term. Bold letter: option is available in the APT.*

Overall, the adaptation pathways for the Tourism sector in Azores are characterized by a significant heterogeneity across the four potential adaptation policy trajectories (APTs) and across adaptation objectives.

Under APT B and D scenarios, the financial capital measures that were selected to address **vulnerability reduction**, indicate that the region is initially centred on the development of Economic Policy Instruments and later on Financial incentives to retreat from high risk areas (medium to long term). The selection of the Financial incentives to retreat in the end of the century is related with the perception that the risks will increase over time.

To adapt via Human Capital (class 2), diversification of the activities and products in opposition to awareness campaigns should be implemented. However, in Minimum Intervention scenario (APT A), investment in public awareness can be appropriate for short and mid-term. At the same time, within a System Restructuring scenario (APT D), in all time periods, the diversification of the activities and products gain importance. The same pattern occurs for Social Capital class, where awareness campaigns were selected for the short-term in opposition to local circular economy which gain relevance in the middle and long-term.

The option related with water restrictions and cuts (Natural Capital) was excluded from all periods when a System Restructuring scenario (ATP D) is performed but was selected in an Efficiency Enhancement scenario (APT C) in middle and long term. The pathways developed seem to consider the growing evolution of the climate change risks and the urgency to respond to them.

This rational is coherent with the Physical Capital options taken in APT B. Beach nourishment (or replenishment) was valued in the beginning of the century while towards the end of the century, the region should invest in desalinization.

For **Disaster Risk Reduction**, and to manage long term risk, the decisions need to be sensible to the level of investment and reflects the climate change risk identified for the region. Coastal protection is a priority for the region throughout the scenarios where the level of investment and commitment are median to high - APTs B, C and D. In opposition, for APT A, drought and water conservation plans are a priority in the short and middle term. In Azores, adequate improvement of water harvesting from waterlines is possible in a scenario of low investment.

The Efficiency Enhancement scenario (ATP C) is the only scenario which considers the Preparedness class. In the short and mid-term, mainstreaming DRM was selected in detriment of using water to cope with heat waves. This result, follows the risk response rational, addressing disasters management in a first stage and heat waves when the risks related with temperature became higher towards the end of the century.

The risks related with fire were considered low in all time periods in Azores. The pathway clearly reflects the climate-risk context of the region.

Generically, to address DRR on tourism sector, it is necessary to continue to promote planning and allocate funds to develop climate change resilience in the region.

In **Social-Ecological Resilience,** groundwater management is not urgent for the sector in the short term. The Region should in the next decades (until 2050) invest efforts in information systems to improve climate information reliability. In the end of the century, with a higher drought risk, the adaptation focus should be in groundwater management. This measure was selected in the scenarios where the commitment to policy is low (Minimum Intervention – ATP A and Economic Capacity Expansion – ATP B). For the scenarios with medium and high investment and commitment (ATP C and D), the policy options were selected in short to medium timeframes.

Options for regulation of natural services in the Tourism sector will benefit from the maintenance of the rivers/valleys functions, creating recreational areas with a positive impact on tourism attractiveness. Regulating and Maintenance Services, is only defined within medium and low commitment to policy change. In this context, coastal restoration should only happen when coastal risks increase in the end of the century.

Since 2008 some islands have been under relevant meteorological droughts. For example, two years ago (2018) Azores faced a drought which originated indirect costs for the sector. During this period, it was necessary to implement measures such as water drilling or additional water treatment. Additionally, it was identified that some of the periods of drought have relevant implications in the crop yields and consequentially impacts on the milk sector. However, droughts have been worsened by the agricultural activity specially because of animal husbandry (mainly by free grazing livestock that has a relevant freshwater input). There are specific areas in each island where the problem is worse, namely where soils are poorer and in low laying areas.

The potential impacts of a reduction in precipitation on the landscape and its indirect impact on tourism attractivity were highlighted. Significant changes in landscape can be challenging for the tourism sector considering visitor's expectations and the promotion of the islands' natural resources. In this context, adapting tourism promotion was identified as a priority option.

In medium investment and medium commitment to policy change scenario (APT C - Efficiency Enhancement) cultural services are relevant. In this case, the region considered to dedicate efforts to preserve and minimize the impacts on biodiversity and ecosystems, while also preserving the attractiveness of the region.

Local knowledge options were focused on the preservation and promotion of the natural attractiveness of the region and reflect the relevance of this issue for the Azorean tourism sector, in the four pathways. All pathways reflect the need of conservation of the natural areas to continuous address multiple risk. This approach promotes water resource availability without hard and irreversible infrastructures. The vector borne diseases were not considered urgent for this sector. Like the options agroforestry related options sector does not have direct control on the health policy.

3.1.2 Sustainability Performance

Figure 96 - Pathways evaluation for the tourism sector considering: Cost Efficiency; Environmental protection; Mitigation (GHG emissions) win-wins and trade-offs; Technical applicability; Social acceptability. The policy pathways scenarios: APT A - Minimum Intervention; APT B - Economic Capacity Expansion (ECE); APT C- Efficiency Enhancement (EE); APT D - System Restructuring (SR), for different timeframes: short, medium, and long term

The performance of the four ATP scenarios for tourism sector are considerably similar during the three timeframes considered. In general, scenarios show a high level of social acceptability and technical applicability and a medium cost efficiency and environmental protection with a low performance in mitigation win-wins and trade-offs.

Additionally, for all pathway scenarios the performance level decreased with time, specially from middle to long term.

The minimum intervention scenario (APT A) tends to have socially acceptable options and adaptation solutions with technical applicability. However, in this scenario the pathway has a low performance on mitigation and environmental protection which agrees with the level of investment and commitment characterized by in ATP A, which ultimately expresses the results on mitigation and environmental protection. The efficiency enhancement scenario (ATP C) defines a pathway with a high level of environmental protection and mitigation.

In general, the pathway defined in APT D (System Restructuring scenario), has the lower performance when considering all timeframes.

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3.2 Maritime Transport

Maritime transport pathways are based on choices made by 3 expert island stakeholders.

3.2.1 Selected Adaptation Pathways

ID	Name	Class number	APT A			APT B			APT C			APT D		
			S	M	L	S	M	L	S	M	L	S	M	L
MT1	Insurance mechanisms for ports	1					B						D	
MT2	Financial incentives to retreat from high-risk areas	1					B						D	
MT10	Social dialogue for training in the port sector	2		A			B			C			D	
MT9	Awareness campaigns for behavioural change	2		A			B			C			D	
MT12	Climate resilient economy and jobs	3								C				
MT11	Diversification of trade using climate resilient commodities	3								C				
MT13	Refrigeration, cooling and ventilation systems	4								C			D	
MT14	Restrict development and settlement in low-lying areas	4								C			D	
MT16	Increase operational speed and flexibility in ports	5					B							
MT15	Sturdiness improvement of vessels	5					B							
MT17	Climate proof ports and port activities	6		A			B			C			D	
MT18	Consider expansion/retreat of ports in urban planning	6		A			B			C			D	
MT19	Reinforcement of inspection, repair and maintenance of	7								C				
MT20	Early Warning Systems (EWS) and climate change monitoring	7								C				
MT21	Intelligent Transport Systems (ITS)	8		A										
MT22	Prepare for service delays or cancellations	8		A										
MT23	Backup routes and infrastructures during extreme weather	9		A									D	
MT24	Post-Disaster recovery funds	9		A									D	
MT4	Combined protection and wave energy infrastructures	10		A			B			C			D	
MT3	Marine life friendly coastal protection structures	10		A			B			C			D	
MT5	Hybrid and full electric ship propulsion	11					B			C				
MT6	Coastal protection structures	11					B			C				
MT7	Integrate ports in urban tissue	12								C				
MT8	Ocean pools	12								C				
MT25	Strengthen coastal protection, giving priority to the maintenance	Local		A			B			C			D	
MT26	Evaluate and plan retreat of buildings /infrastructures from risk	Local		A			B			C			D	
MT27	Strengthen coastal monitoring	Local		A			B			C			D	

Figure 97 - Adaptation options for the Maritime Transport sector. Options are identified with an ID number, full name, and class of adaptation number. Adaptation objectives are identified in each option by colour: ***vulnerability reduction (red),*** *Disaster* ***Risk Reduction (blue); Social-Ecological Resilience (green);*** *Local Knowledge adaptation options (grey). Each ATP (APT A; APT B; APT C; APT D) is represented in three timeframes: S - Short term (up to 2030), M- Medium term (up to 2050), L - Long term (until 2100). Bold letters in each ATP indicate the option was available to be selected in the three time frames. Highlighted options indicate the measure was selected in each ATP and timeframe: ATP A (light blue); ATP B (light green); ATP C (Light orange) and ATP D (light purple). Space with colour: option was selected for the timeframe: Short term, Medium term, or Long term. Bold letter: option is available in the APT.*

The Azorean maritime transport sector adaptation pathways are characterized by a significant heterogeneity across the four potential adaptation policy trajectories (APTs) which they built upon.

In the **Minimum Intervention (APT A)** scenario which favours limited investment costs and the use of no-regret strategies, the Azorean maritime transportation sector follows a pathway of interventions that seek to sustain sector activities during and after the occurrence of extreme events. Reducing vulnerabilities in a policy scenario were changes in current policy commitment is less likely to occur, investment in **human**

capital takes the form of social dialogue targeting workforce training up to 2050. After that period, reinvestment in information and behavioural change will be necessary to respond to increasing climate related threats. Disaster risk reduction focuses on **managing long term risks** via climate proofing of infrastructure and activities while developing alternative routes during extremes events as a means of assuring **post-disaster recovery and rehabilitation** of sector value chains. This strategy is complemented by **disaster responses** that include new procedures to handle service disturbances up to 2030 and the development of tailored automated Intelligent Transport Systems after that. **Ecosystem resilience and provisioning services** in this pathway take the form of tailored protection structures, first by using marine life friendly materials and, after 2030, by strengthening the nexus port protection-energy production.

The **Capacity Expansion (APT B)** and **System Restructuring (APT D)** scenarios offer a higher level of investment but diverge in the commitment to policy change, which is low on the first case and high on the later. In terms of **human capital** differences across the two pathways developed in these scenarios are not significant. The only slight variation is an initial investment in behavioural change in APT B, that soon (after 2030) reverts to social dialogue, the preferred option in APT D throughout the century. The reason for such initial investment could be driven by a perceived small departure from the current status quo in a scenario were resources to invest are large, which in turn, translates in the need for additional education of the Archipelago's sector agents. In both pathways **financial capital** is initially focused on incentives to retreat from higher-risk areas that are later followed by the deployment of risk-sharing mechanisms such as insurance. **Natural capital** options are only available in APT D (not in APT B) and in this scenario's pathway, after an initial focus on restricting the development in low-lying risk areas there is a shift to the preservation of marketable natural resources via the investment in refrigeration and/or cooling systems. On the other hand, the APT B scenario includes the possibility to investment in **physical capital**. In this particular case, the Azorean maritime transport pathway clearly favours investments in the operationality and flexibility of ports in detriment of vessels. In relation to managing the long-term climate risk both pathways favour the climate proofing of existing infrastructure and activities, with the notable exception of a middle of the century planed revision of the localization and size of port infrastructures in APT D pathway. **Ecosystem resilience and provisioning services** in both these high-investment pathways take the form of integrated port protection-energy production structures, while **regulation and maintenance services** (available only in APT B but not in APT D) focus exclusively on hard coastal protection infrastructures, again in detriment of vessel technology.

Finally, the sector pathway in the **Efficiency Enhancing (APT C)** scenario (medium investment and medium change in policy commitment) is characterized by the flexibility of actions along the time. The Azorean maritime transportation sector will alternate between options targeting social dialogue and awareness raising (**human capital**), trade diversification and climate resilient jobs (**social capital**), and restrictions to the development in high-risk areas and investments in refrigeration and/or cooling systems for marketable products (**natural capital**). The same flexibility is seen in the **management of long-term disaster risks**, with the pathway considering the planed revision of the localization and size of port infrastructures up to 2030, followed by the climate proofing of ports and port activities. Similarly, **preparedness** actions will focus on an initial stepping up of the sector's infrastructures repair and maintenance efforts to be followed by the development of new early warning systems and monitoring schemes. Regarding **ecosystem resilience and services** in this pathway, the maritime transportation sector will, unlike in ATP B and D, focus initially on marine friendly coastal protections and ship technology, to be followed by more classical coastal protection structures (**regulation and maintenance services)** some with integrated energy technology (**provisioning services**). One additional feature of this pathway is related to **cultural services** (only available in the APT C scenario), were the sector will seek to better integrate ports in urban tissue over construction of new ocean pools.

Local knowledge options were focused on coastline protection and reflect the relevance of this issue for the Azorean maritime transport sector, in the four pathways. All pathways reflect the need for continuous maintenance of infrastructures, while coastal monitoring systems are centred around the short and long term. This is potentially in line with the prospects of using adaptive management in the region (i.e., review

adaptation decisions over time in line with changes in risks factors), which would facilitate incremental adaptation despite the level of investment scenarios. Additionally, such an approach can avoid locking-in the sector choices into hard infrastructures that are later difficult to revert.

3.2.2 Sustainability Performance

Figure 98 - Pathways evaluation for the maritime transport sector considering: Cost Efficiency; Environmental protection; Mitigation (GHG emissions) win-wins and trade-offs; Technical applicability; Social acceptability. The policy pathways scenarios: APT A - Minimum Intervention; APT B - Economic Capacity Expansion (ECE); APT C- Efficiency Enhancement (EE); APT D - System Restructuring (SR), for different timeframes: short, medium, long term

All four adaptation pathways for the Azorean maritime transport sector up to 2100 reveal a similar structure in terms of their sustainability performance. These pathways are comprised of measures that have a relatively high **social acceptability** and medium **technical acceptability** and **cost efficiency**. However, these sector pathways will have difficulty in meeting the archipelago's **mitigation objectives** and will not perform well in terms of future **environmental protection**. This particularly relevant in APT A and D pathways, curiously those responding to scenarios with the lowest (highest) investment and policy change levels, respectively. In fact, the pathway with the highest investment and policy change levels and that preconizes a system restructuring (APT D) underperforms the other pathways in all sustainability criteria, with the noteworthy exception of technical applicability.

3.3 Energy

Energy pathways are based on choices made by 6 expert island stakeholders.

3.3.1 Selected Adaptation Pathways

ID	Name	Class number	APT A			APT B			APT C			APT D		
			S	M	L	S	M	L	S	M	L	S	M	L
E2	Financial support for smart control of energy in houses and	1					**B**						**D**	
E1	Financial support for buildings with low energy needs	1					**B**						**D**	
E9	Green jobs and businesses	2		**A**			**B**			**C**			**D**	
E10	Public information service on climate action	2		**A**			**B**			**C**			**D**	
E11	Small scale production and consumption (prosumers)	3								**C**				
E12	Risk reporting platform	3								**C**				
E13	Energy storage systems	4								**C**			**D**	
E14	Collection and storage of forest fuel loads	4								**C**			**D**	
E16	Demand Side Management (DSM) of Energy	5					**B**							
E15	Seawater Air Conditioning (SWAC)	5					**B**							
E17	Review building codes of the energy infrastructure	6		**A**			**B**			**C**			**D**	
E18	Upgrade evaporative cooling systems	6		**A**			**B**			**C**			**D**	
E19	Early Warning Systems (EWS)	7								**C**				
E20	Grid reliability	7								**C**				
E22	Energy-independent facilities (generators)	8		**A**										
E21	Study and develop energy grid connections	8		**A**										
E24	Local recovery energy outage capacity	9		**A**									**D**	
E23	Energy recovery microgrids	9		**A**									**D**	
E3	Energy efficiency in urban water management	10		**A**			**B**			**C**			**D**	
E4	Underground tubes and piping in urban planning	10		**A**			**B**			**C**			**D**	
E5	Biomass power from household waste	11					**B**			**C**				
E6	Urban green corridors	11					**B**			**C**				
E7	Educational garden plots	12								**C**				
E8	Heated pools with waste heat from power plants	12								**C**				
E25	Develop risk maps for the electrical infrastructure	Local		**A**			**B**			**C**			**D**	
E26	Assess and map impacts caused in quality and power reserves	Local		**A**			**B**			**C**			**D**	

Figure 99 - Adaptation options for the Energy sector. Options are identified with an ID number, full name, and class of adaptation number. Adaptation objectives are identified in each option by colour: ***vulnerability reduction (red),*** *Disaster* ***Risk Reduction (blue); Social-Ecological Resilience (green);*** *Local Knowledge adaptation options (grey). Each ATP (APT A; APT B; APT C; APT D) is represented in three timeframes: S - Short term (up to 2030), M- Medium term (up to 2050), L - Long term (until 2100). Bold letters in each ATP indicate the option was available to be selected in the three time frames. Highlighted options indicate the measure was selected in each ATP and timeframe: ATP A (light blue); ATP B (light green); ATP C (Light orange) and ATP D (light purple). Space with colour: option was selected for the timeframe: Short term, Medium term, or Long term. Bold letter: option is available in the APT.*

In general, the energy sector in Azores is characterized by a homogenous selection of adaptation options in all adaptation policy trajectories (APTs). This indicates that the measures/options within each adaptation class are selected regardless of the different scenarios and timeframes.

Across all ATPs, for **vulnerability reduction**, pathways mainly rely on green jobs (**Human capital**; all ATPs) and energy storage (**Natural capital**; ATP C and D). Green jobs are able to support Azores reliance on adaptation energy issues while serving as a form of economic diversification, reducing the dependency on the Tourism sector. In contrast, public information on climate action (also Human capital; all APTs) is not part of the pathways since it is assumed that there is and will be a sufficient level public information in the island for it to pursue climate action. Energy storage is part of pathways characterized by medium to high commitment and investment, something that is expected when considering its relevance for energy

services reliability and decarbonization. The collection of forest fuel loads (**Natural capital**; ATP C and D) is limited in Azores Energy pathways because forest fires are not an issue in the region. In all other vulnerability reduction classes, adaptation measures are endorsed in the time frames where they most clearly respond to the climate risks or reflect expected sector changes. This seems to happen regardless of whether these options are dependent on technologies that are already in use today or in an initial development stage. For example, houses with low energy needs (**Financial capital**; ATP B and D) may prove to be necessary in the short term, later evolving to smart houses in the mid and end-century time frames.

For Disaster Risk Reduction, a path is set to climate proof structures (**Managing long term risk;** All APTs), which is in line with the observed violent weather events which put the energy infrastructure in Azores under stress. Towards the end of the century, the path is set to continue to have a local recovery energy outage capacity. This will allow the islands to continue to be able to recover from disasters (or malfunctions) using a proven concept instead of using a novel and conceptual architecture based on microgrids. Evaporative cooling (**Managing long term risk**; All APTs) is excluded from the pathways because this is a technology that has proven to be unreliable and unsuited for the islands needs and climate mainly due to the high humidity levels in Azores. In addition, the measure on Grid connections between different islands proves to be economically unfeasible given the investment cost and lack of operational savings due to reliability constrains. It is considered more prudent to rely on backup power based on each island rather than depending upon a grid connection which is more vulnerable to climate hazards.

Regarding **Social-Ecological Resilience**, in **provisioning services** (all ATPs) not only show a preference for proven technology but also the need to respond to the growing problem of water scarcity in some islands. Underground piping for cooling can be a difficult energy resource concept to grasp and to account for in energy planning. Waste to energy solutions (Regulating and Maintenance Services) were preferred as the islands already have significant green areas. These solutions need Combined Heat and Power (CHP) and Combined Cold Heat and Power (CCHP) to be implemented, something which is not in use in the islands. This is because there are only a few industries working and because the existing ones did not prefer to have them. Heated pools (Cultural services), another form of CHP, were not a chosen option, thus disregarding their tourism potential to provide an off-season offer as well as to provide emergency heat sinking for power plants. Thus, Educational Garden plots were preferred instead.

The choice in local knowledge measures addresses the risks posed by extreme weather events. The second option that is chosen towards the end of the century relates with the decarbonization process and the impact of Renewable Energy Sources (RES) in the energy service quality and reliability.

3.3.2 Sustainability Performance

Figure 100 - Pathways evaluation for the energy sector considering: Cost Efficiency; Environmental protection; Mitigation (GHG emissions) win-wins and trade-offs; Technical applicability; Social acceptability. The policy pathways scenarios: APT A - Minimum Intervention; APT B - Economic Capacity Expansion (ECE); APT C- Efficiency Enhancement (EE); APT D - System Restructuring (SR), for different timeframes: short, medium, long term

All four pathways in the Energy sector have a similar evaluation across all timeframes. In the energy sector, the analysis showed no differences in the scoring of criteria as a reflection of the different ATP narratives.

The cost efficiency of the pathways is the same in all APTs. The environmental protection has an overall low value but with differences in APT A (lower value), APT B and D (intermediate value) and APT C (highest value). Mitigation performance is higher and shows a wider range of values. APT A (minimal intervention) has the lowest value and APT B (capacity expansion) the highest, leaving C (efficiency enhancement) and D (system restructuring) in the middle. The option for a high use of low emissions technology is coherent with a capacity expansion scenario where high investment is the main solution for climate change challenges. Technical Ability is similar across all APTs and has an intermediate value.

Social acceptability has the highest values with APT D having more and APT B less. It can be expected that APT D would have the most challenging options in terms of social acceptability because it is the scenario with the highest commitment to policy change. It is assumed that a higher commitment could better cope

with options which have a lower social acceptance. Using the same principal, in APT B (low commitment) could have had a higher (than D) social acceptability result. APTs A and C have intermediate results, which are within what can be expected from them, especially for C. In APT A this is because there are is also low investment, which limits the available options, and APT C because it is an intermediate policy scenario (medium commitment with medium investment).

SOCLIMPACT

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4 Decarbonization Performance [10]

The use of the word decarbonization is used instead of mitigation as to not to confuse with risk mitigation in the Disaster Risk Reduction context.

To prepare a discussion with stakeholder in this regard a set of tables were presented containing information about the decarbonization performance. This performance is based on the mitigation criteria of the Multi Criteria Analysis (MCA) result, used to characterize the options. Bellow to the left we can see an example[11] of the percentages that were presented to communicate how the different sector performed in each APT to this regard.

Azores - Energy

APT	Pathway			
	Short	Medium	Long	Full
A	57%	57%	59%	58%
B	73%	73%	72%	72%
C	66%	62%	67%	65%
D	67%	67%	69%	68%

APT	Mitigation win-wins and trade-offs (Average)					
		Pathway				
	Worst	Short	Medium	Long	Full	Optimum
A	1,0	2,7	2,7	2,8	2,7	4,0
B	1,0	3,2	3,2	3,2	3,2	4,0
C	1,0	3,0	2,9	3,0	2,9	4,0
D	1,0	3,0	3,0	3,1	3,0	4,0

Azores - Maritime Transport

APT	Pathway			
	Short	Medium	Long	Full
A	38%	45%	43%	42%
B	41%	43%	43%	43%
C	45%	51%	44%	47%
D	39%	43%	42%	41%

APT	Mitigation win-wins and trade-offs (Average)					
		Pathway				
	Worst	Short	Medium	Long	Full	Optimum
A	1,0	2,1	2,3	2,3	2,3	4,0
B	1,0	2,2	2,3	2,3	2,3	4,0
C	1,0	2,4	2,5	2,3	2,4	4,0
D	1,0	2,2	2,3	2,3	2,2	4,0

Azores - Tourism

APT	Pathway			
	Short	Medium	Long	Full
A	34%	38%	33%	35%
B	41%	38%	31%	37%
C	41%	46%	43%	45%
D	40%	43%	35%	39%

APT	Mitigation win-wins and trade-offs (Average)					
		Pathway				
	Worst	Short	Medium	Long	Full	Optimum
A	1,0	2,0	2,2	2,0	2,1	4,0
B	1,0	2,2	2,2	1,9	2,1	4,0
C	1,0	2,2	2,4	2,4	2,3	4,0
D	1,0	2,2	2,3	2,1	2,2	4,0

Figure 101 - Decarbonization (Mitigation) Performance of the three sectors analysed in the Azores

These percentages are the normalized theoretical result, that come from the values on the right, between the minimum performance (with a value of one) and the optimum performance (with a value of four). The this was made for each APT where the full pathway value is the average of all three time frames.

Furthermore, a performance table was made, which lead to conclusions that were presented to stakeholders for discussion. The table shown below ranks the measures by decarbonization performance and then analyses the cost of opportunity per sector and class. The switch column shows the score differential available in the opposing option (of the same sector and class) when the ratio of choice is equal or below 50%. For instance, in the first class (Financial capital) of the energy sector the score for the decarbonization performance[12] is the same for the two options (both with a value of four), which means that the potential for improvement is zero. Also, for class 11 (Regulation and maintenance services) having MT5 with a value of 4 and MT6 with a value of 2, leads to a potential for improvement which is considered to have a value of 2 (where the ratio of choice equal to 50%). This means that if MT5 was chosen more often, especially for APT B (where is not part of the pathway), then the overall decarbonization performance of the adaptation pathways would increase.

[10] This chapter was just made for the Azores Region as to make it coherent climate policy in the region

[11] The original tables were later updated with these values.

[12] Low performance has a value of 1 which represents having more mitigation trade-offs and high performance means 4 which represents having more mitigation win-wins

ID	Name	Switch	Class	Ratio	Mit	APT A	APT B	APT C	APT D
E2	Financial support for smart control of energy in houses and buildings		1	67%	4,0	A	B	C	D
E1	**Financial support for buildings with low energy needs**	0,0	1	33%	4,0	A	B	C	D
MT4	Combined protection and wave energy infrastructures		10	75%	4,0	A	B	C	D
MT5	**Hybrid and full electric ship propulsion**	2,0	11	50%	4,0	A	B	C	D
E5	Biomass power from household waste		11	74%	3,8	A	B	C	D
E13	Energy storage systems		4	90%	3,5	A	B	C	D
E16	Demand Side Management (DSM) of Energy		5	71%	3,5	A	B	C	D
E8	**Heated pools with waste heat from power plants**	0,5	12	29%	3,5	A	B	C	D
E6	**Urban green corridors**	-0,3	11	26%	3,5	A	B	C	D
T11	Local circular economy		3	57%	3,5	A	B	C	D
T21	*Fire management plans*		8	29%	3,5	A	B	C	D
E3	Energy efficiency in urban water management		10	80%	3,3	A	B	C	D
E15	**Seawater Air Conditioning (SWAC)**	-0,3	5	29%	3,3	A	B	C	D
E21	**Study and develop energy grid connections**	0,5	8	29%	3,3	A	B	C	D
E4	**Underground tubes and piping in urban planning**	0,0	10	20%	3,3	A	B	C	D
E14	*Collection and storage of forest fuel loads*		4	10%	3,3	A	B	C	D
MT12	Climate resilient economy and jobs		3	67%	3,3	A	B	C	D
MT3	**Marine life friendly coastal protection structures**	-0,8	10	25%	3,3	A	B	C	D
E11	Small scale production and consumption (prosumers)		3	71%	3,0	A	B	C	D
E7	Educational garden plots		12	71%	3,0	A	B	C	D
E18	**Upgrade evaporative cooling systems**	0,5	6	18%	3,0	A	B	C	D
MT11	**Diversification of trade using climate resilient commodities**	-0,3	3	33%	3,0	A	B	C	D
T30	**Define protection regime for "Maximum Infiltration Zones", within the scope of the current and climate change risks.**	0,3	Local	19%	3,0	A	B	C	D
T27	**Adapt agroforestry systems to drought conditions**	0,3	Local	11%	3,0	A	B	C	D

Figure 102 - Decarbonization performance analysis

Using this analysis, a discussion about the gap and overall use of adaptation options with stronger decarbonization performance was proposed for the Energy and Maritime Transport sectors. The overall use (of stronger decarbonization options) is appropriated, has there are not fond too many gaps in the top 24 measures. These gaps were presented for discussion to the stakeholders in the following list:

(1) Hybrid and full electric ship propulsion (green ship propulsion) (MT5) can be further explored for the decarbonization goal, as costal protection (MT6) was a priority for adaptation pathways (especially in APT B) in the Maritime Transport sector.

(2) Waste to energy from green, organic and sewage wastes (in the form of Biogas) (E5) is an opportunity for decarbonization when comparing with Urban green corridors (E6), although the potential differential is very small.

(3) Fostering Combined Heat and Power (CHP) and Combined Cold Heat and Power (CCHP) (relevant for E2, E5, E8 and E22) can enhance synergies between decarbonization and adaptation.

(4) Evaporative Cooling upgrade (E18) is considered a minor issue by adaptation.

(5) Grid connections (E21) are considered a minor issue by adaptation.

The discussion for both sectors was incorporated in the Sector Adaptation Pathways (Chapter **Error! Reference source not found.**), including option M16[13] which was not present in these discussion points, but for the energy sector the discussion was more detailed as follows.

Regarding issue #3, Combined Heat and Power (CHP)[14] and Combined Cold Heat and Power (CCHP)[15] were considered most advantageous when this energy recovery system is planned and built from the ground up, such as what happens with the construction of new industrial facilities. In the islands there have no major industries with that kind of needs and if these technologies were cost efficient the

[13] Increase operational speed and flexibility in ports, class 5 (Physical capital)
[14] Waste heat from a power unit is recovered to be used in heating needs such as hot water
[15] The waste heat can also be used to produce a cold source displacing electricity consuming technology such as air conditioners or freezers

existing industries would probably have them already. However, the exception may be the dairy industry as they need both heat and cold. Technologies are evolving so in the future this solution can benefit the grid and relieve it of peak power demand.

Regarding issue #4, the evaporative cooling is considered an inappropriate climatization technology considering the island climate. It is not used in the island because the average humidity is around 80% or even larger[16] so the cooling ambient air (for human comfort) this way does not work well[17]. In the summer, namely in June, there is an atmospheric air circulation pattern which brings higher humidity and fogs. When the temperature is at its high the levels of relative humidity are also high which overlaps with periods of greater need (because of the tourism in the summer). The combination of higher temperatures with high humidity increases the thermal stress in humans making the situation even worst.

In the energy sector evaporative cooling technology has been tried for power systems[18]. It was discovered that power plants with evaporative cooling had a substantial need for water especially in the summer months. This need was far too great as water streams are a limited and unreliable resource. There is less available water in the summer when there is the most need for cooling. To improve reliability in cooling, the option was made to use air cooling[19], which also provides a greater flexibility for the power plants location.

Regarding issue #5, grid connections have a lower priority because the Azores Islands are a consolidated set of nine independent energy systems (one per island). Because they cannot rely on each other the grids are considered one by one in a standalone perspective. The island of São Miguel (the biggest and with half the population of the archipelago) is more complex and has several different energy sources, so there is more redundancy. This issue is brought back from time to time (namely when considering Faial and Pico islands which are the closest to one another) and each time it is found that there is little or no return from the economical point of view. Also, considering climate change risks it seems prudent not to rely solely on such a connection for the baseline and backup power needs[20]. This means that with the present technology each island will still need to have its main fossil fuelled power plant or at least keep them on standby, something which then reduces the potential economic benefit.

From this discussion perspective the technological development has the potential to influence the of shaping the adaptation pathways decarbonization performance.

[16] Climate data sheet from the national weather service IPMA confirms that the average annual humidity is around 84% and never decreasing below 82%

[17] Meaning direct (air) evaporative cooling which happens at lower temperatures (around 20˚C) when compared with power and industrial applications

[18] Using closed circuit (evaporative) cooling towers, which are different from direct evaporative cooling and deal with higher temperatures (ranging from 80˚C to 160˚C)

[19] PRAC has identified air cooling to be also vulnerable to climate change

[20] If the one islands power plant is shut down, then it will depend on the other islands power plant using the (underwater cable) grid connection.

5 Discussion and Conclusions

5.1 Covid-19 comments from the stakeholders

A discussion was proposed to the stakeholders regarding the Covid-19 pandemic[21]. A set of questions were made to start the discussion, as follows:

(1) What were the impacts of the pandemic in regard with the choices that were made?

(2) Should an adaptation strategy address the effects of the pandemic?

(3) Which sectors suffered the biggest effects?

(4) What implications can the pandemic have in regard with the process of climate change adaptation?

The several comments resulted in the following points:

a) The pandemic has brought with it an impact in the energy consumption in the islands, mainly because of the tourism sector, changing the amount of energy consumed and its patterns.

b) Lessons can be learned from this event both in economic and environmental fields. The participants considered that the anthropogenic impact on nature became evident across all society.

c) Climate action is different from the pandemic as the first is a man-made phenomenon with much larger time scale in both the problems and the solutions involved, but the pandemic provided a lesson namely in terms of having less available transport. As transports are a major source of emissions so in a climate crisis context this could be critical for the islands.

d) Unexpected economic effects happened because of the dependency of air travel. This is relevant for the region has the dependence from the tourism sector became evident. What will take place with air travel in the climate change context is still not known but this event showed what can happen if air travel suffers a major setback.

e) The maritime transport and mainly air transport the provided less mobility and greater need for local consumption. As most of the products are currently brought from outside the need for the Azores to be less dependent from mainland became evident. This will help face future crisis namely the ones related with climate change.

f) In the far future (30 years or so) the pandemic will be seen as a one-of event that forced the island to think things through, but that at the scale of decades it will eventually become an outlier (if all goes well in dealing with the pandemic). The future tendency for the tourism sector is for it to its former intensity but the lessons learned should be incorporated into climate change policy, although they are different things.

[21] This discussion was optional for the second regional workshops.

5.2 Conclusions

Overall, the process for the definition of alternative adaptation pathways in a decarbonization context while dealing with political uncertainty was successful. It had 18 stakeholders who used the Online Survey Tool and provided their individual choices, with the Energy and the Tourism sectors having more participants, the Maritime Transport less and the Aquaculture only one (not included in the analysis). The feedback was good and fruitful as stakeholders understand most of the major issues of climate change, are interested in making their contribution and are experts of their particular sectors. There is however the potential to increase the number of participants because the region has a history of high engagement, namely in their Regional Program for Climate Change (PRAC). This would increase the reliability of the results and would better embody the needs of the island.

Regionalized and accurate climate projections proved to be beneficial for decision making. At this stage stakeholders in the region have an idea of the most relevant future impacts, thus adaptation action (both autonomous or policy lead) is already under way. However, there is the risk of maladaptation since the choices for adaptation can be led by past and current events but not in the (most accurate) science based future projections.

Future adaptation policies should envision or make room for different solutions regarding different islands of the archipelago. The Azores archipelago is a set of 9 islands having a population of around 120 000 people in the biggest island (São Miguel) and 440 in the smallest one (Corvo). The population size is just one socioeconomical factor that makes the islands different from each other. Regarding risks related with climate hazards like water scarcity, some islands have it more than others (like Terceira and Graciosa) and the interaction with animal husbandry (mainly by free grazing livestock) is important.

The application of the methodology and the use of the materials proved to be straightforward not only because the IFP had designed it (having also the role of task leaders in T7.3), but also because of the stakeholders' interest and skill, who already accumulate experience in the subject.

The majority of the available Adaptation Options were related with the needs of the islands but there were exceptions. For instance, options related with fire risks were not chosen so often as this risk is low (FWI raw value) and will continue to be so until the end of the century in RCP 8.5. Similarly, some options like Upgrade evaporative cooling systems (E18), proved to be improper for the islands context as this technology is not used in current climate conditions (high humidity) and an it has a high-water demand. There is however the chance that (meanwhile) some technologies may have become better adapted to the islands needs and are now suitable for application. This is can be relevant to know in order to increase the sustainability performance of the adaptation pathways.

The different APT that provided different political contexts for alternative adaptation pathways may have had little influence on the choices for the Energy sector. The measures themselves seem to have been more import in the stakeholder choices. This can be observed when classes of adaptation are available under different APTs but the choices are still similar between them. This was not observed in the Maritime Transport and Tourism sectors were the political context was relevant for the decisions made. There was however a sense of urgency expressed in the chosen measures in different time frames for the three analysed sectors.

6 Webinars

6.1 1st Webinar

6.1.1 Objectives

1. The context of the Project: Sectors, Models and Outputs
2. Background material to support your decisions.
3. Present the Online Survey Tool – Design of adaptation pathways for Azores.
   - Adaptation options up to 2030, 2050 and until the end of the century
   - How to fill in and submit the Online Survey Tool

6.1.2 Agenda

Azores Local Working Group Meeting

"ONLINE REGIONAL WORKSHOP"

Designing Adaptation pathways for the Blue Economy sectors

15TH September 2020, 9h45 UTC

Agenda

Address and facilities available: Zoom online meeting Link here!
For registration in the web-workshops and Online Survey Tool: Link here!
Objective: Design Adaptation pathways with stakeholders for blue economy sectors

The webinar and interaction with participants will be performed in Portuguese (all the inputs and materials will be in English).

9h45-10h00	***Reception and Opening***
10h00-10h05	***Introduction to workshop agenda and objectives*** Hugo Costa, FC.ID/FCUL *Agenda and objectives will be presented. Stakeholder participation process in the 1st and 2nd web-workshops and the changes due to Covid-19 contingency will be explained.* (5min) *Objectives for today's meeting:* *1. Present the update climate risks and hazards in Azores Islands* *2. Present the Online Survey Tool – Design of adaptation pathways for Azores* *- Adaptation options up to 2030, 2050 and until the end of the century* *- How to fill in and submit the Online Survey Tool*

10h05-10h15	***SOCLIMPACT´s context*** Marcelo Mautone, Univesidad de las Palmas e Gran Canaria *Brief introduction to the SOCLIMPACT project (Blues economy sectors scope, models involved, major limitations and Regional Exchange Information Platform - REIS). Main expected results of the Project for all Islands.* (10min)
10h15-10h30	***Climate hazards, risks and socio-economic impacts for the Azores Islands*** Hugo Costa, FC.ID/FCUL *The background material that supports the Online Survey Tool for Azores will be presented: climate hazards, risks and socio-economic impacts for Energy, Maritime Transport, Aquaculture and Tourism.* (15min)
10h30-10h40	***Coffee break***
10h40-11h40	***The Online Survey Tool: objectives, concepts and guidance on the design of Adaptation pathways*** Ricardo Coelho, FC.ID/FCUL *Participants will be guided through the use of the Online Survey Tool:* *- Concepts and background* *- Adaptation options up to 2030, 2050 and until the end of the century* *- How to fill in and submit the Online Survey Tool* *- Expected results* *- Discussion and questions from participants*
11h40-12h00	***Reflexions, next steps and wrap-up*** Tiago Capela Lourenço and Andreia Sousa, FC.ID/FCUL

6.3 2nd Webinar

6.3.1 Objectives

- Present the final *Pathways Adaptation* AZORES
- Discuss the *Pathways Adaptation* results
- Discuss about the *Pathways Adaptation* application within Covid-19 context

6.3.2 Agenda

Azores Local Working Group Meeting #2

"ONLINE REGIONAL WORKSHOP"

Designing Adaptation pathways for the Blue Economy sectors #2

13TH October 2020, 9h45 UTC +0

Agenda

Address and facilities available: Zoom online meeting Link here!
Objective: Design Adaptation pathways with stakeholders for blue economy sectors

The webinar and interaction with participants will be performed in Portuguese (all the inputs and materials will be in English).

9h45-10h00	***Reception and Opening***
10h00-10h05	***Introduction to workshop agenda and objectives*** Hugo Costa, FC.ID/FCUL *Agenda and objectives will be presented. Stakeholder Objectives for today's meeting:*
10h05-10h30	***Online Survey Tool Results*** Ricardo Coelho, FC.ID/FCUL - Most voted options - Final Adaptation pathway for the Island - Radar graphics with pathways evaluation (based on options evaluation) - Discuss results
10h30-10h40	***Coffee break***

10h40-11h40	***Covid-19 sector discussion strategic options related with climate change policy*** Tiago Capela Lourenço, FC.ID/FCUL *Participants*

6.4 List of participants

Name	Organization
Ana Goulart	Direção Regional do Ambiente
David Estrela	EDA/ EDA renováveis
Diamantino Henriques	Instituto Português do Mar e da Atmosfera - Delegação dos Açores
Fernanda Carvalho	Instituto Português do Mar e da Atmosfera - Delegação dos Açores
Joana Soares	Aircentre
José Azevedo	Uaç-University of Azores, CE3C
Jose Luiz Moutinho	Aircentre
José Fortuna Pereira	Direção Regional do Turismo
Laura Gonzalez	Futurismo
Lorenzo Fiori	Terra Azul Whale Watching
Luísa Couteiro	Inspeção Regional do Turismo
Maria Meirelles	Universidade dos Açores
Mário Fortuna	Diretor do Departamento de Economia e Gestão da Universidade dos Açores
Nuno Mota	Secretaria Regional dos Transportes e Obras Públicas, Direção Regional dos Transportes
Patricia Navarro	Instituto Português do Mar e da Atmosfera - Delegação dos Açores
Pedro Leite	Direção Regional da Energia - DREn
Rui Rodrigues	Futurismo
Susana Brasil	Direção Regional do Turismo

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8 Annexes - Azores

8.1 Adaptation Options Evaluation

8.1.1 Tourism

Table 6 – Adaptation option characterization for Tourism sector

Options Characterization				Criteria				
ID	Name	Description	Class of adaptation	Cost Efficiency	Environmental protection	Mitigation (GHG emissions) win-wins and trade-offs	Technical applicability	Social Acceptability
T1	**Economic Policy Instruments (EPIs)**	Economic Policy Instruments (EPIs) are incentives designed and implemented with the purpose of adapting individual decisions to collectively agreed goals. Different type of instruments can be applied, like pricing (e.g. water tariffs), environmental taxes and charges, subsidies; trading (e.g. tradable permit for pollution or water abstraction, compensation mechanisms, payments for environmental services); and voluntary agreements and risk management schemes such as insurances.	1. Financial capital	3	3	2	4	3
T2	**Financial incentives to retreat from high-risk areas**	Financial incentives to retreat from high-risk areas refers to the creation of financial incentives to retreat or relocate settlements, infrastructure and productive activities from the original location due to their high exposure to risks such as flood, sea-level rise and storm surges.	1. Financial capital	2	3	2	3	2
T3	**Adaptation of groundwater management**	Adaptation of groundwater management can be used to (1) conserve groundwater reservoirs, limiting water use and optimizing water reuse, and (2) restore or increase natural infiltration capacity. Both contribute to adaptation in circumstances of reduced precipitation and sea saltwater intrusion aggravated with groundwater over-exploitation. Different packages of interventions usually include freshwater injection, modifying pumping practice, delayed inflow, artificial recharge or efficient use of freshwater.	10. Provisioning services	3	3	3	2	3
T4	**Monitoring, modelling and forecasting systems**	Monitoring, modelling and forecasting systems are information system that provide timely and reliable climate information, as well as up-to-date data on the occurrence and severity of extreme events, possible impacts and their duration. Different systems can be implemented to respond to different climate hazards, such as drought-related, water quality monitoring, water resources management and predicting and managing flood risks.	10. Provisioning services	3	2	2	3	4
T5	**Dune restoration and rehabilitation**	Coastal (e.g. dune) restoration and rehabilitation refers to the strengthening of the flood safety and sand reservoir functions of dunes and other coastal structures. Erosion happens as a result of wind action, marine erosion, human activities and Sea Level Rise (SLR). Possible technics examples include grass planting, thatching and fencing.	11. Regulating and Maintenance Services	3	4	2	3	4

T6	**River rehabilitation and restoration**	River and valley rehabilitation and restoration are measures that emphasise the natural functions of rivers/valleys and create vegetated buffer zones alongside watercourses. This contributes to the improvement of micro-climatic conditions, reduces run-off and erosion, and increases groundwater recharge. For Tourism, this option also increases available leisure areas, increases thermal comfort areas and the availability of water.	11. Regulating and Maintenance Services	3	4	3	3	3
T7	**Adaptive management of natural habitats**	Adaptive management of natural habitats refers to the preservation of ecosystem services which are essential for human well-being. Human activities induce pressure and impacts on biodiversity and ecosystems that tend to be aggravated by climate change. Adaptive management measures include understanding species response; make space for the development of rivers and coasts; aid gene flow; species translocation; targets and conservation mechanisms/plans.	12. Cultural services	3	4	3	3	3
T8	**Ocean pools**	Ocean pools are seawater pools located by the sea where waves can wash into the pool. The width, length and depth of ocean pools varies and often depends on their location on the coastline. These recreational structures are useful on SLR context, doubling as an additional protection of the coast and creating alternatives to beach leisure areas.	12. Cultural services	4	3	2	4	4
T9	**Activity and product diversification**	Activity and product diversification include actions to diversify the tourism activities and products and aim to reduce seasonality and overload in infrastructures and ecosystems. Shifting the dependency from 'sun, sea and sand' products to alternative leisure activities can reduce the impacts of heat waves, coastal erosion or ecosystem degradation, and thus help to maintain destination attractiveness.	2. Human capital	3	4	2	3	3
T10	**Public awareness programmes**	Public awareness programmes establish targeted programmes that raise awareness about climate change (specific values and protection needs) among guides, site managers and local communities.	2. Human capital	3	3	2	4	4
T11	**Local circular economy**	Local circular economy is an economic system aimed at eliminating waste and the continual use of resources that offers a valuable framework for reduced carbon emissions from materials (decarbonization) and increased resilience to climate change and its impacts.	3. Social capital	3	4	4	2	3
T12	**Tourist awareness campaigns**	Tourist awareness campaigns target behavioural change of visitors and aim to increase tourists (individuals and organisations) knowledge about climate change and the risk faced by tourism destinations. These campaigns can be targeted to regions affected by a particular climate threat, specific groups of visitors or the general tourism sector as a whole.	3. Social capital	3	3	2	4	4
T13	**Local sustainable fishing**	Local sustainable fishing refers to the promotion of fishing zones/rights for local small-scale fishers maintaining stocks and using sustainable methods. This option aims to add value to local resources and products, protect ecosystems services and decrease external dependency.	4. Natural capital	3	4	2	3	3
T14	**Water restrictions, consumption cuts and grey-water recycling**	Restrictions can be applied to allow water administration services to cope with water crises. Restriction (or rationing) of certain uses of water such as irrigation of lawns, car washing, filling swimming pools or hosing down pavement areas may be necessary during these times. Grey-water recycling (or reclamation) is the reuse of non-drinkable water (usually treated wastewater) to cover water use needs that don't demand such a high-quality standard.	4. Natural capital	3	3	3	3	2
T15	**Beach nourishment**	Beach nourishment (or replenishment) is the artificial placement of sand to compensate for erosion. Beach nourishment also often aims at maintaining beach width (for tourism and recreational purposes). Several beach nourishment techniques can be used including beach, backshore and shoreface nourishment, and large-scale coastal nourishment (e.g. using sand motors).	5. Physical capital	2	2	2	3	4

T16	**Desalination**	Desalination is the process of removing salt from sea or brackish water to make it useable for a range of purposes including drinking and can contribute to adaptation in circumstances of current or future water scarcity problems. Technological examples include electrically driven technologies, like reverse osmosis, and thermally driven technologies, based mainly on vapor distillation processes.	5. Physical capital	2	2	1	3	3
T17	**Coastal protection structures**	Coastal protection structures such as groynes, breakwaters, artificial reefs and seawalls are different types of artificial structures, built in the shoreline (or rivers), which are designed to protect the coast from SLR or storms. Those structures can be used to, for example, drift and trap sediments, protect from erosion, absorb wave energy, or allow navigation.	6. Managing long term risk	3	2	2	3	4
T18	**Drought and water conservation plans**	Drought and water conservation plans refer to tourism-lead adaptation and/or involvement in drought management plans with the aim to reduce the economic, social, and environmental consequences of drought and water scarcity, and to reduce the loss of water and improve efficiency in the sector.	6. Managing long term risk	4	3	2	4	4
T19	**Mainstreaming Disaster Risk Management (DRM)**	Mainstreaming Disaster Risk Management (DRM) aims to plan and organize DRM along five stages including prevention, protection, preparedness, and response, recovery and review. Examples include interventions to limit urban development in flood prone areas; identify natural hazard prone areas; develop strategies, arrangements, and procedures to address crises; and post-emergency recovery activities.	7. Preparedness	3	2	2	3	4
T20	**Using water to cope with heat waves**	Water use to cope with heat waves in cities are a set of investments in water supply services and infrastructures that aim to increase urban resilience regarding heat waves. Different packages of grey interventions are usually applied, as for example: creating and/or repairing fountains for drinking water and cooling; water spray fountains; and wetting streets.	7. Preparedness	3	2	2	3	3
T21	**Fire management plans**	Fire management plans are management actions have wide range of application such as early warning detection, with escape routes and advice to local citizens and tourists, mobilization and suppression of unwanted and damaging fires, or use of fire to manage fuel. Additionally, these plans help to increase the understanding of the interactions of climate change with vegetation cover and fire regimes.	8. Response	3	3	4	3	3
T22	**Health care delivery systems**	Health care delivery systems are pre-emptive actions and adjustments that need to be made to health care systems, namely reinforcing less prepared aspects of its operation and/or logistics, in order to guarantee effectiveness and efficiency during, for example, high temperature and heat-wave situations. .	8. Response	3	2	2	4	4
T23	**Post-Disaster recovery funds**	Post-Disaster recovery funds is the creation of recovery funds for the Tourism sector to recover after disasters, through initiatives that get the economy up and running quickly while building-back-better (e.g. rebuild damaged critical infrastructures such as ports and roads or recover the landscape from fires). The aim is to minimize the economic and social impacts (which may include future loss of the touristic destination attractiveness) that can occur in a post-disaster context.	9. Post disaster recovery and rehabilitation	3	2	2	3	3

T24	**Pre-disaster early recovery planning**	Pre-disaster early recovery planning processes include the development of knowledge, good practices and objectives that aim to improve the living conditions of the affected communities, while facilitating the adjustments necessary to reduce the risk of future disasters. Examples of good practices are may include identifying critical ecosystems (goods and services) that require immediate restoration after a disaster or particularly vulnerable communities.	9. Post disaster recovery and rehabilitation	3	3	2	3	3
T25	**Adapt tourism promotion to Climate Change risks**	Adapt the promotion of tourism to Climate Change aims to maximize opportunities for tourism development. The need to adjust the promotional offer to climatic scenarios, namely at the level of the forest landscape mosaic and nautical tourism. Biodiversity conservation could be boosted together with the forestry sector to maximize the positive impacts on water regularization, carbon capture and thermal comfort.	Local knowledge	3	3	3	4	3
T26	**Improve Natura 2000 habitats - terrestrial, coastal and marine habitats.**	Create new protected areas or ecological corridors and restore/ protect habitats considering the Climate Change risk.	Local knowledge	3	4	3	3	3
T27	**Adapt agroforestry systems to drought conditions**	Increase and improve the water supply systems to farms, considering the installation of water meters and the application of fees / tariffs. This option links up the agroforestry (landscape mosaic and products) with the tourism attractiveness.	Local knowledge	3	4	3	3	2
T28	**Create water storage reservoirs to ensure water availability without overloading natural resources in times of scarcity.**	Frequency and intensity of periods of water scarcity may occur more often. Maximizing water storage capacity without increasing pressure on resources will allow greater resilience in times of scarcity without affecting water resources	Local knowledge	3	2	2	3	4
T29	**Create a mosquito detection information system**	The mosquito detection information system (a public access portal where the presence of mosquitoes is reported) is a surveillance and detection process to raise awareness on vector-borne diseases, involving the local community.	Local knowledge	3	2	2	3	4
T30	**Define protection regime for "Maximum Infiltration Zones", within the scope of the current and climate change risks.**	Define protection regime for "Maximum Infiltration Zones", within the scope of the current and climate change risks. It is intended to adapt the regime of uses and activities to be applied to strategic areas of protection and recharge of aquifers.	Local knowledge	3	3	3	3	3

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8.1.2 Maritime Transport

Table 7 – Adaptation option characterization for Maritime Transport sector

Options Characterization				Criteria				
ID	Name	Description	Class of adaptation	Cost Efficiency	Environmental protection	Mitigation (GHG emissions) win-wins and trade-offs	Technical applicability	Social Acceptability
MT1	**Insurance mechanisms for ports**	Insurance mechanisms for ports include risk-sharing schemes that aim to assist port operators in responding to the climate risks they are enabled to reduce. Insurance outsources the risks to a third party in exchange for a regular financial compensation.	1. Financial capital	3	2	2	4	4
MT2	**Financial incentives to retreat from high-risk areas**	Financial incentives to retreat from high-risk areas refers to the creation of financial incentives to retreat or relocate settlements, infrastructure and productive activities from the original location due to their high exposure to risks such as flood, sea-level rise and storm surges.	1. Financial capital	2	3	2	3	2
MT3	**Marine life friendly coastal protection structures**	Marine life friendly coastal protection structures are coastal protection structures constructed with materials that maximize the fixation of marine organisms. This option reduces climate change impacts on local ecosystems, provides water waste depuration (made by marine organisms) and water quality bio-indicators inside the ports.	10. Provisioning services	3	4	3	2	4
MT4	**Combined protection and wave energy infrastructures**	Combined protection and wave energy infrastructures are an energy measure that combines sea protection structures with wave energy production. This can create economies of scale, increase coastal protection and further decrease wave propagation inside the port during normal operations.	10. Provisioning services	3	3	4	2	3
MT5	**Hybrid and full electric ship propulsion**	Hybrid and full electric ship propulsion are environmentally friendly for marine life, decreases carbon emissions and can increase ship manoeuvrability which is useful in small ports and under difficult weather conditions. Low speed manoeuvring with conventional engines creates air and water pollution, noise and fuel consumption. Electrically driven propulsion can address these issues while increasing manoeuvrability using for instance azimuth thrusters.	11. Regulating and Maintenance Services	3	4	4	2	4
MT6	**Coastal protection structures**	Coastal protection structures such as groynes, breakwaters, artificial reefs and seawalls are different types of artificial structures, built in the shoreline (or rivers), which are designed to protect the coast from SLR or storms. Those structures can be used to, for example, drift and trap sediments, protect from erosion, absorb wave energy, or allow navigation.	11. Regulating and Maintenance Services	3	2	2	4	4

MT7	**Integrate ports in urban tissue**	Integrate ports into the urban tissue opening port areas to other activities, namely cultural, while gaining room in the urban landscape. This allows some port activities to be pooled from low-laying areas while leisure and cultural activities can access more waterfront space.	12. Cultural services	3	2	2	2	3
MT8	**Ocean pools**	Ocean pools are situated by the sea where waves can wash into the pool. The width, length and depth of ocean pools varies and often depends on their location on the coastline. These recreational structures are a response to SLR, protect the coast and create alternatives to beach leisure areas.	12. Cultural services	4	3	2	3	4
MT9	**Awareness campaigns for behavioural change**	Awareness campaigns for behavioural change aim to increase individuals and organisations' knowledge about climate change and the risk faced by the maritime transport sector. These campaigns can be targeted to regions affected by a particular climate threat, specific groups of infrastructures or the general transport sector as a whole.	2. Human capital	3	3	2	4	4
MT10	**Social dialogue for training in the port sector**	Social dialogue for training in the port sector refers to social and educational issues related with the gender equality and attracting the young to the sector, while tackling climate change. It relies on social dialogue between workers and employees to define common guidelines for training. It considers key challenges that ports are facing and how the industry is adapting to change and preparing for the future.	2. Human capital	3	2	2	3	3
MT11	**Diversification of trade using climate resilient commodities**	Diversification of trade using climate resilient commodities aims to reduce dependency on trade of perishable goods and critical services, create larger stocks of goods that are climate resilient and consider were changing trading systems to endure changes in climate is economically feasible, strategically justifiable and equitable.	3. Social capital	3	2	3	2	3
MT12	**Climate resilient economy and jobs**	Climate resilient economy and jobs aims to shift the economy and jobs towards a more climate resilient society. Perishable goods and some critical services rely heavily on the marine transport which can be affected by unpredictable extreme weather events. To address this the economy needs to adapt by shifting to products and services that depend less on Just In Time (JIT) operations, using for instance larger stocks.	3. Social capital	3	3	3	2	3
MT13	**Refrigeration, cooling and ventilation systems**	Improve the efficiency of refrigeration, cooling and ventilation systems in order to reduce costs in warmer weather and maintain operations during heat waves. Human thermal comfort provided by efficient ventilation and cooling is relevant to ensure the health and safety of passengers and port workers. Refrigeration is relevant for managing goods that need low temperatures.	4. Natural capital	3	2	2	3	4
MT14	**Restrict development and settlement in low-lying areas**	Restrict development and settlement in low-lying areas means to assure that ports are not further developed in low-laying areas exposed to SLR. Planning must consider the long-term potential risks.	4. Natural capital	3	3	2	3	2
MT15	**Sturdiness improvement of vessels**	Improve the strength of vessels to sea storms while decreasing the noise and increasing efficiency. Wave-induced loads on the ship structures are a major concern in hull design process. Ship owners should prefer designs that allow for more demanding wave regimes (for instance including the survivability to rouge waves).	5. Physical capital	3	2	3	2	4
MT16	**Increase operational speed and flexibility in ports**	Increase operational speed and flexibility in ports aims to increase the attractiveness of ship transport in order to capture more freight and passenger movement. This can promote a modal shift towards shipping and create new opportunities including those related with exports and tourism. Faster operations also reduce the effects of heat waves on goods and people as well as decarbonise the economy.	5. Physical capital	3	2	3	2	3

MT17	**Climate proof ports and port activities**	Climate-proof ports and port activities refers to investments that consider specific climate change projections to manage future risks in port infrastructures and improve operational safety conditions. These can include retrofitting or reconfiguring breakwaters and other port structures to avoid overtops and flooding due to storm surges, heavy precipitation, extreme heat, strong winds events and extreme swell conditions. The Copernicus Emergency Management Services (EMS) services can provide regarding climate change and disaster risk reduction.	6. Managing long term risk	3	2	2	3	4
MT18	**Consider expansion/retreat of ports in urban planning**	Consider expansion/retreat of ports in urban planning means to consider the expansion or reallocation of areas for future maritime transport infrastructures due to climate change risks. The urban planning and expansion should consider the potential requirements for port expansion/retreat options.	6. Managing long term risk	3	2	2	3	3
MT19	**Reinforcement of inspection, repair and maintenance of infrastructures**	A continuous reinforcement of inspection, repair and maintenance of infrastructures aims to adapt monitoring to a new climate context. Changes in the frequency and/or intensity of storms, SLR or temperature, for example, may have impacts in infrastructure, increasing degradation of the materials and requiring new maintenance plans.	7. Preparedness	3	2	2	3	4
MT20	**Early Warning Systems (EWS) and climate change monitoring**	Early Warning Systems (EWS) is an information system with several components that assesses climate risks and relays that information to decision makers, companies' utilities and the general public in real time. Transport operators should integrate this tool in procedures in order to protect the safety of people and goods. The collected data can also be used to study the evolution of climate impacts as time progresses, for instance the impact of heat waves and storms in operations.	7. Preparedness	3	3	2	3	4
MT21	**Intelligent Transport Systems (ITS)**	Intelligent Transport Systems (ITS) are technologies that relay automated and tailored data and safety-related messages to ships, regarding climate hazards and other relevant information. ITS use communication and information standards that are uniform and widely accepted by other ports that the island is linked to.	8. Response	3	3	3	3	3
MT22	**Prepare for service delays or cancellations**	Prepare for service delays or cancellations aims to promote the creation of new procedures, alternative options and channels to sell goods and transport passengers, as well as better communication to deal with delays or cancellations. Dealing with more frequency and/or intensity of storms (which will happen in some regions) improves port reputation and customer preferences.	8. Response	3	2	2	3	3
MT23	**Backup routes and infrastructures during extreme weather**	Backup routes and infrastructures during extreme weather aims to creates a post disaster response that ensures available alternatives when the main ports are damaged or inaccessible due to extreme weather events. It considers alternative ports and access roads. Alternative ports can be smaller in size, simpler and be used for other purposes, but should have a different location and orientation from the main ones.	9. Post disaster recovery and rehabilitation	3	2	2	3	4
MT24	**Post-Disaster recovery funds**	Post-Disaster recovery funds is the creation of recovery funds for the maritime transport sector to recover after disasters, through initiatives that get the economy up and running quickly while building-back-better (e.g. rebuild damaged critical infrastructures such as ports and roads). The aim is to minimize the economic and social impacts that can occur in a post-disaster context.	9. Post disaster recovery and rehabilitation	3	2	2	3	3
MT25	**Strengthen coastal protection, giving priority to the maintenance and adaptation of**	The climate scenarios point to an increased probability of occurrence of extreme weather events in the RAA. As part of the POOC review, the adequacy of the protection response must be assessed and the degree of resistance of the existing works evaluated, establishing an adequate schedule of needs in terms of maintenance, adaptation or construction of new works.	Local knowledge	3	2	2	3	3

	urban areas and port infrastructures							
MT26	**Evaluate and plan retreat of buildings /infrastructures from risk areas, through cost-benefit analysis**	Buildings or infrastructures in risk areas relocation in cases of greater sensitivity and vulnerability. Developed within the appropriate territorial management instruments. Cost-benefit analysis should be performed to manage the relocation actions.	Local knowledge	**3**	**3**	**2**	**3**	**2**
MT27	**Strengthen coastal monitoring**	Monitoring the occurrence of coastline phenomena such as erosion, overflow / flood, and instability of the cliffs, which generate risk situations for people and property. It is therefore essential to ensure greater monitoring of coastal risks, considering the scenarios of Climate Change for medium- and long-term time horizons. Including monitoring and systematic analysis of sedimentary dynamics, coastline evolution and coastal protection performance on going.	Local knowledge	**3**	**3**	**2**	**3**	**4**

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8.1.3 Energy

Table 8 – Adaptation option characterization for Energy sector

Options Characterization				Criteria				
ID	**Name**	**Description**	**Class of adaptation**	**Cost Efficiency**	**Environmental protection**	**Mitigation (GHG emissions) win-wins and trade-offs**	**Technical applicability**	**Social Acceptability**
E1	**Financial support for buildings with low energy needs**	Financial schemes in the form of loans, subsidies or tax reliefs are ways to support the reduction of energy needs of new or existing buildings, making them address climate change in a more efficient manner. For example, architecture and construction materials that rely on passive thermal comfort reduce the use of energy for human comfort, so less air-conditioning is necessary in the cooling season.	1. Financial capital	3	2	4	3	3
E2	**Financial support for smart control of energy in houses and buildings**	The support of smart control of energy in houses and buildings allows for an efficient and automated use of energy that enables savings and creates synergies with utilities. For example, such a system could coordinate the automated opening vents with the air conditioning operation, avoiding energy consumption when possible. This will allow for the adaptation of buildings at a controlled cost, while complying with mitigation goals.	1. Financial capital	3	2	4	3	4
E3	**Energy efficiency in urban water management**	Energy efficiency in urban water management is the adaptation of urban design and construction for water conservation that avoids energy use under scarcity scenarios. For instance, Water Sensitive Urban Design (WSUD) aims to plan water conservation and storm water storage with integration with elements of urban design. This both to minimises hydrological impacts on the environment and the associated energy use of water supply.	10. Provisioning services	4	3	3	3	4
E4	**Underground tubes and piping in urban planning**	Underground tubes and piping are used for space heating/cooling across the globe and are more resilient to climate change. These systems can be Earth Air Heat Exchanger (EAHE) and Ground Source Heat Pump (GSHP) types. Both systems use tubes or pipes that usually need to be buried beyond the footprint of the building or house. The measure considers this need, and both allows and encourages the use of such space in urban planning.	10. Provisioning services	3	2	3	2	3
E5	**Biomass power from household waste**	Biomass power plants burn household waste, waste from parks and public gardens and sludge generated by sewage treatment plants. Towns and cities can also realise urban production and recreational woods, which can be used for producing biomass for co-generation (Combine Heat and Power) as well as tri-generation (Combined Cold Heat and Power) plants.	11. Regulating and Maintenance Services	3	2	4	3	3
E6	**Urban green corridors**	Urban green areas decrease the air temperature in a city and thus decrease energy needs. Warm air tends to transport pollution and particulate matter to higher layers of atmosphere, causing a cloud of smog. Creating green corridors also promotes biodiversity, increases the touristic value and decreases water run-off during storms.	11. Regulating and Maintenance Services	3	4	4	3	4
E7	**Educational garden plots**	Educational garden plots are sites where people, especially children, can garden with volunteers one afternoon a week after school. The harvest can be taken home. This creates well-being while having local fresh produce reduces the energy consumption and pollution. These garden plots can be further exploring to educate people about other climate action measures, directly and indirectly related with energy such as waste to energy, composting, water retention and green corridors.	12. Cultural services	3	4	3	3	4

E8	**Heated pools with waste heat from power plants**	Power plants need cooling and their waste heat can be used in swimming pools for public use and tourism. This creates an attractive leisure activity in off-peak winter times which diversifies the touristic offer and promote community well-being. This type of heat recovery design is called Combined Heat and Power (CHP). Pools provide a heat sink for the power plants which increases efficiency and is useful during heat waves.	12. Cultural services	3	2	4	3	3
E9	**Green jobs and businesses**	The promotion of green jobs and businesses consists in training people and supporting green businesses to implement energy solutions across the economy, both in mitigation and adaptation. One example can be the support of research projects to help businesses deal with new technologies relevant to climate action.	2. Human capital	3	3	3	3	3
E10	**Public information service on climate action**	Public information service on climate action aims to provide the general public with information about adaptation and mitigation options available for their activities and businesses. This includes information dissemination and counselling about available solutions and the public support. This type of information is relevant, for example, to support dwellings, hotels or commerce to adapt to climate change.	2. Human capital	3	2	3	4	4
E11	**Small scale production and consumption (prosumers)**	Small scale production and consumption (prosumers) aims to promote cooperation by creating economies of scale both in the production and consumption of energy. This allows for a greater use of local renewable resources and waste energy recovery which allow for a better resilience when dealing with climate change events such as heat waves.	3. Social capital	3	3	3	3	4
E12	**Risk reporting platform**	Risk reporting platform intends to promote the communication between the general public and the administration bodies concerning the risks related with climate change. It is a platform were the general public reports directly the risks as they become aware of. These can be for example related with cliff instability, trees falling over energy lines, uncleared bushes that can be ignited by power lines or unstable structures that may fall due to strong winds.	3. Social capital	3	2	2	3	4
E13	**Energy storage systems**	The development of energy storage systems can provide an alternative when the main power sources fail and need time to recover. This allows for a more resilient energy grid while enabling decarbonization and peak levelling at a controlled cost. This includes not only electric batteries (like those in cars and buses), but also other forms of energy storage such as thermal tanks (heat), ice banks (cold) or water height (reversed pumping).	4. Natural capital	3	2	4	3	4
E14	**Collection and storage of forest fuel loads**	Collection and storage of forest fuel loads intend to promote and regulate the collection and storage of wood and combustible material to reduce wildfire hazard. Actions may include clearing of small trees out of dense areas, reduce the amount of fuel on the ground and increasing the spacing between trees. Materials collected can be used in energy to waste applications such as pellets, biogas or other energy solutions.	4. Natural capital	2	2	3	3	3
E15	**Seawater Air Conditioning (SWAC)**	The Seawater Air Conditioning (SWAC) measure is an alternate-energy system design that uses cold water from the deep ocean to provide more efficient, decarbonized and reliable cooling. The sweater is piped to heat exchangers for process cooling or to provide condensation water in air conditioning systems. It replaces air cooling units or fresh water evaporative cooling towers which performances degrades in heat waves. Other subsequent or parallel seawater uses can be combined, like for swimming pools or desalinisation.	5. Physical capital	3	2	3	2	3
E16	**Demand Side Management (DSM) of Energy**	Demand Side Management (DSM) of energy is an operational strategy that better coordinates producers and consumers of energy. More renewable energy (like solar and wind) use is possible while ensuring the energy service reliability and controlled costs. DMS balances off-peak and peak demand using peek shaving, which is important, for example, during heat waves.	5. Physical capital	3	2	4	2	3
E17	**Review building codes of the energy infrastructure**	Review energy infrastructure building codes aims to climate-proof the energy system by reviewing regulatory codes and infrastructures considering the spatial distribution of climate risks. This should include establishment of new procedures, maintenance practices, operational changes, retrofitting and the use of climate and mapping services such as those produced by the Copernicus Emergency Management Service (EMS).	6. Managing long term risk	4	2	3	3	4

E18	**Upgrade evaporative cooling systems**	Upgrade of evaporative cooling systems that rely on a given range of air temperature and water availability is necessary given that this type of cooling systems is a technology that can be affected by climate change and become compromised due to heat waves and water scarcity.	6. Managing long term risk	3	2	3	3	3
E19	**Early Warning Systems (EWS)**	Early Warning Systems (EWS) is an information system that assesses climate risks and provides real time information to decision makers, companies, utilities and the general public. Climate data used to control and monitor the energy infrastructure can be relayed to the EWS. Using this data to monitor the evolution of climate related impacts in the energy sector increases the knowledge necessary to make long term climate adaptation decisions.	7. Preparedness	4	2	3	4	4
E20	**Grid reliability**	Grid reliability improvement aims to find and upgrade critical components and to enhance the energy system resilience to climate risks. This may include redundant circuitry or components that provide alternative dispatch of energy, equipment upgrades (e.g. better cooling to cope with heat waves) or power downrating (e.g. decrease power output of energy transformers so that they do not overheat during heat waves).	7. Preparedness	3	2	3	3	4
E21	**Study and develop energy grid connections**	Energy grid connections aims to develop interconnections between islands and/or with the mainland allowing for the creation of economies of scale, energy system reliability improvements and more Renewable Energy Sources (RES) penetration.	8. Response	2	2	3	3	3
E22	**Energy-independent facilities (generators)**	Energy-independent facilities (generators) make it possible for buildings to temporarily create their own energy supply. In case of an energy supply failure (power outage), essential amenities remain functional and can be optimized with Combined Heat and Power (CHP) designs and other decentralised energy generation solutions.	8. Response	3	2	3	3	3
E23	**Energy recovery microgrids**	Energy recovery microgrids are operational elements of the energy grids that rely on distributed generation to restore systems from power outages and to stabilize the grid. This allows for a flexible and swifter recovery from power outages caused by knock-out events (e.g. tree falls on energy lines), excess demand (e.g. during heat waves) or other causes.	9. Post disaster recovery and rehabilitation	2	2	3	2	3
E24	**Local recovery energy outage capacity**	Local recovery energy outage capacity consists in increasing and improving the ability of the islands to recover from energy outages caused by or worsen by climate extreme events, like severe sea or windstorms that can lead to island isolation and exacerbate logistical hurdles. To facilitate a swift recovery, it's useful to have more mobile backup power, power line replacements and other grid components, logistics, supplies and personnel.	9. Post disaster recovery and rehabilitation	3	2	3	3	4
E25	**Develop risk maps for the electrical infrastructure**	Develop maps to better protect and identify climate risks in the infrastructure (production, transport, and distribution centres) and plan expansion or changes in the infrastructure.	Local knowledge	3	2	3	3	4
E26	**Assess and map impacts caused in quality and power reserves through changes in climate patterns**	Evaluate and map FER production and the impacts associated with unfavourable climatic patterns to production. It can be also used to identify additional effort or actions to regulate quality and power in the present and for the future.	Local knowledge	3	2	3	3	3

SOCLIMPACT

This project has received funding from the European Union's Horizon 2020 research and innovation programme under Grant Agreement No776661

SOCLIMPACT

Downscaling climate impacts and decarbonisation pathways in EU islands, and enhancing socioeconomic and non-market evaluation of Climate Change for Europe, for 2050 and beyond

SoClimPact project has received funding from the European Union's Horizon 2020 Research and Innovation Programme under Grant Agreement No 77661

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Work Package 7:

This is a result of Tasks 7.3. This deliverable will include the agendas, the list of participants, and the workshops outputs including the decisions taken.

Deliverable 7.3.

Workshop Report – Balearic Islands

Island Focal Point coordinated by ULPGC

Matías Manuel Gonzalez Hernandez, Yen Elizabeth Lam, Ainhoa Bilbao Altés

Final version - 29/12/2020

1 Introduction

This document presents the results of the stakeholders' consultation process to design the **SOCLIMPACT Adaptation Pathways Workshops in the Balearic Islands region**. This process is included in SOCLIMPACT Task 7.3 - Engage islands' stakeholders in the design of alternative pathways. According to the project Description of Action is expected that these online workshops use the background material prepared in Task 7.2/D7.2 and include the main results from previous WPs.

In the consultation process, the following objectives are expected to be covered:

4. **Identify and present the characterized packages of adaptation and risk management options** available for each archipelago/island.
5. **Develop detailed archipelago/island integrated adaptation pathways**, in three timeframes: Short term (up to 2030), Mid-century (up to 2050) and End-century (up to 2100).
6. **Evaluate** and rank pathways for Blue Economy sectors.

The consultation process of the Balearic Islands was identical to the Canary Islands process. Instead of holding a webinar and collecting the different opinions by means of a questionnaire, the personal interview approach was considered to be the most appropriate to obtain the views of the most representative stakeholders for three sectors of the blue economy (Aquaculture was excluded from this region due to the negligible presence this sector has in the archipelago). In addition, this approach made it possible to understand the reasoning behind each choice and, at the same time, to clarify any doubts or misinterpretations that the questions may have caused during the exercise, in order to better qualify the information collected.

The original plan was to conduct the interviews in person, but due to the Covid-19 restrictions, the interviews had to be carried out online. The interviews were held between 1st October 2020 and 9th December 2020, where experts from the four sectors of the blue economy were involved. The interviews were performed taking into consideration the specific requirements of the region and the resources available. For the Balearic Islands the process was similar to the one in the Canary Islands but based in a lesser number of stakeholders.

Prior to the interviews, several webinars were held with the aim of informing about the impacts of climate change in both Spanish archipelagos (Canary and Balearic Islands). The first one was the launch webinar, which took place on July 21st, 2020, where the impacts of climate change and how to deal with these risks were presented. The second, was a series of three more specific webinars focusing on different aspects of the energy sector, which took place between 21st and 25th September 2020. In the first webinar, the challenge of involving the most representative stakeholders through a webinar was observed.

In parallel to the interviews, the Slack platform was developed to encourage wider participation of relevant stakeholders, not just the key informants. Where different channels of conversation were

created to discuss the different impacts that each of the four sectors may suffer. However, despite the effort, the expected success in terms of stakeholder participation was not achieved.

The 24 options/measures available per sector were characterized by the IFP using the five criteria defined. In addition, up to six additional adaptation options per island and per sector were added by the LWG (class of adaptation "Local Knowledge"). The "Local Knowledge" options for the Balearic Islands were developed considering the opinion of experts in each sector.

The report follows what was defined in the proposal by presenting the online interview materials, namely: (1) decisions taken; (2) agendas and (3) list of participants.

The **Adaptation Pathways methodology applied in SOCPLIMPACT was based in the framework developed by Suckall et al.2018 and considered the three main strategic vectors for climate resilience: (1) vulnerability reduction -** Five capitals of Sustainable Livelihoods Approach (SLA)**; (2) Disaster Risk Reduction –** developed throughout Hyogo and Sendai Frameworks; **(3) Social-Ecological Resilience** – that emerge from the Millennium Ecosystem Assessment (MEA) and Common International Classification of Ecosystem Services (CICES).

The **Adaptation Pathways** aim to capture the policy preferences in time and the relevancy of the context traduced in investment and commitment (Suckall et al., 2018). These Adaptation Pathways Trajectories (APT) (Table 1) were delineated as a set of adaptation classes each one with two options/measures to choose from. Each individual stakeholder choices contribute to create a policy pathway together with the other choices made by different stakeholders. If most of the stakeholders chose one option, then that measure was incorporated in the island adaptation pathway for that specific class in each APT, per sector. The result of the series of choices in the three timeframes defines the pathway. If there is a tie between two options, then they will both be included and become part of the adaptation pathway in each time frame. The options were included in the pathway when they were selected more than 50% in each time frame in each APT. Local Knowledge measures were included if they were chosen by at least 20% of all stakeholders.

APT	Make your choice	Summary
APT A **Minimum Intervention (MI)** ***low investment, low commitment to policy change***	**APT A - Pathway**	This policy trajectory assumes a no-regrets strategy where the lowest cost adaptation policies are pursued to protect citizens from some climate impacts. This APT addresses those areas where maximum impact can be achieved for the lowest cost.
APT B **Economic Capacity Expansion (ECE)** ***high investment, low commitment to policy change***	**APT B - Pathway**	This policy trajectory focuses primarily on encouraging climate-proof economic growth but does not seek to make significant changes to the current structure of the economy. In this APT a high level of investment is required to prepare the economy for future change, but adaptation policy does not aim to reorient the economy or create significant change.
APT C **Efficiency Enhancement (EE)** ***medium investment, medium commitment to policy change***	**APT C - Pathway**	This policy direction is based on an ambitious strategy that promotes adaptation consistent with the most efficient management and exploitation of the current system, looking at ways of distributing labour, balancing livelihood choices, and best utilising ecosystem services to enhance livelihoods and wellbeing under climate change.
APT D **System Restructuring (SR)** ***high investment, high commitment to policy change*** **PROTECT, ACCOMMODATE and RETREAT**	**APT D - Pathway**	This policy direction embraces a pre-emptive fundamental change at every level in order to completely transform the current social-ecological and economic systems and thus changing the social and physical functioning of archipelago/islands sectors. In this APT there is a guiding belief that significant/radical landscape and societal modifications are justified to create long term system restructuring despite the short-term costs that may be accrued, among some social groups or economic sectors.

Table 1 – Adaptation Policy Trajectory (APT) narratives

Pathway options are grouped around three objectives: (1) actions to reduce socio-economic vulnerability; (2) actions that address disaster risk reduction; and (3) actions that affect social-ecological resilience. Adaptation policy under **vulnerability reduction**, **disaster risk reduction**, and

social-ecological resilience were developed considering classes of adaptation (Figure 1) under which the participants decide which are the most relevant options for the Balearic Islands region.

For **vulnerability reduction** five classes were considered: (1) Financial capital; (2) Human capital; (3) Social capital; (4) Natural capital; and (5) Physical capital. For **Disaster Risk Reduction** four classes were considered: (6) managing long term risk; (7) preparedness; (8) response; (9) post disaster recovery and rehabilitation. For **Social-Ecological Resilience** three classes were considered: (10) Post disaster recovery and rehabilitation; (11) Provisioning services; and (12) Regulating and Maintenance Services (Figure 5 - The 12 classes of adaptation are structured in three broader objectives (Vulnerability reduction, Disaster Risk reduction and Ecosystem and social resilience) and linked to each APT narrative.

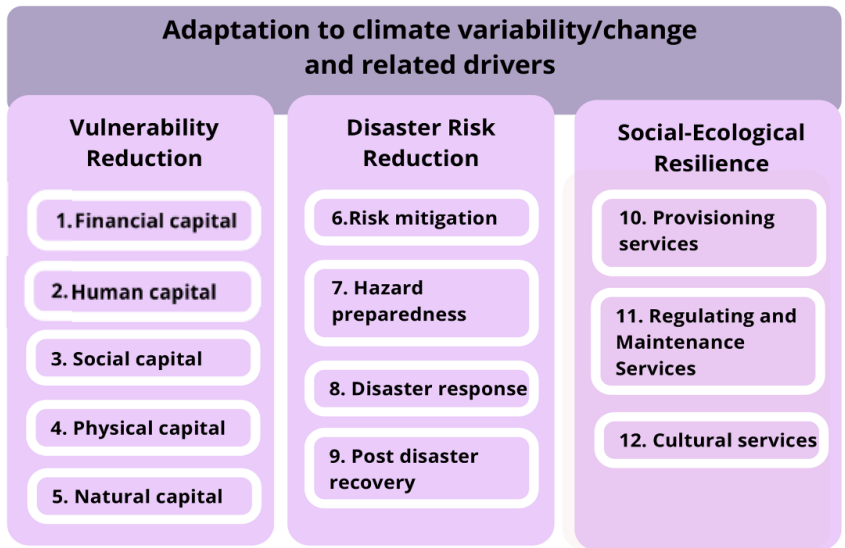


Figure 103 - The 12 classes of adaptation in the figure are structured in three broader objectives (Vulnerability reduction, Disaster Risk reduction and Ecosystem and social resilience).

The results of the Adaptation Pathways are presented in this report in two different outputs per sector: **(1) Selected Adaptation Pathways; and (2) Sustainability Performance.**

The (**1) Selected Adaptation Pathways** outputs aim to capture the acceptance of each adaptation option by calculating the options (number of times) selected within the maximum number of times they can be selected (Ratio – Selected/Maximum). This considers the number of times the option was selected by all stakeholders in all four APTs and three timeframes.

The **(2) Sustainability performance** outputs aim to characterize each pathway through the evaluation of the options chosen in each APT. The options selected in each APTs are evaluated considering a set of criteria: Cost Efficiency; Environmental protection; Mitigation (GHG emissions) win-wins and trade-offs; Technical applicability; Social acceptability (Table 2).

Criteria	Description	
Cost Efficiency	Ability to efficiently address current or future climate hazards/risks in the most economical way	Higher score = higher cost efficiency

- *Environmental protection*	Ability to protect the environment, now and in the future	Higher score = higher environmental protection
- *Mitigation (GHG emissions) win-wins and trade-offs*	Current ability to meet (win-win) or not (trade-off) the island/archipelago's mitigation objectives	Higher score = higher mitigation win-wins and lower trade-offs
- *Technical applicability*	Current ability to technically implement the option/measure in the island/archipelago	Higher score = higher technical applicability
- *Social acceptability*	Current social acceptability of the option/measure in the island/archipelago	Higher score = higher social acceptability

Table 2 – Description of the criteria used to evaluate the adaptation pathways performance.

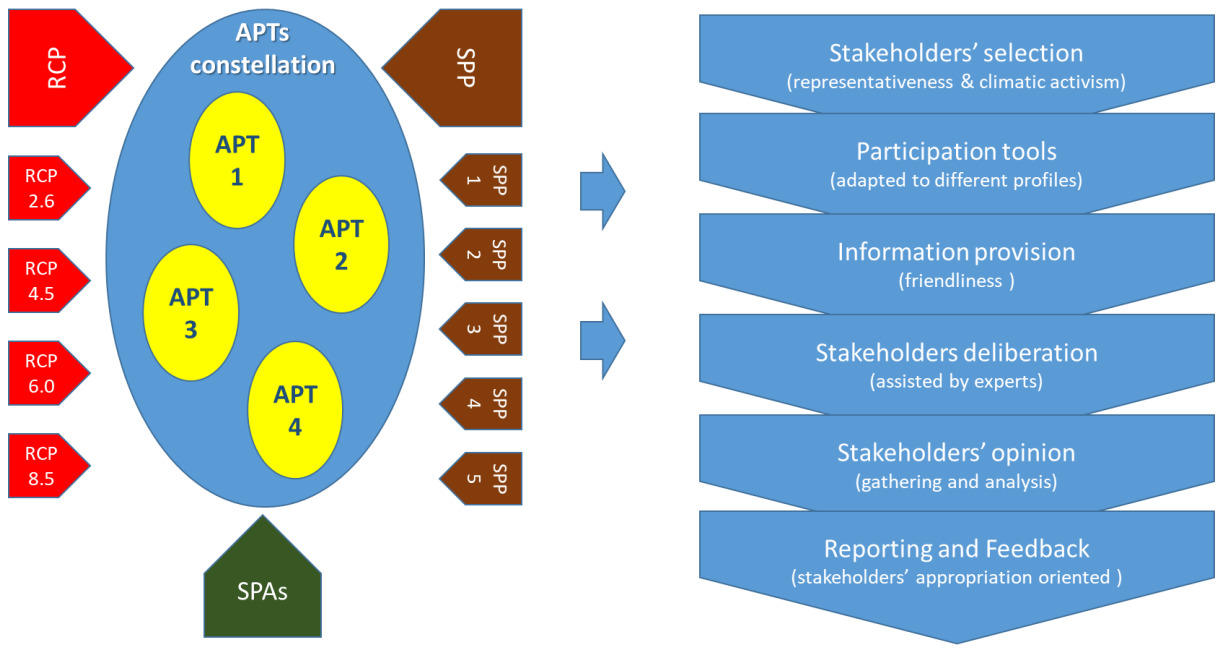
The results are presented in a spider diagram and is the average of all options chosen for the participants in each APT pathway.

2 Methodology

2.1 Theoretical framework and participation process

The participatory process of the Balearic Islands, which involved stakeholders in defining the adaptation pathway to climate change for blue economy sector, was undertaken within the theoretical framework depicted in figure 2 (left side) and was developed following the steps shown in figure 2 (right side).

The theoretical framework based on the combination of RCPs, SSPs and SPAs to obtain an ordered range of *adaptation policy trajectories* (APTs) has already been presented earlier in this Deliverable. Through the definition of APTs, the constellation of opinions and evaluations can be systematised and sorted to provide a clearer and more useful stakeholder input in order to better feed the decision-making process. During the participation process all participants were invited to reveal their preferences regarding the set of adaptation policy trajectories they were faced with. For those who did not, their preferences were deduced from their opinions and assessments expressed during the interview.



RCP: Representative Concentration Pathways

SPP: Shared Socio-economic Pathways

SPA: Shared climate Policy Assumptions

Figure 2. Theoretical framework and participation process. (Source: own elaboration)

Stakeholders selection was mainly aimed at involving the most representative people from companies, entrepreneurial associations, public administrations and research boards related to the blue economy sectors on the respective islands. Yet, the most active individuals in the fight against climate change in the concerned industries and those leading environmental innovation, decarbonisation and adaptation measures at the enterprise level were also invited to participate. Thus, a mixed criterion of representativeness and pro-activism helped to define the list of participants. With regard to the public administration, instead of focusing on the heads of the concerned departments, efforts to involve participants were directed mainly at the regional government's ecological transition department, which is coordinating the design of the climate policy for the archipelago.

The participation process and tools were adapted to the specificities of the different groups of participants. Usually, the highest representatives in the industry showed a low willingness to participate in collective processes that compromised several hours in the morning and early afternoon. Our response was to develop a plurality of tools to adapt the participatory process to the availability of the participants. As a result, a triple-fold participation tool was designed. More details on this point will be presented in association with figure 3 below.

In addition, the participation process was designed to encourage deliberation and exchange of opinions amongst participants. Thus, an information phase was followed by a deliberation phase which lead to a phase of opinion gathering and assessment. Given that climate change issues have not been part of participants' daily assessment and discussion, and that well-founded views on climate

change issues were probably still lacking, the deliberation phase was of critical relevance in order to obtain well-founded opinions and facilitate consensual perspectives and proposals on this relevant issue.

Finally, while this report is being delivered, a sectoral webinar is being planned to gather the results of the participatory process of the informants and to refine the collective definition of the adaptation options presented at the beginning of the process. This process will coincide with the development of the Deliverable 7.4 in which islands' reports will link the entire set of research results and the participatory definition of the adaptation policy trajectories for the SOCLIMPACT islands.

2.2 The set of participation tools

As already mentioned, the participation tools were adapted to the specific requirements of the participating groups in order to involve the highest representatives of companies, associations, administrations and research teams. Figure 3 depicts the tools used in the phases through which the participation process was deployed.

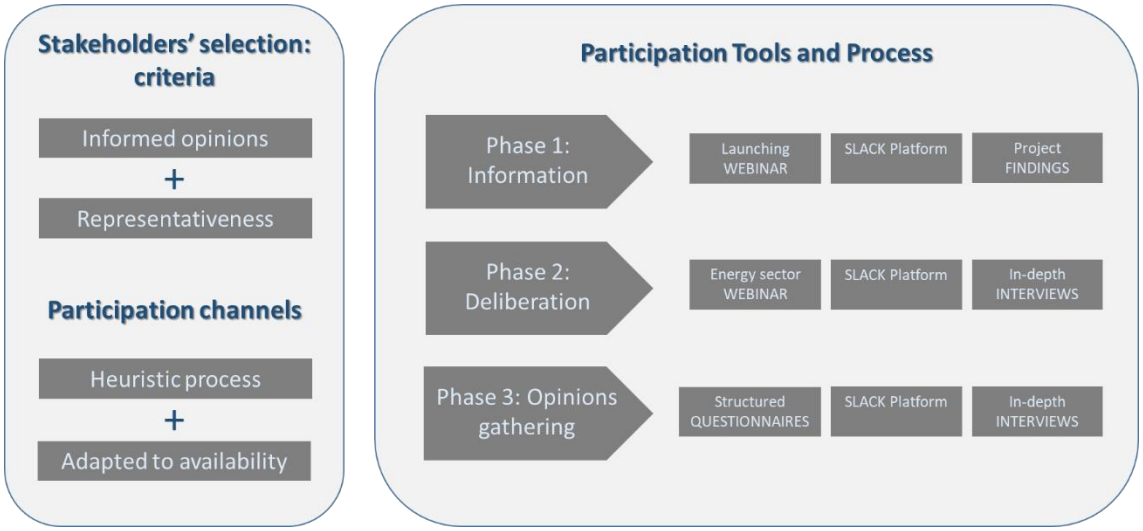


Figure 3. Tools for participation. (Source: own elaboration)

Figure 3, on the left, shows the aims of the design of the participation process: to gather informed and representative opinions through a process capable of adapting the tools to the availability and preferences of the key informants and to obtain not just scores from comparisons, Likert-type scales and ordering; but also the reasoning behind those scores by making explicit the information being considered and the arguments being used to deliver the scores.

Phase 1 began with a launch of a Multi-Sectoral Webinar that provided updated climatic information on the past events and the forecast for the 21st century for the Canary and Balearic Islands, with the

participation of the Spanish Meteorological Agency and outstanding researchers in the fields of climatology, ecology, marine physics and marine biology. Selected stakeholders and the general public were called to attend and participate in the web seminar. The video recording of the event has been available ever since. Additionally, the main findings of the project (based on the deliverable 7.2) were translated into a user-friendly format and then disseminated amongst the selected stakeholders and hosted: either through the project's website - www.soclimpact.net – (Figure 4), or through the Slack discussion platform specifically created to give support to the participation process (Figure 5).

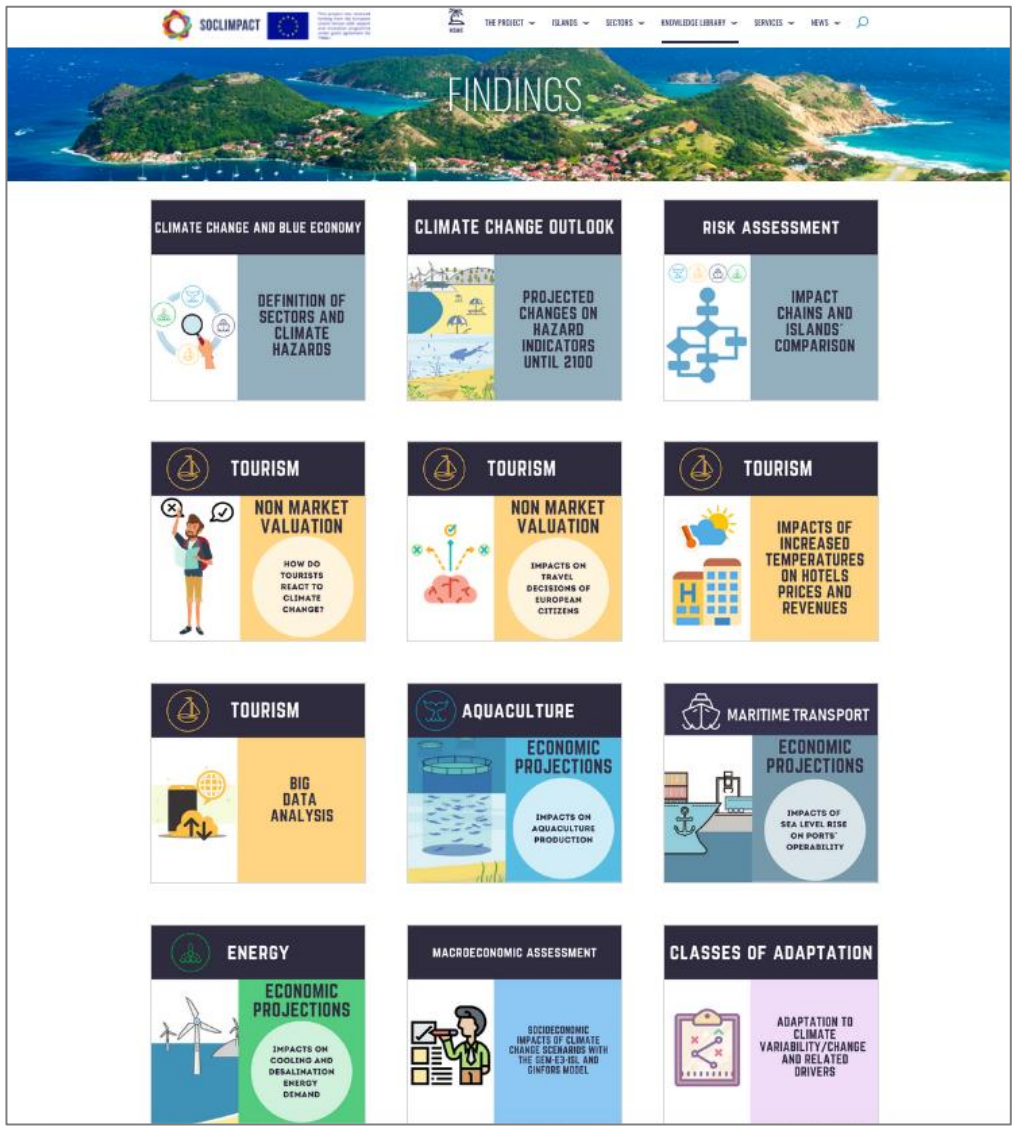


Figure 4 - Findings of the project shared with stakeholders

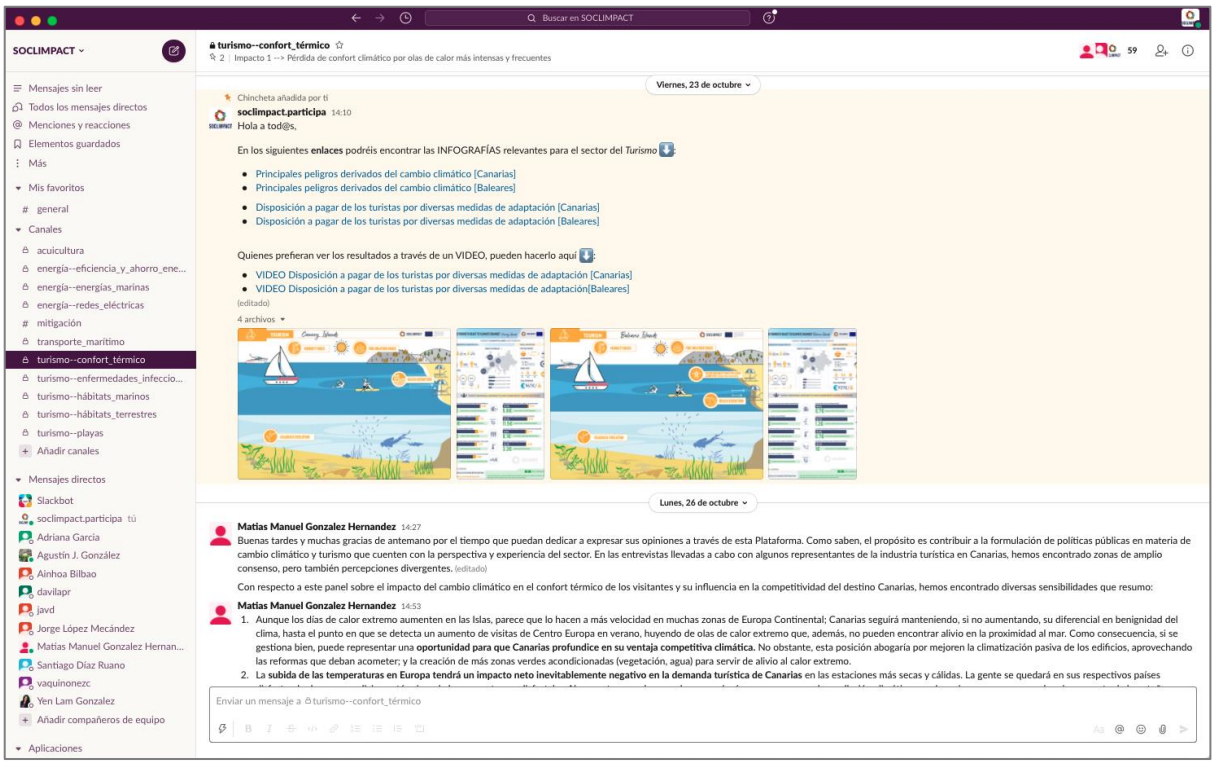


Figure 5 - Visual representation of one of the Slack platform canals

Phase 2 was intended to provide an in-depth understanding of the relevance that stakeholders give to climate change issues, the information they currently have on climate change, the relevance that weather events and forecasts play in their planning and managing activities, and the opinions they have built on the actions to be taken to adequately address climate change issues. Favourable conditions allowed the celebration of three specific webinars on the energy sector and the threats it will face due to the impacts of climate change.

The Slack platform was expected to be a channel to foster debates on climate change hotspots and the blue economy sectors on the islands. Four Slack rooms were set up, one for each sector, and five other inside-rooms were additionally prepared within the tourism sector room to host the debate on the 5 main impact chains stablished by SOCLIMPACT in the previous research phases. No more than 20 participations were collected through this channel, probably due to failures in facilitation techniques. Finally, in-depth interviews allowed for the collection of many valuable qualitative information that would be very useful to qualify the scores provided by the informants through questionnaires.

Phase 3 consisted of obtaining and systematising opinions on preferences for alternative adaptation options for the sectors of the blue economy studied in three different time horizons: up to 2030, up to 2050 and up to 2100. The questionnaires were filled out both through self-completed interviews and in the frame of in-depth interviews. The scores gathered in relation to perceptions of climate hazards and risks, the evaluation of adaptation options based on 5 relevant criteria and the choices between alternative adaptation options by paired comparison over the short-, medium- and long-term scenarios were organised in tables to present a synthetic picture of the stakeholders' opinions. These tables are presented and discussed in the following section. In addition, all interviews were

supported by a presentation that served as a script, in which respondents could read and understand the questions through the visual design that was created to facilitate the exercise (see Appendix 6.4).

3 Interviewed stakeholders

As mentioned above, a total of 5 interviews were conducted with the most relevant stakeholders from three sectors of the blue economy. The profile of each interviewee will be detailed and categorised by sector.

All interviews were recorded with the consent of the interviewees.

3.1 Tourism

Name	Organization	Position
Cati Torres Figuerola	Universitat Illes Balears (UIB)	Head of the Department of Applied Economics
		Professor / Researcher
	Laboratori Interdisciplinari sobre Canvi Climàtic de la UIB (LINCC UIB)	Secretary
Pau De Vilchez Moragues	Universitat Illes Balears (UIB)	Assistant Research Lecturer of International Public Law
	Laboratori Interdisciplinari sobre Canvi Climàtic de la UIB (LINCC UIB)	Deputy Director

Table 3 – List of stakeholders interviewed for the tourism sector.

Both interviewees are scientific researchers with a vast knowledge of the effects of climate change in the Mediterranean and especially in the Balearic Islands. Cati Torres Figuerola's research has mainly focused on the economic valuation of the environment and Cost-Benefit Analysis in marine and coastal ecosystem contexts. The last few years, she initiated a line of research around the critical analysis of environmental economics and to introduce itself into the study of disciplines which also analyse the relationship between nature and the economy as well as the causes of environmental degradation and the mechanisms necessary to tackle it. In this context, she also devotes research efforts to analysing the role of the socio-economic metabolism of industrial civilisation in the current ecological and social crisis.

Pau de Vilchez Moragues, besides being professor of Public International Law at the UIB, his main line of research is on the environment and human rights, focusing mainly on climate change and domestic litigation. Since 2018 he is Deputy Director of the UIB Interdisciplinary Laboratory on Climate Change

(LINCC UIB), representative of the UIB in international climate conferences (COPs) and responsible in Spain for the European project Clean Energy for EU Islands.

3.2 Maritime Transport

Name	Organization	Position
Gabriel Jordà Sánchez	Spanish Institute of Oceanography in Mallorca (COB-IEO)	Senior research scientist
	Universitat Illes Balears (UIB)	Professor
Miguel Agulles Gámez	Spanish Institute of Oceanography in Mallorca (COB-IEO)	Scientific researcher
	Universitat Illes Balears (UIB)	PhD in Physical Oceanography

Table 4 – List of stakeholders interviewed for the maritime transport sector.

Both interviewees are scientific researchers with a vast knowledge of the effects of climate change in the Mediterranean and especially in the Balearic Islands. Gabriel Jordá Sánchez's main line of research is the study of marine climate variability with special focus on the Mediterranean and on the interactions with biological processes. His research is mainly based on numerical modelling and on the analysis of climatic databases. In that framework he has developed several observation-based products for climate studies on hydrography, sea level and waves. He has worked on 11 international projects and 22 national projects, with management responsibilities in 9 of them. At present he is member of the steering committee of MedCORDEX, HyMEX and CLIVAR-Spain.

Miguel Agulles Gámez is specialized in the study and evaluation of coastal risks. In the last years, he has worked with large observations databases related to physical oceanography (wind, waves, tides, temperature…) and high-resolution numerical models in the field of coastal dynamics. He is currently working as scientific researcher at IEO (Spanish Institute of Oceanography), under the MOCLI project (related to assess and develop climate modelling research, especially in the Mediterranean Sea). Meanwhile he is doing his PhD in Physical Oceanography within the doctoral program at UIB (Universitat de les Illes Balears).

3.3 Energy

Name	Organization	Position
Alexandre Duran i Grant	Som Energia	Coordinator for Mallorca
		Communications Officer
	Ecotxe	President

Table 5 – List of stakeholders interviewed for the energy sector.

Alexandre Duran i Grant is specialized in Ecological Economics and Eco-innovation. His research has focused on carrying out several comparative analyses of the large companies in the environmental sector (water, waste, etc.) and getting to know the cooperative movement. He is ¡ convinced that this type of more democratic organization is more compatible with the objectives of sustainability. That's why he is currently working in two cooperatives (Som Energia and Ecotxe) and collaborating with other organisations in the Social and Solidarity Economy.

4 Sector Adaptation Pathways

Each interviewee was asked to choose different time frames between two adaptation options for a total of 24 options, and then to prioritize between 6 specific options from local knowledge. Each interviewee only responded according to their own point of view, as it seemed to us that if they responded by placing themselves in a different APT than what they believed, the responses might be biased and not reflect reality. Consequently, in some sectors there will be empty columns, due to the fact that we did not find interviewees who fit all the profiles.

4.1 Tourism

Tourism pathways are based on choices made by 2 expert island stakeholders.

4.1.1 Selected Adaptation Pathways

ID	Name	Class number	APT A			APT B			APT C			APT D		
			S	M	L	S	M	L	S	M	L	S	M	L
T1	Economic Policy Instruments (EPIs)	1					B						D	
T2	Financial incentives to retreat from high-risk areas	1					B						D	
T9	Activity and product diversification	2		A			B			C			D	
T10	Public awareness programmes	2		A			B			C			D	
T11	Local circular economy	3								C				
T12	Tourist awareness campaigns	3								C				
T13	Local sustainable fishing	4								C			D	
T14	Water restrictions, consumption cuts and grey-water recycling	4								C			D	
T15	Beach nourishment	5					B							
T16	Desalination	5					B							
T17	Coastal protection structures	6		A			B			C			D	
T18	Drought and water conservation plans	6		A			B			C			D	
T19	Mainstreaming Disaster Risk Management (DRM)	7								C				
T20	Using water to cope with heat waves	7								C				
T21	Fire management plans	8		A										
T22	Health care delivery systems	8		A										
T23	Post-Disaster recovery funds	9		A									D	
T24	Pre-disaster early recovery planning	9		A									D	
T3	Adaptation of groundwater management	10		A			B			C			D	
T4	Monitoring, modelling and forecasting systems	10		A			B			C			D	
T5	Dune restoration and rehabilitation	11					B			C				
T6	River rehabilitation and restoration	11					B			C				
T7	Adaptive management of natural habitats	12								C				
T8	Ocean pools	12								C				
T25	Thermal isolation of buildings	Local		A			B			C			D	
T26	Zero sewage discharge to the sea	Local		A			B			C			D	
T27	Distributed electric grids powered by renewables	Local		A			B			C			D	
T28	Forest fire prevention	Local		A			B			C			D	
T29	Effective plan of water demand management and investment in re	Local		A			B			C			D	
T30	Residual organic matter composting to reduce methane emissions,	Local		A			B			C			D	

Figure 6 - Adaptation options for the tourism sector. Options are identified with an ID number, full name, and class of adaptation number. Adaptation objectives are identified in each option by colour: ***vulnerability reduction (red), Disaster Risk Reduction (blue); Social-Ecological Resilience (green);*** *Local Knowledge adaptation options (grey). Each ATP (APT*

A; APT B; APT C; APT D) is represented in three timeframes: S - Short term (up to 2030), M- Medium term (up to 2050), L - Long term (until 2100). Bold letters in each ATP indicate the option was available to be selected. Highlighted options indicate the measure was selected in each ATP and timeframe: ATP A – Minimum Intervention (light blue); ATP B – Economic Capacity Expansion (light green); ATP C – Efficiency Enhancement (Light orange) and ATP D – System Restructuring (light purple). Space with colour: option was selected for the timeframe: Short term, Medium term, or Long term. Bold letter: option is available in the APT.

The adaptation options and choices for the tourism sector are summarized in Figure 6. At first glance, it can be noted that the *APT A (Minimum Intervention)* and *APT B (Economic capacity expansion)* have not been supported by any of the experts.

Vulnerability Reduction

The first class of adaptation considered under the reduction of socio-economic vulnerability is *Financial Capital*. In this case, there is only APT D scenario, where the adaptation option *Economic Policy Instruments (EPIs) (T1)* was selected in the short and medium-term. While for the long-term, the adaptation option *Financial incentives to retreat from high-risk areas (T2)*, was chosen since these are much deeper and structural measures, which involve relocating people, that it is difficult to do in a short period of time.

When considering Human Capital, between the two Adaptation Policy Trajectories analysed, there is a clear difference. For APT D, *Public awareness programmes* (T10) is selected for all time frames. Seeing awareness, as a crucial aspect for citizens to be aware of the importance of nature and its resources, as a driver of change. Whereas, in APT C, *Activity and product diversification* (T9) is selected for all time frames. Seeing this measure as more urgent, in the belief that awareness is most useful when people see real alternatives.

In the *Social Capital* class, the adaptation options are available only under the APT C – Efficiency Enhancement, where *Local circular economy (T11)* is selected in all time frames in opposition to *Tourist awareness campaigns (T12).* With the idea that we have to start now, since there is little time. Being too late to start raising awareness among tourist, if we want to achieve changes in the short-term.

Regarding the fourth class, *Natural Capital*, the APTs considered are C and D. From the two options available, *Local sustainable fishing* (T13) and *Water restrictions, consumption cuts and grey-water recycling* (T14), the chosen one under both APTs and in all timeframes is the latter. The pathways developed consider the growing evolution of the climate change risks in particular for the Balearic Islands: the urgency to respond to water scarcity, one of the biggest issues in the archipelago. Water must be managed correctly, as there is a great shortage of water, with many tourists, swimming pools, etc. Action must be taken, regulating it more efficiently in order to achieve a responsible management of water. However, T13 is also seen as important for the archipelago.

Disaster Risk Reduction

For *Disaster Risk Reduction*, and to manage long term risk, the decisions need to be sensible to the level of investment and reflect the climate change risk identified for the region. *Drought and water conservation plans (T18)* is the most important measure for the region throughout the scenarios. However, APT C includes *Managing long term risk* and *Coastal protection (T17)* on the long-term, clearly showing, once again, the issue of water scarcity.

The Efficiency Enhancement scenario (ATP C) is the only scenario which considers the *Preparedness* class. *Mainstreaming DRM (T19)* was selected in the short-term, because it is something that needs to be developed immediately. While *Using water to cope with heat waves (T20)* has been selected for medium and long-term.

In *Post disaster recovery*, to address DRR on the tourism sector, in APT D, the *Pre-disaster early recovery planning (T24)* was selected for all time frames over *Post-disaster recovery funds (T23).* Even if T23 is also important, many future problems could be solved with T24, while there is still a lot to do in this sense.

Social-Ecological Resilience

For *Provisioning services*. *Adaptation of groundwater management* (T3) is urgent for APT D in all time frames, due to the importance of a healthy ecosystem; if we protect ourselves, there is no need for a monitoring system. However, incorporating *Monitoring, modelling and forecasting systems* (T4) for APT C is important in the medium and longer term, because the most severe impacts of climate change will occur in the upcoming years.

Regulating and maintenance services, is considered only in scenario C. Where the priority for *Dune restoration and rehabilitation* (T5) is shown, since beaches are already suffering. Then for the long-term, *River rehabilitation and restoration* (T6) is selected, because right now they are not so affected, but they will be in the future. However, it should be noted that both are seen as important.

Cultural services are only considered for the APT C - Efficiency Enhancement (medium investment and medium commitment to policy change scenario). In this case, the region considered to dedicate efforts in the short and medium-term to preserve and minimize the impacts on biodiversity and ecosystems, while also preserving the attractiveness of the region (*Adaptive management of natural habitats* - T7). As opposed to *Ocean pools* (T8), in the long-term.

Local Knowledge adaptation options

The specific adaptation options for the tourism sector include solutions of various kinds. Where the problem of water scarcity throughout the archipelago can be clearly seen, being *Effective plan of water demand management and investment in reducing losses along the water distribution system (T29)* the most urgent adaptation option selected along with T27. The issue of the huge energy consumption

the tourism sector has becomes clear, as *Distributed electric grids powered by renewables (T27)* is also selected as urgent. Showing the need this sector has to transform its energy into renewable sources. The *Zero sewage discharge to the sea (T26)* is also clearly emphasized in both APTs, due to the impact it has in the entire marine ecosystem.

Even if they are selected for the end of the century or not selected, the other measures are also important for the archipelago, but having to choose among six options for three scenarios, shows the priority other measures have. *Thermal isolation of buildings (T25)* is crucial since the Balearic Islands Architects Association recognises around 45% of buildings at the island exhibit a deficient level of thermal isolation; and the potential reduction of energy consumption and emissions would range from 30 to 80% with respect to the current levels. Then, the problem of wildfires is mainly due to the lack of management and prevention of them. The measure *Forest fire prevention* (T28) emphasises the importance of prevention rather than action to extinguish the fire, which would be a much more effective measure. *Residual organic matter composting to reduce methane emissions (T30)* shows how the issue of waste it is also a major problem on the islands, especially the challenge of properly managing organic waste.

4.1.2 Sustainability Performance

Figure 7 - Pathways evaluation for tourism sector considering: Cost Efficiency; Environmental protection; Mitigation (GHG emissions) win-wins and trade-offs; Technical applicability; Social acceptability. The policy pathways scenarios: APT A - Minimum Intervention; APT B - Economic Capacity Expansion (ECE); APT C- Efficiency Enhancement (EE); APT D - System Restructuring (SR), for different timeframes: short, medium, and long term

The pathways selected in the Tourism sector in the Balearic Islands, APT C (Efficiency Enhancement) and APT D (System Restructuring), have almost an identical evaluation across all timeframes. Moreover, the analysis showed no significant differences in the scoring of criteria as a reflection of these two different ATP narratives.

The cost efficiency of the pathways is the one with highest score, and the rest have a medium score, practically similar. On this sector there is no one with a lower value. In conclusion, not many differences between APTs are made clear.

4.2 Maritime Transport

As all islands, the Balearic exhibit high dependency from imports and exports and, as a consequence, from the maritime transport and port operations. Additionally, to the extent in which the Balearic also show an extreme economic dependence from tourism, it exacerbates the necessity of a wide range of intermediate and final goods import, and also encourages the development of an extensive sector of recreational navigation. Nowadays, the Balearic holds around 24.200 boat mooring points, 5% of the whole Mediterranean Sea and 17% of those held by the Spanish coasts. As a result, the economy of the Balearic Islands is highly exposed to the climate change hazards that affect the marine conditions for navigability and keeping port operations on.

To date, relevant stakeholders from port activity have not scheduled time to participate providing information either through questionnaires or through in-depth interviews. Yet, their participation over the next few weeks is still open so this absence could be reversed before SOCLIMPACT ends and their opinions would be included in further versions of the present Deliverable. In any case, opinions from the best adaptation options for this sector of activity have been collected from SOCLIMPACT researchers belonging to local research institutions, who besides having a vast knowledge of the effects of climate change in the Mediterranean and especially in the Balearic Islands, are familiar with port infrastructures, after having participated in some working sessions on the expected impacts of climate change on the Balearic economy and society. In those sessions, they had the opportunity to meet high representatives of the Archipelago ports sector and exchange relevant information about the challenges Balearic ports will face due to climate change impacts.

Complementarily, we have resorted to indirect sources of information about plans and policies related to climate change mitigation and adaptation in the field of maritime transport and ports at the Balearic Islands. In a recent Report by the Economic and Social Council of the Balearic Government 2019 (file:///D:/descargas/CES-UIB%20H2030%20SEPARATA.pdf), it was informed that the authority is starting to study the vulnerability factors for the maritime infrastructures, a priori appointing to the relevance of the sea level rise, as it exacerbates the potential damages from high waves and storm surges (pg.36). For that purpose, the regional Government, which co-manage together with the Spanish central port authority the whole regional port system, hired the services of the Maritime Engineering laboratory of the Universitat Politècnica de Catalunya (LIM / UPC) to develop a detailed plan of climate plan adaptation assisted by complex numeric modelling.

In addition, in June 2020 a General Plan for Ports of the Balearic Islands was launched planning to concentrate main efforts to ameliorate and strengthen the current port infrastructures to better face climate change and adapt to the future challenges of the maritime transport, refusing to build new ports or enlarge those which are currently operative. This information, also in the hands of the key informants, will be useful to contextualise the answers provided, together with the research outcomes delivered from SOCLIMPACT Project in previous phases, as well as from other research projects. Regarding this, it is relevant to underline that extreme wind and waves and storm surges height are not expected to increase around the Balearic Islands over the present century in any of the studied emissions scenarios. As a consequence, sea level rise and the frequency of extreme heat are the main

hazards that will threaten the operability of the Balearic Islands ports over the levels already mentioned above.

Knowing what is currently being undertaken and what is already planned to prepare ports and the maritime transport for climate change impacts, allowed consulted experts to provide an accurate opinion of what really needs to be done and over what time horizon in the Balearic Islands. The following section displays the tables containing the experts' opinions gathered from questionnaires and in-depth interviews.

4.2.1 Selected Adaptation Pathways

ID	Name	Class number	APT A			APT B			APT C			APT D		
			S	M	L	S	M	L	S	M	L	S	M	L
MT1	Insurance mechanisms for ports	1					B						D	
MT2	Financial incentives to retreat from high-risk areas	1					B						D	
MT9	Awareness campaigns for behavioural change	2		A			B			C			D	
MT10	Social dialogue for training in the port sector	2		A			B			C			D	
MT11	Diversification of trade using climate resilient commodities	3								C				
MT12	Climate resilient economy and jobs	3								C				
MT13	Refrigeration, cooling and ventilation systems	4								C			D	
MT14	Restrict development and settlement in low-lying areas	4								C			D	
MT15	Sturdiness improvement of vessels	5					B							
MT16	Increase operational speed and flexibility in ports	5					B							
MT17	Climate proof ports and port activities	6		A			B			C			D	
MT18	Consider expansion/retreat of ports in urban planning	6		A			B			C			D	
MT19	Reinforcement of inspection, repair and maintenance of infrastruct	7								C				
MT20	Early Warning Systems (EWS) and climate change monitoring	7								C				
MT21	Inteligent Transport Systems (ITS)	8		A										
MT22	Prepare for service delays or cancellations	8		A										
MT23	Backup routes and infrastructures during extreme weather	9		A									D	
MT24	Post-Disaster recovery funds	9		A									D	
MT3	Marine life friendly coastal protection structures	10		A			B			C			D	
MT4	Combined protection and wave energy infrastructures	10		A			B			C			D	
MT5	Hybrid and full electric ship propulsion	11					B			C				
MT6	Coastal protection structures	11					B			C				
MT7	Integrate ports in urban tissue	12								C				
MT8	Ocean pools	12								C				
MT25	Development of an adaptation plan to adequate infrastructure to (	Local		A			B			C			D	
MT26	Improve and ensure operational safety in ship repair	Local		A			B			C			D	
MT27	Develop the potential of maritime navigation between the Balearic	Local		A			B			C			D	
MT28	Strengthen and prepare the provisioning system to heat waves	Local		A			B			C			D	
MT29	Improve monitoring systems	Local		A			B			C			D	
MT30	Encourage the adaptation of recreational marinas to the main clim	Local		A			B			C			D	

Figure 8 - Adaptation options for the Maritime Transport sector. Options are identified with an ID number, full name, and class of adaptation number. Adaptation objectives are identified in each option by colour: ***vulnerability reduction (red),*** *Disaster* ***Risk Reduction (blue); Social-Ecological Resilience (green);*** *Local Knowledge adaptation options (grey). Each ATP (APT A; APT B; APT C; APT D) is represented in three timeframes: S - Short term (up to 2030), M- Medium term (up to 2050), L - Long term (until 2100). Bold letters in each ATP indicate the option was available to be selected. Highlighted options indicate the measure was selected in each ATP and timeframe: ATP A (light blue); ATP B (light green); ATP C (Light orange) and ATP D (light purple). Space with colour: option was selected for the timeframe: Short term, Medium term, or Long term. Bold letter: option is available in the APT.*

The adaptation options and choices for the maritime transport sector are summarized in Figure 8. At first glance, it can be noted that the *APT A (Minimum Intervention)* and *APT B (Economic capacity expansion)* have not been supported by any of the experts.

Vulnerability Reduction

The first class of adaptation considered under the reduction of socio-economic vulnerability is *Financial Capital*. In this case, there is only APT D scenario, where the adaptation option *Insurance mechanisms for ports (MT1)* was selected in all time frames over *Financial incentives to retreat from high-risk areas (MT2)*. Basically, because there is no way to retract from high-risk areas as there is no space available to expand or locate the ports.

When considering *Human Capital*, both Adaptation Policy Trajectories analysed are quite similar. Both consider important to start with *Awareness campaigns for behavioural change (MT9),* so that money to protect ports can be justified. APT C considers that MT9 should be extended until 2050 since 2030 is very close, and the effects of CC will be seen at the end of the century. In contrast, APT D shows that *Social dialogue for training in the port sector (MT10)* should start earlier, in the mid-term and be extended to the long-term, since MT9 would be already implemented for that time, and the port sector should be trained on how to act, giving security.

In the *Social Capital* class, the adaptation options are available only under the APT C – Efficiency Enhancement, where *Diversification of trade using climate resilient commodities (MT11)* is preferred over *Climate resilient economy and jobs (MT12)*.

Regarding the fourth class, *Natural Capital*, the APTs considered are C and D. From the two options available, *Refrigeration, cooling and ventilation systems (MT13)* and *Restrict development and settlement in low-lying areas (MT14)*, the chosen one under both APTs and in all timeframes is the latter; since it makes more sense than the MT13, with little chance of improving the thermal conditions of the stevedores.

Disaster Risk Reduction

For *Disaster Risk Reduction*, and to manage long term risk, the decisions need to be sensible to the level of investment and reflect the climate change risk identified for the region. *Climate proof ports and port activities (MT17)* is clearly seen as the priority. Climate change risks have to be analysed, to better adapt and prepare for those impacts. All investments must take climate change into account before moving forward with them. *Consider expansion/retreat of ports in urban planning (MT18)* does not make sense for this archipelago, since there is no possible location for relocating the ports.

The Efficiency Enhancement scenario (ATP C) is the only scenario which considers the *Preparedness* class. *Reinforcement of inspection, repair and maintenance of infrastructure (T19)* was selected in all

time frames over *Early Warning Systems (EWS) and climate change monitoring (MT20).* Since the latter, despite being crucial, is already in place. The monitoring of the ports, on the other hand, is something local that they have to do.

In *Post disaster recovery*, to address DRR on the tourism sector, in APT D, *Backup routes and infrastructures during extreme weather (MT23)* was selected for all time frames over *Post-Disaster recovery funds (MT24).*

Social-Ecological Resilience

For *Provisioning services*. *Marine life friendly coastal protection structures (MT3)* is urgent for APT C in the short-term, due to the importance of protecting marine life. As it is currently a process that is already underway, for the medium and long-term *Combined protection and wave energy infrastructures (MT4)* is selected; being important to ensure that this infrastructure can be made productive from the investments that are made. In contrast, for APT D it is just the opposite, selecting MT4 for the short and medium-term, and MT4 in the long term.

Regulating and maintenance services, is considered only in scenario C. Where the priority for *Hybrid and full electric ship propulsion (MT5)* is shown, because to lessen the fuel used by ships is crucial, since vessels pollute the marine environment. Then for the long-term, *Coastal protection structures (MT6)* is selected, because is when the greatest rise in the sea level will occur, and when the structure can be affected.

In regard to *Cultural services,* the sector will seek to better *Integrate ports in urban tissue (MT7)* over construction of new Ocean pools (MT8) as the latter is not seen as a relevant aspect for this sector.

Local Knowledge adaptation options

Local knowledge options are mainly focused on coastline and infrastructure protection, reflecting how having safe and operational ports is of paramount importance for the Balearic maritime transport sector: *Development of an adaptation plan to adequate infrastructure to climate threats (MT25)* and *Encourage the adaptation of recreational marinas to the main climate change hazards (MT30).* MT25 focuses on adapting mooring structures, increase of dikes and the free board in old docks, particularly to the rise in sea level, so as to enable the Balearic Islands to maintain and improve their position in international recreational boating and recreational cruise traffic. Also highlighting the importance of freight traffic. And MT30, to stimulate and encourage the adaptation of recreational marinas to the main climate change hazards, in order to guarantee the operation and future expansion of recreational sailing. Nautical activities are of special importance for the Balearic Islands tourism, since tourism accounts for about 45% of the GDP.

Linked to climate hazards, to *Improve monitoring systems (MT29),* since they still can be improved, Identifying operational working windows in case of extreme events. Then, *Improve and ensure operational safety in ship repair (MT26)* to improve and guarantee the operational safety of large ship repair activity against climatic events, the Balearic Islands being very specialized in recreational boating and mega-yachts. Also, transfer knowledge and capacities for the adaptation to climate change to the Spanish peninsula and the Mediterranean region, which will guarantee their future connectivity with the Balearic Islands and the development of the potential of maritime navigation between the Balearic Islands and the Mediterranean region: *Develop the potential of maritime navigation between the Balearic Islands and the Mediterranean region (MT27)*. Lastly, *Strengthen and prepare the provisioning system to heat waves (MT28*), to reinforce and improve, in the face of possible climatic events, in particular to heat waves, the storage areas.

4.2.2 Sustainability Performance

Figure 9 - Pathways evaluation for Maritime Transport sector considering: Cost Efficiency; Environmental protection; Mitigation (GHG emissions) win-wins and trade-offs; Technical applicability; Social acceptability. The policy pathways scenarios: APT A - Minimum Intervention; APT B - Economic Capacity Expansion (ECE); APT C- Efficiency Enhancement (EE); APT D - System Restructuring (SR), for different timeframes: short, medium, long term

The pathways selected in the Maritime Transport sector in the Balearic Islands, APT C (Efficiency Enhancement) and APT D (System Restructuring), all four adaptation pathways reveal a similar structure during the three timeframes considered, according to the answers obtained. Social acceptability shows the highest score along with technical applicability. While the other three; cost efficiency, environmental protection and mitigation win-wins and trade-offs show medium score. The only time frame that shows a clearer variation is the third one (end-century), where environmental protection scores the lowest for APT C.

4.3 Energy

Energy pathways are based on choices made by 1 expert island stakeholders.

4.3.1 Selected Adaptation Pathways

ID	Name	Class number	APT A			APT B			APT C			APT D		
			S	M	L	S	M	L	S	M	L	S	M	L
E1	Financial support for buildings with low energy needs	1					B						D	
E2	Financial support for smart control of energy in houses and building	1					B						D	
E9	Green jobs and businesses	2		A			B			C			D	
E10	Public information service on climate action	2		A			B			C			D	
E11	Small scale production and consumption (prosumers)	3								C				
E12	Risk reporting platform	3								C				
E13	Energy storage systems	4								C			D	
E14	Collection and storage of forest fuel loads	4								C			D	
E15	SeaWater Air Conditioning (SWAC).	5					B							
E16	Demand Side Mangement (DSM) of Energy	5					B							
E17	Review building codes of the energy infrastructure	6		A			B			C			D	
E18	Upgrade evaporative cooling systems	6		A			B			C			D	
E19	Early Warning Systems (EWS)	7								C				
E20	Grid reliability	7								C				
E21	Study and develop energy grid connections	8		A										
E22	Energy-independent facilities (generators)	8		A										
E23	Energy recovery microgrids	9		A									D	
E24	Local recovery energy outage capacity	9		A									D	
E3	Energy efficiency in urban water management	10		A			B			C			D	
E4	Underground tubes and piping in urban planning	10		A			B			C			D	
E5	Biomass power from household waste	11					B			C				
E6	Urban green corridors	11					B			C				
E7	Educational garden plots	12								C				
E8	Heated pools with waste heat from power plants	12								C				
E25	Promotion of domestic and small-scale photovoltaic solar energy	Local		A			B			C			D	
E26	Financial support for the energy rehabilitation of buildings	Local		A			B			C			D	
E27	Mass development of the public transport network powered by rer	Local		A			B			C			D	
E28	Encourage electric individual transport and car-sharing	Local		A			B			C			D	
E29	Training development in installation and thermal insulation of build	Local		A			B			C			D	
E30	Promoting storage systems for renewable energy installations	Local		A			B			C			D	

Figure 10 - Adaptation options for the Energy sector. Options are identified with an ID number, full name, and class of adaptation number. Adaptation objectives are identified in each option by colour: ***vulnerability reduction (red),*** *Disaster* ***Risk Reduction (blue); Social-Ecological Resilience (green);*** *Local Knowledge adaptation options (grey). Each ATP (APT A; APT B; APT C; APT D) is represented in three timeframes: S - Short term (up to 2030), M- Medium term (up to 2050), L - Long term (until 2100). Bold letters in each ATP indicate the option was available to be selected. Highlighted options indicate the measure was selected in each ATP and timeframe: ATP A (light blue); ATP B (light green); ATP C (Light orange) and ATP D (light purple). Space with colour: option was selected for the timeframe: Short term, Medium term, or Long term. Bold letter: option is available in the APT.*

The adaptation options and choices for the energy sector are summarized in Figure 10. Being APT D *(System restructuring)* the only one supported.

Vulnerability Reduction

The first class of adaptation considered under the reduction of socio-economic vulnerability is *Financial Capital*. In this case, the adaptation option *Financial support for buildings with low energy needs (E1)* is necessary in the short and medium-term. While *Financial support for smart control for energy in houses and buildings* (E2) has been selected for the long-term, showing the need of evolving to smart houses in the end-century.

When considering *Human Capital*, for the only Adaptation Policy Trajectories analysed (APT D), sees as urgent need for *Green jobs and businesses (E9),* where a radical change is needed. These being able to support the Balearic Islands reliance on adaptation energy issues while serving as a form of economic diversification, reducing the dependency on the Tourism sector. Then, *Public information service on climate action (E10)* being selected for the medium and long-term.

Regarding the fourth class, *Natural Capital*, APT D selected *Collection and storage of forest fuel loads (E14)* as a required for the short-term, since it is something they are already suffering from. Followed by *Energy storage systems (E13)* for the medium and long-term, since in the short-term they will not be so necessary, as they are not so developed yet. It is expected to have a surplus of renewable energy and this will be required. Energy storage is crucial for energy services reliability and decarbonization objectives, since it will be key to the development and penetration of renewable energy.

Disaster Risk Reduction

For Disaster Risk Reduction, and to *Manage long term risk*, the decisions need to be sensible to the level of investment and reflect the climate change risk identified for the region. APT D considers *Review building codes of the energy infrastructure (E17)* a priority in the short and medium term, since many things need to be changed in order to adapt to climate change. Then, *upgrade evaporative cooling systems (E18)* for the long term, in case the technology already exists for the end of the century.

In *Post disaster recovery*, to address DRR on the energy sector, in APT D, the *Local recovery energy outage capacity (E24)* was selected for the shorter term, whereas *Energy recovery microgrids (E23)* for the medium and longer term, in order to make them more autonomous.

Social-Ecological Resilience

For *Provisioning services*. *Energy efficiency in urban water management (E3)* is urgent for the sector in all time frames. Showing again, the need to respond to the growing problem of water scarcity in the archipelago. E3 was selected over *Underground tubes and piping in urban planning (E4)* since it can be a difficult energy resource concept to grasp and to account for in energy planning.

Local Knowledge adaptation options

The specific adaptation options for the energy sector include solutions of various kinds. Taking APT D, *Promotion of domestic and small-scale photovoltaic solar energy (E25)* and *Financial support for the energy rehabilitation of buildings (E26)* are categorized as urgent. It is urgent to encourage the massive development of photovoltaic energy sources (the one with most potential on the islands) on rooftops, instead of creating photovoltaic parks that occupy territory that could be used for other uses. These incentives would allow citizens to install solar panels, thus socialising electricity production. Then, E25 will allow improvements in old buildings with terrible energy efficiency. Usually, owners cannot afford to insulate the house, in order to make it passive building. In addition, it could give many people an alternative job.

Then the *Mass development of the public transport network powered by renewable energies (E27)* it is also of vital importance. Improving the public transport network will reduce the GHG emissions, making it much more effective and useful for citizens, in order to encourage its use. In particular, developing the railway network (tramway networks), taking advantage of the existing infrastructure of the old railway network. GHG emissions cannot be reduced if this following measure is not applied: *Encourage electric individual transport and car-sharing (E28)*. This measure is focused on individual mobility, promoting the use of hydrogen-powered vehicles. Additionally, encouraging the use of vehicle sharing, in order to avoid the need to acquire a vehicle to move around the islands. The concept of sharing includes cars, motorbikes and bicycles.

Then, to condition housing, *Training development in installation and thermal insulation of buildings (E29)* would be necessary, which consist in training initiatives in installation and thermal insulation of buildings. Lastly, with the aim of solving or diminishing surplus problems, the idea of *Promoting storage systems for renewable energy installations (E30)*. Being key, since besides being the most mature technology and the one that has the most potential in the islands, photovoltaic energy is the one that everyone can adopt.

4.3.2 Sustainability Performance

Figure 11 - Pathways evaluation for Energy sector considering: Cost Efficiency; Environmental protection; Mitigation (GHG emissions) win-wins and trade-offs; Technical applicability; Social acceptability. The policy pathways scenarios: APT A - Minimum Intervention; APT B - Economic Capacity Expansion (ECE); APT C- Efficiency Enhancement (EE); APT D - System Restructuring (SR), for different timeframes: short, medium, long term

The only pathway selected in the Energy sector in the Balearic Islands is APT D (System Restructuring), All four adaptation pathways reveal a similar structure during the three timeframes considered: scoring high in four criterion (cost efficiency, social acceptability, technical applicability and mitigation wins-wins and trade-offs) except for the short-term scenario, where environmental protection criterion also scores high. In this scenario, the five criteria score practically the same. Whereas in the other two scenarios, environmental protection scores the lowest by a considerable difference.

5 Discussion and next steps

The Balearic Islands are the first region in Spain that has approved and is already ruling a strategy to fight against climate change through an effective action in mitigation and adaptation. Additionally, this region has exhibited activism in an early regulation for the protection of ecosystems that are currently being affected by climate change impacts, mainly in the marine environment. On top of that effort is the law for the conservation of the *Posidonia oceanica*¸2018, that plays a key role as a CO2 reservoir. The Balearic hold the largest reef of Posidonia all over the Mediterranean Sea, that makes its conservation a key stone in fighting against climate change.

SOCLIMPACT has feed from the research effort led by this policy framework and is now contributing with further research outcomes on climate change impacts for the Blue Economy sectors, their economic valuation and macroeconomic effect, and the participated design of adaptation policies. In this regard, the results provided for SOCLIMPACT contribute heterogeneously to the precious state-of-the-art in policy making in the islands.

More accurate, downscaled forecasting on climate change associated hazards, provide enhanced information to underpin future decision making in the field of energy transition and energy-devices protection against extreme climate events. Also key informants on tourism potential affection due to climate chain and adaptation options have taken advantage from previous participated work sessions; amongst them the meeting recently hosted by CONAMA (http://www.fundacionconama.org/tag/adaptacion-al-cambio-climatico/).

Aquaculture activity is almost irrelevant in the Balearic while the maritime sector, in spite of its importance, is conditioned for external timing defined by the central port authority of Spain, which is now starting with the definition of an adaptation strategy for the whole Spanish ports system. Secondary ports dependent from the regional authority, however, exhibit a more advanced position in this policy making process. Anyway, SOCLIMPACT research results allow for a clear definition of the priorities by pointing out sea level rise as the most relevant hazard and the heightening of external dikes and docking areas, as the most priority actions to keep ports operating.

6 Annexes - Balearic Islands

6.1 List of all interviewed stakeholders

Name	Organization	Position	Sector
Cati Torres Figuerola	Universitat Illes Balears (UIB)	Head of the Department of Applied Economics	Tourism
		Professor / Researcher	
	Laboratori Interdisciplinari sobre Canvi Climàtic de la UIB (LINCC UIB)	Secretary	
Pau De Vilchez Moragues	Universitat Illes Balears (UIB)	Assistant Research Lecturer of International Public Law	Tourism
	Laboratori Interdisciplinari sobre Canvi Climàtic de la UIB (LINCC UIB)	Deputy Director	
Alexandre Duran i Grant	Som Energia	Coordinator for Mallorca	Energy
		Communications Officer	
	Ecotxe	President	
Gabriel Jordà Sánchez	Spanish Institute of Oceanography in Mallorca (COB-IEO)	Senior research scientist	Maritime Transport
	Universitat Illes Balears (UIB)	Professor	
Miguel Agulles Gámez	Spanish Institute of Oceanography in Mallorca (COB-IEO)	Scientific researcher	Maritime Transport
	Universitat Illes Balears (UIB)	PhD in Physical Oceanography	

6.2 Webinars

6.2.1 1st Webinar (21st July 2020)

6.2.1.1 Objective

How to face the risks of climate change in the Canary and Balearic Islands

6.2.1.2 Agenda

- ✓ Impacts and vulnerability of the Balearic Islands to climate change: evidence from the SOCLIMPACT project
  Gabriel Jordá Sanchez - Balearic Islands Oceanographic Centre and University of the Balearic Islands

- ✓ Impacts, risks and action in facing global change: a challenge for governance
  Javier Irastegui - Institute of Oceanography and Global Change (IOCAG) of the University of Las Palmas de GC, IPCC partner

- ✓ Rising sea levels: the case of las Canteras
  Alonso Hernández Guerra - Institute of Oceanography and Global Change (IOCAG) of the University of Las Palmas de GC

- ✓ Climate change, currents, nutrients and marine life

Santiago Hernández León - Institute of Oceanography and Global Change (IOCAG) of the University of Las Palmas de GC

- ✓ Global change in the islands: climate, pouring, coastal infrastructures and marine ecosystems
  Fernando Tuya Cortes - ECOAQUA University Institute, University of Las Palmas de GC

6.2.1.3 Poster


SOCLIMPACT
This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 776661.
WEBINAR
JULIO
21
15:30 h.
Martes
¿Cómo enfrentar los riesgos del
CAMBIO CLIMÁTICO
en las islas?
EVIDENCIAS DE
Canarias y Baleares
IMPACTOS Y VULNERABILIDAD DE LAS ISLAS BALEARES AL CAMBIO CLIMÁTICO: EVIDENCIAS DEL PROYECTO SOCLIMPACT.
Gabriel Jordá Sanchez, Centro Oceanográfico de Baleares y Universidad de Islas Baleares.
IMPACTOS, RIESGOS Y ACCIÓN ANTE EL CAMBIO GLOBAL: UN RETO PARA LA GOBERNANZA.
Javier Aristegui, Instituto de Oceanografía y Cambio Global (IOCAG) de la Universidad de Las Palmas de GC, colaborador IPCC.
LA SUBIDA DEL NIVEL DEL MAR: EL CASO DE LAS CANTERAS.
Alonso Hernández Guerra, Instituto de Oceanografía y Cambio Global (IOCAG) de la Universidad de Las Palmas de GC.
CAMBIO CLIMÁTICO, CORRIENTES, NUTRIENTES Y VIDA MARINA.
Santiago Hernández León, Instituto de Oceanografía y Cambio Global (IOCAG) de la Universidad de Las Palmas de GC.
EL CAMBIO GLOBAL EN LAS ISLAS: CLIMA, VERTIDOS, INFRAESTRUCTURAS LITORALES Y ECOSISTEMAS MARINOS.
Fernando Tuya Cortes, Instituto Universitario ECOAQUA, Universidad de Las Palmas de GC.
Follow our Live session
www.soclimpact.net

6.2.2 2nd Webinar series (21st September)

6.2.2.1 Objective

Marine Energy in the context of Climate Change

6.2.2.2 Agenda

- ✓ Brief introduction
- ✓ Context of marine energies in the insular territories of the Canary Islands
  Gonzalo Piernavieja Izquierdo - R+D+i Coordinator of the Canary Islands Technological Institute (ITC)
- ✓ Scenarios of climate change in the Canary Islands and marine energy as a key to its mitigation
  Santiago Díaz Ruano - Head of section of the RE department of the Canary Islands Technological Institute (ITC)
- ✓ The need for marine energy in island territories
  Matt Folley - Director of Applied Renewables Research, Ltd.
- ✓ Large-scale deployment of marine energy as a key to the decarbonization of island energy systems

Pedro Mayorga Rubio - CEO EnerOcean

6.2.2.3 Poster


SOCLIMPACT
The SoClimPact project has received funding from the European Union´s Horizon 2020 Research and Innovation Programme under Grant Agreement No 776661
WEBINAR
SEPTIEMBRE
21
10:00-11:30
HORA CANARIA
(LUNES)
LAS ENERGÍAS MARINAS
en el contexto del cambio climático.
CONTEXTO DE LAS ENERGÍAS MARINAS EN LOS TERRITORIOS INSULARES DE CANARIAS
Gonzalo Piernavieja Izquierdo. Coordinador del I+D+i del Instituto Tecnológico de Canarias
ESCENARIOS DEL CAMBIO CLIMÁTICO EN CANARIAS Y LAS ENERGÍAS MARINAS COMO CLAVE PARA SU MITIGACIÓN.
Santiago Díaz Ruano. Jefe de sección del departamento de EERR del Instituto Tecnológico de Canarias
LA NECESIDAD DE LAS ENERGÍAS MARINAS EN TERRITORIOS INSULARES.
Matt Folley. Director de Applied Renewables Research, Ltd.
DESPLIEGUE A GRAN ESCALA DE ENERGÍAS MARINAS COMO CLAVE PARA LA DESCARBONIZACIÓN DE SISTEMAS ENERGÉTICOS INSULARES
-Pedro Mayorga Rubio. CEO EnerOcean
PARTICIPA en directo
INSCRÍBETE AQUÍ
GoToMeeting
www.soclimpact.net

6.2.3 2nd Webinar series (23rd September)

6.2.3.1 Objective

Resilience of electrical infrastructure to climate change related events

6.2.3.2 Agenda

- ✓ Brief introduction
- ✓ Capacity of electricity networks to adapt to situations caused by climate change

  Adrián Castellanos Perdomo – Renewable energies department technician of the Canary Islands Technological Institute (ITC)
- ✓ Distributed generation as a model of adaptation to climate change

  Daniel Henríquez Álamo - Head of section of the RE department of the Canary Islands Technological Institute (ITC)
- ✓ Challenges facing the Spanish island electricity systems in the context of the energy transition and climate change
  Pablo Santos Arozarena – Operations Department of Red Electrica de España

6.2.3.3 Poster


SOCLIMPACT
The SoClimPact project has received funding from the European Union's Horizon 2020 Research and Innovation Programme under Grant Agreement No 776651
WEBINAR
SEPTIEMBRE
23
10:00-11:00 H
(MIÉRCOLES)
Resiliencia de las
INFRAESTRUCTURAS ELÉCTRICAS
a eventos derivados del cambio climático.
CAPACIDAD DE ADAPTACIÓN DE LAS REDES ELÉCTRICAS A LAS SITUACIONES PROVOCADAS POR EL CAMBIO CLIMÁTICO.
Jesús de León Izquier. Jefe de sección del departamento de EERR del Instituto Tecnológico de Canarias, S.A.
LA GENERACIÓN DISTRIBUIDA COMO MODELO DE ADAPTACIÓN AL CAMBIO CLIMÁTICO.
Daniel Henríquez Álamo. Jefe de sección del departamento de EERR del Instituto Tecnológico de Canarias, S.A.
RETOS A LOS QUE SE ENFRENTAN LOS SISTEMAS ELÉCTRICOS INSULARES ESPAÑOLES EN EL CONTEXTO DE LA TRANSICIÓN ENERGÉTICA Y EL CAMBIO CLIMÁTICO
Pablo Santos Arozarena. Departamento de operación de Red Eléctrica de España.
PARTICIPA en directo
INSCRÍBETE AQUÍ
GoToMeeting
www.soclimpact.net

6.2.4 2nd Webinar series (25th September)

6.2.4.1 Objective

Climate change mitigation actions based on the commitment to energy efficiency and sustainable construction

6.2.4.2 Agenda

- ✓ Brief introduction
- ✓ Climate change mitigation actions in energy-intensive sectors in island territories
  Pilar Navarro Rivero - Head of section of the RE department of the Canary Islands Technological Institute (ITC)
- ✓ Climate change and sustainable building action plans
  Celia Bueno Vega - Head of section of the RE department of the Canary Islands Technological Institute (ITC)
- ✓ Description and current status of clean energy for EU islands
  Luís García Benedicto – Head of the IDAE's demand management and renewable energy network integration department.

6.2.4.3 Poster


SOCLIMPACT
The SoClimPact project has received funding from the European Union´s Horizon 2020 Research and Innovation Programme under Grant Agreement No 776661
WEBINAR
SEPTIEMBRE
25
10:00-11:00 H
(VIERNES)
ACCIONES DE MITIGACIÓN
del cambio climático basadas en la apuesta por la eficiencia energética y la edificación sostenible
ACCIONES DE MITIGACIÓN DEL CAMBIO CLIMÁTICO EN SECTORES DE USO INTENSIVO DE LA ENERGÍA EN LOS TERRITORIOS INSULARES.
Pilar Navarro Rivero. Jefa de Sección del departamento de EERR del Instituto Tecnológico de Canarias, S.A.
PLANES DE ACCIÓN DE CAMBIO CLIMÁTICOS Y EDIFICACIÓN SOSTENIBLE
Celia Bueno Vega. Jefa de Sección del departamento de EERR del Instituto Tecnológico de Canarias, S.A.
DESCRIPCIÓN Y SITUACIÓN ACTUAL DEL CLEAN ENERGY FOR EU ISLANDS
Luís García Benedicto. Jede del Departamento de Gestión de la Demanda e Integración de Renovables en Red del IDAE
PARTICIPA en directo
INSCRÍBETE AQUÍ
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6.3 Adaptation Options Evaluation

6.3.1 Tourism

Options Characterization				Criteria				
ID	Name	Description	Class of adaptation	Cost Efficiency	Environmental protection	Mitigation win-wins and trade-offs	Technical applicability	Social Acceptability
T1	**Economic Policy Instruments (EPIs)**	Economic Policy Instruments (EPIs) are incentives designed and implemented with the purpose of adapting individual decisions to collectively agreed goals. Different type of instruments can be applied, like pricing (e.g. water tariffs), environmental taxes and charges, subsidies; trading (e.g. tradable permit for pollution or water abstraction, compensation mechanisms, payments for environmental services); and voluntary agreements and risk management schemes such as insurances.	1. Financial capital	4	3	3	4	3
T2	**Financial incentives to retreat from high-risk areas**	Financial incentives to retreat from high-risk areas refers to the creation of financial incentives to retreat or relocate settlements, infrastructure and productive activities from the original location due to their high exposure to risks such as flood, sea-level rise and storm surges.	1. Financial capital	2	1	2	3	2

T3	**Adaptation of groundwater management**	Adaptation of groundwater management can be used to (1) conserve groundwater reservoirs, limiting water use and optimizing water reuse, and (2) restore or increase natural infiltration capacity. Both contribute to adaptation in circumstances of reduced precipitation and sea saltwater intrusion aggravated with groundwater over-exploitation. Different packages of interventions usually include freshwater injection, modifying pumping practice, delayed inflow, artificial recharge or efficient use of freshwater.	10. Provisioning services	**4**	**3**	**3**	**4**	**4**
T4	**Monitoring, modelling and forecasting systems**	Monitoring, modelling and forecasting systems are information system that provide timely and reliable climate information, as well as up-to-date data on the occurrence and severity of extreme events, possible impacts and their duration. Different systems can be implemented to respond to different climate hazards, such as drought-related, water quality monitoring, water resources management and predicting and managing flood risks.	10. Provisioning services	**4**	**3**	**3**	**4**	**3**
T5	**Dune restoration and rehabilitation**	Dune restoration and rehabilitation refers to the strengthening of the flood safety and sand reservoir functions of dunes. Dune erosion happens as a result of wind action, marine erosion, human activities and Sea Level Rise (SLR). Possible technics examples include grass planting, thatching and fencing.	11. Regulating and Maintenance Services	**4**	**4**	**2**	**3**	**3**

T6	**River rehabilitation and restoration**	River rehabilitation and restoration are measures that emphasise the natural functions of rivers and create vegetated buffer zones alongside watercourses. This contributes to the improvement of micro-climatic conditions, reduces run-off and erosion, and increases groundwater recharge. For Tourism, this option also increases available leisure areas, increases thermal comfort areas and the availability of water.	11. Regulating and Maintenance Services	**3**	**4**	**3**	**3**	**2**
T7	**Adaptive management of natural habitats**	Adaptive management of natural habitats refers to the preservation of ecosystem services which are essential for human well-being. Human activities induce pressure and impacts on biodiversity and ecosystems that tend to be aggravated by climate change. Adaptive management measures include understanding species response; make space for the development of rivers and coasts; aid gene flow; species translocation; targets and conservation mechanisms/plans.	12. Cultural services	**4**	**4**	**4**	**3**	**3**
T8	**Ocean pools**	Ocean pools are seawater pools located by the sea where waves can wash into the pool. The width, length and depth of ocean pools varies and often depends on their location on the coastline. These recreational structures are useful on SLR context, doubling as an additional protection of the coast and creating alternatives to beach leisure areas.	12. Cultural services	**3**	**1**	**2**	**4**	**3**

T9	**Activity and product diversification**	Activity and product diversification include actions to diversify the tourism activities and products and aim to reduce seasonality and overload in infrastructures and ecosystems. Shifting the dependency from 'sun, sea and sand' products to alternative leisure activities can reduce the impacts of heat waves, coastal erosion or ecosystem degradation, and thus help to maintain destination attractiveness.	2. Human capital	**4**	**3**	**2**	**3**	**3**
T10	**Public awareness programmes**	Public awareness programmes establish targeted programmes that raise awareness about climate change (specific values and protection needs) among guides, site managers and local communities.	2. Human capital	**3**	**3**	**3**	**3**	**3**
T11	**Local circular economy**	Local circular economy is an economic system aimed at eliminating waste and the continual use of resources that offers a valuable framework for reduced carbon emissions from materials (decarbonization) and increased resilience to climate change and its impacts.	3. Social capital	**3**	**4**	**4**	**3**	**3**
T12	**Tourist awareness campaigns**	Tourist awareness campaigns target behavioural change of visitors and aim to increase tourists (individuals and organisations) knowledge about climate change and the risk faced by tourism destinations. These campaigns can be targeted to regions affected by a particular climate threat, specific groups of visitors or the general tourism sector as a whole.	3. Social capital	**3**	**3**	**3**	**3**	**3**
T13	**Local sustainable fishing**	Local sustainable fishing refers to the promotion of fishing zones/rights for local small-scale fishers maintaining stocks and using sustainable methods. This option aims to add value	4. Natural capital	**2**	**4**	**3**	**3**	**4**

		to local resources and products, protect ecosystems services and decrease external dependency.						
T14	**Water restrictions, consumption cuts and grey-water recycling**	Restrictions can be applied to allow water administration services to cope with water crises. Restriction (or rationing) of certain uses of water such as irrigation of lawns, car washing, filling swimming pools or hosing down pavement areas may be necessary during these times. Grey-water recycling (or reclamation) is the reuse of non-drinkable water (usually treated wastewater) to cover water use needs that don't demand such a high-quality standard.	4. Natural capital	**2**	**3**	**3**	**2**	**1**
T15	**Beach nourishment**	Beach nourishment (or replenishment) is the artificial placement of sand to compensate for erosion. Beach nourishment also often aims at maintaining beach width (for tourism and recreational purposes). Several beach nourishment techniques can be used including beach, backshore and shoreface nourishment, and large scale coastal nourishment (e.g. using sand motors).	5. Physical capital	**2**	**1**	**1**	**3**	**2**
T16	**Desalination**	Desalination is the process of removing salt from sea or brackish water to make it useable for a range of purposes including drinking and can contribute to adaptation in circumstances of current or future water scarcity problems. Technological examples include electrically driven technologies, like reverse osmosis, and thermally driven technologies, based mainly on vapor distillation processes.	5. Physical capital	**2**	**2**	**1**	**3**	**2**

T17	**Coastal protection structures**	Coastal protection structures such as groynes, breakwaters, artificial reefs and seawalls are different types of artificial structures, built in the shoreline (or rivers), which are designed to protect the coast from SLR or storms. Those structures can be used to, for example, drift and trap sediments, protect from erosion, absorb wave energy, or allow navigation.	6. Managing long term risk	**3**	**1**	**1**	**4**	**3**
T18	**Drought and water conservation plans**	Drought and water conservation plans refer to tourism-lead adaptation and/or involvement in drought management plans with the aim to reduce the economic, social, and environmental consequences of drought and water scarcity, and to reduce the loss of water and improve efficiency in the sector.	6. Managing long term risk	**4**	**3**	**3**	**2**	**2**
T19	**Mainstreaming Disaster Risk Management (DRM)**	Mainstreaming Disaster Risk Management (DRM) aims to plan and organize DRM along five stages including prevention, protection, preparedness, and response, recovery and review. Examples include interventions to limit urban development in flood prone areas; identify natural hazard prone areas; develop strategies, arrangements, and procedures to address crises; and post-emergency recovery activities.	7. Preparedness	**4**	**3**	**3**	**2**	**3**
T20	**Using water to cope with heat waves**	Water use to cope with heat waves in cities are a set of investments in water supply services and infrastructures that aim to increase urban resilience regarding heat waves. Different packages of grey interventions are usually applied, as for example: creating and/or repairing fountains for drinking water and cooling; water spray fountains; and wetting streets.	7. Preparedness	**3**	**2**	**2**	**3**	**3**

T21	**Fire management plans**	Fire management plans are management actions have wide range of application such as early warning detection, with escape routes and advice to local citizens and tourists, mobilization and suppression of unwanted and damaging fires, or use of fire to manage fuel. Additionally, these plans help to increase the understanding of the interactions of climate change with vegetation cover and fire regimes.	8. Response	**4**	**4**	**4**	**3**	**4**
T22	**Health care delivery systems**	Health care delivery systems are pre-emptive actions and adjustments that need to be made to health care systems, namely reinforcing less prepared aspects of its operation and/or logistics, in order to guarantee effectiveness and efficiency during, for example, high temperature and heat-wave situations.	8. Response	**4**	**2**	**2**	**3**	**4**
T23	**Post-Disaster recovery funds**	Post-Disaster recovery funds is the creation of recovery funds for the Tourism sector to recover after disasters, through initiatives that get the economy up and running quickly while building-back-better (e.g. rebuild damaged critical infrastructures such as ports and roads or recover the landscape from fires). The aim is to minimize the economic and social impacts (which may include future loss of the touristic destination attractiveness) that can occur in a post-disaster context.	9. Post disaster recovery and rehabilitation	**2**	**1**	**1**	**3**	**4**
T24	**Pre-disaster early recovery planning**	Pre-disaster early recovery planning processes include the development of knowledge, good practices and objectives that aim to improve the living conditions of the affected communities, while facilitating the adjustments necessary to reduce the risk of future disasters. Examples of good practices are may include identifying critical ecosystems	9. Post disaster recovery and rehabilitation	**4**	**4**	**2**	**3**	**4**

		(goods and services) that require immediate restoration after a disaster or particularly vulnerable communities.						
T25	**Thermal isolation of buildings**	Funding and technical assistance for the adoption of bioclimatic architecture criteria in reformed and newly built tourist buildings; regulation forcing it should be delivered together with economic incentives, socially justified by the positive externality of contribution a more environmentally friendly image of the destination. Balearic Islands Architects Association recognises around 45% of buildings at the island exhibit a deficient level of thermal isolation and the potential reduction of energy consumption and emissions would range from 30 to 80% with respect to the current levels.	Local knowledge	**4**	**3**	**4**	**3**	**3**
T26	**Zero sewage discharge to the sea**	This measure means to enhance sewage treatment system throughout the islands with two important, climate related purposes. First, mitigate the impact of seawater heating on the seagrass meadows, in turn crucial to sustain the entire marine ecosystems. Second, contribute to water supply with a lesser energy-demanding water source than desalination.	Local knowledge	**3**	**4**	**3**	**4**	**3**

T27	**Distributed electric grids powered by renewables**	Develop distributed electric grids based on renewable sources (pv, wind) to power desalination plants and tourist firms consortia, to reduce electricity cost and emissions, and increase the stability of the general electric grid while increasing renewables participation in the electric mix.	Local knowledge	**4**	**4**	**4**	**3**	**4**
T28	**Forest fire prevention**	Incentive forest traditional cattle-based uses to reduce forest flammability and maintenance of farming activities in the periphery of forest masses, thus performing as firewalls. Social abandon of traditional uses and upper-land agriculture has led to recent 6ª generation, inextinguishable forest fires that destroy endemic terrestrial biodiversity and precious landscapes and put in risk residents' and tourists' lives.	Local knowledge	**3**	**4**	**4**	**3**	**3**
T29	**Effective plan of water demand management and investment in reducing losses along the water distribution system**	Water is one of the chief concerns at Government and societal level in the Balearic Islands when projections on climate chain impacts are made. Experts state that saving water measures have very long run before adopting the contribution of water desalination to the supply-mix. Also, sewage treatment and water reusing should be previous to water desalination.	Local knowledge	**3**	**4**	**3**	**3**	**3**

T30	**Residual organic matter composting to reduce methane emissions, restorage degraded landscapes and enhance soil fertility**	Sewage sludge, organic waste from agriculture and the organic fraction of the MSW are currently disposed in poorly managed landfills, releasing methane to the atmosphere while agricultural soil shows extreme organic poorness and exhausted quarries degrade landscapes. Composting would contribute to link tourism to decarbonization, local food options and landscapes rehabilitation.	Local knowledge	**4**	**4**	**4**	**4**	**3**

6.3.2 Maritime Transport

Options Characterization				Criteria				
ID	Name	Description	Class of adaptation	Cost Efficiency	Environmental protection	Mitigation (GHG emissions) win-wins and trade-offs	Technical applicability	Social Acceptability
MT1	**Insurance mechanisms for ports**	Insurance mechanisms for ports include risk-sharing schemes that aim to assist port operators in responding to the climate risks they are enabled to reduce. Insurance outsources the risks to a third party in exchange for a regular financial compensation.	1. Financial capital	**3**	**3**	**2**	**3**	**4**
MT2	**Financial incentives to retreat from high-risk areas**	Financial incentives to retreat from high-risk areas refers to the creation of financial incentives to retreat or relocate settlements, infrastructure and productive activities from the original location due to their high exposure to risks such as flood, sea-level rise and storm surges.	1. Financial capital	**3**	**2**	**2**	**3**	**2**
MT3	**Marine life friendly coastal protection structures**	Marine life friendly coastal protection structures are coastal protection structures constructed with materials that maximize the fixation of marine organisms. This option reduces climate change impacts on local ecosystems, provides water waste depuration (made by marine organisms) and water quality bio-indicators inside the ports.	10. Provisioning services	**3**	**4**	**3**	**3**	**4**

MT4	**Combined protection and wave energy infrastructures**	Combined protection and wave energy infrastructures is an energy measure that combines sea protection structures with wave energy production. This can create economies of scale, increase coastal protection and further decrease wave propagation inside the port during normal operations.	10. Provisioning services	**2**	**2**	**3**	**2**	**3**
MT5	**Hybrid and full electric ship propulsion**	Hybrid and full electric ship propulsion is environmentally friendly for marine life, decreases carbon emissions and can increase ship manoeuvrability which is useful in small ports and under difficult weather conditions. Low speed manoeuvring with conventional engines creates air and water pollution, noise and fuel consumption. Electrically driven propulsion can address these issues while increasing manoeuvrability using for instance azimuth thrusters.	11. Regulating and Maintenance Services	**3**	**3**	**3**	**2**	**4**
MT6	**Coastal protection structures**	Coastal protection structures such as groynes, breakwaters, artificial reefs and seawalls are different types of artificial structures, built in the shoreline (or rivers), which are designed to protect the coast from SLR or storms. Those structures can be used to, for example, drift and trap sediments, protect from erosion, absorb wave energy, or allow navigation.	11. Regulating and Maintenance Services	**2**	**2**	**2**	**3**	**3**
MT7	**Integrate ports in urban tissue**	Integrate ports into the urban tissue opening port areas to other activities, namely cultural, while gaining room in the urban landscape. This allows some port activities to be pooled from low-laying areas while leisure and cultural activities can access more waterfront space.	12. Cultural services	**3**	**2**	**2**	**4**	**4**

MT8	**Ocean pools**	Ocean pools are situated by the sea where waves can wash into the pool. The width, length and depth of ocean pools varies and often depends on their location on the coastline. These recreational structures are a response to SLR, protect the coast and create alternatives to beach leisure areas.	12. Cultural services	**2**	**2**	**2**	**3**	**3**
MT9	**Awareness campaigns for behavioural change**	Awareness campaigns for behavioural change aim to increase individuals and organisations' knowledge about climate change and the risk faced by the maritime transport sector. These campaigns can be targeted to regions affected by a particular climate threat, specific groups of infrastructures or the general transport sector as a whole.	2. Human capital	**2**	**2**	**2**	**4**	**3**
MT10	**Social dialogue for training in the port sector**	Social dialogue for training in the port sector refers to social and educational issues related with the gender equality and attracting the young to the sector, while tackling climate change. It relies on social dialogue between workers and employees to define common guidelines for training. It considers key challenges that ports are facing and how the industry is adapting to change and preparing for the future.	2. Human capital	**3**	**2**	**2**	**4**	**3**
MT11	**Diversification of trade using climate resilient commodities**	Diversification of trade using climate resilient commodities aims to reduce dependency on trade of perishable goods and critical services, create larger stocks of goods that are climate resilient and consider were changing trading systems to endure changes in climate is economically feasible, strategically justifiable and equitable.	3. Social capital	**2**	**2**	**3**	**2**	**3**

MT12	**Climate resilient economy and jobs**	Climate resilient economy and jobs aims to shift the economy and jobs towards a more climate resilient society. Perishable goods and some critical services rely heavily on the marine transport which can be affected by unpredictable extreme weather events. To address this the economy needs to adapt by shifting to products and services that depend less on Just In Time (JIT) operations, using for instance larger stocks.	3. Social capital	**2**	**3**	**4**	**3**	**3**
MT13	**Refrigeration, cooling and ventilation systems**	Improve the efficiency of refrigeration, cooling and ventilation systems in order to reduce costs in warmer weather and maintain operations during heat waves. Human thermal comfort provided by efficient ventilation and cooling is relevant to ensure the health and safety of passengers and port workers. Refrigeration is relevant for managing goods that need low temperatures.	4. Natural capital	**2**	**2**	**2**	**4**	**3**
MT14	**Restrict development and settlement in low-lying areas**	Restrict development and settlement in low-lying areas means to assure that ports are not further developed in low-laying areas exposed to SLR. Planning must consider the long-term potential risks.	4. Natural capital	**2**	**2**	**2**	**3**	**3**
MT15	**Sturdiness improvement of vessels**	Improve the strength of vessels to sea storms while decreasing the noise and increasing efficiency. Wave-induced loads on the ship structures are a major concern in hull design process. Ship owners should prefer designs that allow for more demanding wave regimes (for instance including the survivability to rouge waves).	5. Physical capital	**3**	**3**	**3**	**3**	**3**

MT16	**Increase operational speed and flexibility in ports**	Increase operational speed and flexibility in ports aims to increase the attractiveness of ship transport in order to capture more freight and passenger movement. This can promote a modal shift towards shipping and create new opportunities including those related with exports and tourism. Faster operations also reduce the effects of heat waves on goods and people as well as decarbonise the economy.	5. Physical capital	**3**	**2**	**3**	**2**	**3**
MT17	**Climate proof ports and port activities**	Climate-proof ports and port activities refers to investments that consider specific climate change projections to manage future risks in port infrastructures and improve operational safety conditions. These can include retrofitting or reconfiguring breakwaters and other port structures to avoid overtops and flooding due to storm surges, heavy precipitation, extreme heat, strong winds events and extreme swell conditions. The Copernicus Emergency Management Services (EMS) services can provide regarding climate change and disaster risk reduction.	6. Managing long term risk	**3**	**3**	**2**	**4**	**3**
MT18	**Consider expansion/retreat of ports in urban planning**	Consider expansion/retreat of ports in urban planning means to consider the expansion or reallocation of areas for future maritime transport infrastructures due to climate change risks. The urban planning and expansion should consider the potential requirements for port expansion/retreat options.	6. Managing long term risk	**4**	**3**	**2**	**4**	**4**

MT19	**Reinforcement of inspection, repair and maintenance of infrastructures**	A continuous reinforcement of inspection, repair and maintenance of infrastructures aims to adapt monitoring to a new climate context. Changes in the frequency and/or intensity of storms, SLR or temperature, for example, may have impacts in infrastructure, increasing degradation of the materials and requiring new maintenance plans.	7. Preparedness	**4**	**3**	**2**	**4**	**4**
MT20	**Early Warning Systems (EWS) and climate change monitoring**	Early Warning Systems (EWS) is an information system with several components that assesses climate risks and relays that information to decision makers, companies' utilities and the general public in real time. Transport operators should integrate this tool in procedures in order to protect the safety of people and goods. The collected data can also be used to study the evolution of climate impacts as time progresses, for instance the impact of heat waves and storms in operations.	7. Preparedness	**4**	**4**	**2**	**4**	**4**
MT21	**Intelligent Transport Systems (ITS)**	Intelligent Transport Systems (ITS) are technologies that relay automated and tailored data and safety-related messages to ships, regarding climate hazards and other relevant information. ITS use communication and information standards that are uniform and widely accepted by other ports that the island is linked to.	8. Response	**3**	**3**	**3**	**3**	**3**
MT22	**Prepare for service delays or cancellations**	Prepare for service delays or cancellations aims to promote the creation of new procedures, alternative options and channels to sell goods and transport passengers, as well as better communication to deal with delays or cancellations. Dealing with more frequency and/or intensity of storms (which will happen in some regions) improves port reputation and customer preferences.	8. Response	**3**	**2**	**2**	**3**	**3**

MT23	**Backup routes and infrastructures during extreme weather**	Backup routes and infrastructures during extreme weather aims to creates a post disaster response that ensures available alternatives when the main ports are damaged or inaccessible due to extreme weather events. It considers alternative ports and access roads. Alternative ports can be smaller in size, simpler and be used for other purposes, but should have a different location and orientation from the main ones.	9. Post disaster recovery and rehabilitation	**3**	**3**	**2**	**4**	**3**
MT24	**Post-Disaster recovery funds**	Post-Disaster recovery funds is the creation of recovery funds for the maritime transport sector to recover after disasters, through initiatives that get the economy up and running quickly while building-back-better (e.g. rebuild damaged critical infrastructures such as ports and roads). The aim is to minimize the economic and social impacts that can occur in a post-disaster context.	9. Post disaster recovery and rehabilitation	**3**	**3**	**2**	**4**	**3**
MT25	**Development of an adaptation plan to adequate infrastructure to climate threats**	Adapt mooring structures, increase of dikes and the free board in old docks, particularly to the rise in sea level, so as to enable the Balearic Islands to maintain and improve their position in international recreational boating and recreational cruise traffic. Also, to the importance of freight traffic.	Local knowledge	**3**	**3**	**4**	**4**	**4**
MT26	**Improve and ensure operational safety in ship repair**	To improve and guarantee the operational safety of large ship repair activity against climatic events, the Balearic Islands being very specialized in recreational boating and mega-yachts.	Local knowledge	**3**	**2**	**3**	**4**	**3**

MT27	**Develop the potential of maritime navigation between the Balearic Islands and the Mediterranean region**	To transfer knowledge and capacities for the adaptation to climate change to the Spanish peninsula and the Mediterranean region, which will guarantee their future connectivity with the Balearic Islands and the development of the potential of maritime navigation between the Balearic Islands and the Mediterranean region.	Local knowledge	**4**	**2**	**3**	**4**	**3**
MT28	**Strengthen and prepare the provisioning system to heat waves**	To reinforce and improve, in the face of possible climatic events, in particular to heat waves, the storage areas. Adapt the provisioning system to heat waves.	Local knowledge	**3**	**2**	**3**	**4**	**4**
MT29	**Improve monitoring systems**	Monitoring systems can be improved. Identifying operational working windows in case of extreme events.	Local knowledge	**4**	**3**	**2**	**4**	**4**
MT30	**Encourage the adaptation of recreational marinas to the main climate change hazards**	To stimulate, accompany and encourage the adaptation of recreational marinas to the main climate change hazards, in order to guarantee the operation and future expansion of recreational sailing. Nautical activities are of special importance for the Balearic Islands tourism, since tourism accounts for about 45% of the GDP.	Local knowledge	**3**	**2**	**2**	**3**	**3**

6.3.3 Energy

Options Characterization				Criteria				
ID	Name	Description	Class of adaptation	Cost Efficiency	Environmental protection	Mitigation win-wins and trade-offs	Technical applicability	Social Acceptability
E1	**Financial support for buildings with low energy needs**	Financial schemes in the form of loans, subsidies or tax reliefs are ways to support the reduction of energy needs of new or existing buildings, making them address climate change in a more efficient manner. For example, architecture and construction materials that rely on passive thermal comfort reduce the use of energy for human comfort, so less air-conditioning is necessary in the cooling season.	1. Financial capital	4	4	4	4	3
E2	**Financial support for smart control of energy in houses and buildings**	The support of smart control of energy in houses and buildings allows for an efficient and automated use of energy that enables savings and creates synergies with utilities. For example, such a system could coordinate the automated opening vents with the air conditioning operation, avoiding energy consumption when possible. This will allow for the adaptation of buildings at a controlled cost, while complying with mitigation goals.	1. Financial capital	4	3	3	4	4

E3	**Energy efficiency in urban water management**	Energy efficiency in urban water management is the adaptation of urban design and construction for water conservation that avoids energy use under scarcity scenarios. For instance, Water Sensitive Urban Design (WSUD) aims to plan water conservation and storm water storage with integration with elements of urban design. This both to minimises hydrological impacts on the environment and the associated energy use of water supply.	10. Provisioning services	**3**	**2**	**4**	**3**	**3**
E4	**Underground tubes and piping in urban planning**	Underground tubes and piping are used for space heating/cooling across the globe and are more resilient to climate change. These systems can be Earth Air Heat Exchanger (EAHE) and Ground Source Heat Pump (GSHP) types. Both systems use tubes or pipes that usually need to be buried beyond the footprint of the building or house. The measure considers this need, and both allows and encourages the use of such space in urban planning.	10. Provisioning services	**3**	**2**	**3**	**4**	**4**
E5	**Biomass power from household waste**	Biomass power plants burn household waste, waste from parks and public gardens and sludge generated by sewage treatment plants. Towns and cities can also realise urban production and recreational woods, which can be used for producing biomass for co-generation (Combine Heat and Power) as well as tri-generation (Combined Cold Heat and Power) plants.	11. Regulating and Maintenance Services	**3**	**4**	**3**	**4**	**3**

E6	**Urban green corridors**	Urban green areas decrease the air temperature in a city and thus decrease energy needs. Warm air tends to transport pollution and particulate matter to higher layers of atmosphere, causing a cloud of smog. Creating green corridors also promotes biodiversity, increases the touristic value and decreases water run-off during storms.	11. Regulating and Maintenance Services	**2**	**4**	**4**	**3**	**4**
E7	**Educational garden plots**	Educational garden plots are sites where people, especially children, can garden with volunteers one afternoon a week after school. The harvest can be taken home. This creates well-being while having local fresh produce reduces the energy consumption and pollution. These garden plots can be further exploring to educate people about other climate action measures, directly and indirectly related with energy such as waste to energy, composting, water retention and green corridors.	12. Cultural services	**3**	**4**	**3**	**4**	**3**
E8	**Heated pools with waste heat from power plants**	Power plants need cooling and their waste heat can be used in swimming pools for public use and tourism. This creates an attractive leisure activity in off-peak winter times which diversifies the touristic offer and promote community well-being. This type of heat recovery design is called Combined Heat and Power (CHP). Pools provide a heat sink for the power plants which increases efficiency and is useful during heat waves.	12. Cultural services	**3**	**3**	**3**	**4**	**3**

E9	**Green jobs and businesses**	The promotion of green jobs and businesses consists in training people and supporting green businesses to implement energy solutions across the economy, both in mitigation and adaptation. One example can be the support of research projects to help businesses deal with new technologies relevant to climate action.	2. Human capital	**4**	**4**	**3**	**2**	**4**
E10	**Public information service on climate action**	Public information service on climate action aims to provide the general public with information about adaptation and mitigation options available for their activities and businesses. This includes information dissemination and counselling about available solutions and the public support. This type of information is relevant, for example, to support dwellings, hotels or commerce to adapt to climate change.	2. Human capital	**4**	**2**	**3**	**4**	**3**
E11	**Small scale production and consumption (prosumers)**	Small scale production and consumption (prosumers) aims to promote cooperation by creating economies of scale both in the production and consumption of energy. This allows for a greater use of local renewable resources and waste energy recovery which allow for a better resilience when dealing with climate change events such as heat waves.	3. Social capital	**4**	**3**	**3**	**4**	**3**
E12	**Risk reporting platform**	Risk reporting platform intends to promote the communication between the general public and the administration bodies concerning the risks related with climate change. It is a platform were the general public reports directly the risks as they become aware of. These can be for example related with cliff instability, trees falling over energy lines, uncleared bushes that	3. Social capital	**3**	**2**	**3**	**4**	**3**

		can be ignited by power lines or unstable structures that may fall due to strong winds.						
E13	**Energy storage systems**	The development of energy storage systems can provide an alternative when the main power sources fail and need time to recover. This allows for a more resilient energy grid while enabling decarbonization and peak levelling at a controlled cost. This includes not only electric batteries (like those in cars and buses), but also other forms of energy storage such as thermal tanks (heat), ice banks (cold) or water height (reversed pumping).	4. Natural capital	**2**	**2**	**3**	**4**	**3**
E14	**Collection and storage of forest fuel loads**	Collection and storage of forest fuel loads intend to promote and regulate the collection and storage of wood and combustible material to reduce wildfire hazard. Actions may include clearing of small trees out of dense areas, reduce the amount of fuel on the ground and increasing the spacing between trees. Materials collected can be used in energy to waste applications such as pellets, biogas or other energy solutions.	4. Natural capital	**3**	**3**	**3**	**2**	**3**

E15	**Sea Water Air Conditioning (SWAC).**	The Seawater Air Conditioning (SWAC) measure is an alternate-energy system design that uses cold water from the deep ocean to provide more efficient, decarbonized and reliable cooling. The sweater is piped to heat exchangers for process cooling or to provide condensation water in air conditioning systems. It replaces air cooling units or fresh water evaporative cooling towers which performances degrades in heat waves. Other subsequent or parallel seawater uses can be combined, like for swimming pools or desalinisation.	5. Physical capital	**2**	**2**	**3**	**3**	**3**
E16	**Demand Side Management (DSM) of Energy**	Demand Side Management (DSM) of energy is an operational strategy that better coordinates producers and consumers of energy. More renewable energy use is possible while ensuring the energy service reliability and controlled costs. DMS balances off-peak and peak demand using peek shaving, which is important, for example, during heat waves.	5. Physical capital	**4**	**3**	**3**	**3**	**3**
E17	**Review building codes of the energy infrastructure**	Review energy infrastructure building codes aims to climate-proof the energy system by reviewing regulatory codes and infrastructures considering the spatial distribution of climate risks. This should include establishment of new procedures, maintenance practices, operational changes, retrofitting and the use of climate and mapping services such as those produced by the Copernicus Emergency Management Service (EMS).	6. Managing long term risk	**4**	**2**	**3**	**3**	**3**

E18	**Upgrade evaporative cooling systems**	Upgrade of evaporative cooling systems that rely on a given range of air temperature and water availability is necessary given that this type of cooling systems are a technology that can be affected by climate change and become compromised due to heat waves and water scarcity.	6. Managing long term risk	**4**	**2**	**3**	**3**	**3**
E19	**Early Warning Systems (EWS)**	Early Warning Systems (EWS) is an information system that assesses climate risks and provides real time information to decision makers, companies, utilities and the general public. Climate data used to control and monitor the energy infrastructure can be relayed to the EWS. Using this data to monitor the evolution of climate related impacts in the energy sector increases the knowledge necessary to make long term climate adaptation decisions.	7. Preparedness	**3**	**4**	**3**	**3**	**3**
E20	**Grid reliability**	Grid reliability improvement aims to find and upgrade critical components and to enhance the energy system resilience to climate risks. This may include redundant circuitry or components that provide alternative dispatch of energy, equipment upgrades (e.g. better cooling to cope with heat waves) or power downrating (e.g. decrease power output of energy transformers so that they do not overheat during heat waves).	7. Preparedness	**3**	**3**	**3**	**4**	**3**

E21	**Study and develop energy grid connections**	Energy grid connections aims to develop interconnections between islands and/or with the mainland allowing for the creation of economies of scale, energy system reliability improvements and more Renewable Energy Sources (RES) penetration.	8. Response	**4**	**3**	**3**	**4**	**3**
E22	**Energy-independent facilities (generators)**	Energy-independent facilities (generators) make it possible for buildings to temporarily create their own energy supply. In case of an energy supply failure (power outage), essential amenities remain functional and can be optimized with Combined Heat and Power (CHP) designs and other decentralised energy generation solutions.	8. Response	**1**	**1**	**3**	**3**	**3**
E23	**Energy recovery microgrids**	Energy recovery microgrids are operational elements of the energy grids that rely on distributed generation to restore systems from power outages and to stabilize the grid. This allows for a flexible and swifter recovery from power outages caused by knock-out events (e.g. tree falls on energy lines), excess demand (e.g. during heat waves) or other causes.	9. Post disaster recovery and rehabilitation	**4**	**2**	**4**	**4**	**3**
E24	**Local recovery energy outage capacity**	Local recovery energy outage capacity consists in increasing and improving the ability of the islands to recover from energy outages caused by or worsen by climate extreme events, like severe sea or windstorms that can lead to island isolation and exacerbate logistical hurdles. To facilitate a swift recovery, it's useful to have more mobile backup power, power line replacements	9. Post disaster recovery and rehabilitation	**2**	**2**	**2**	**3**	**2**

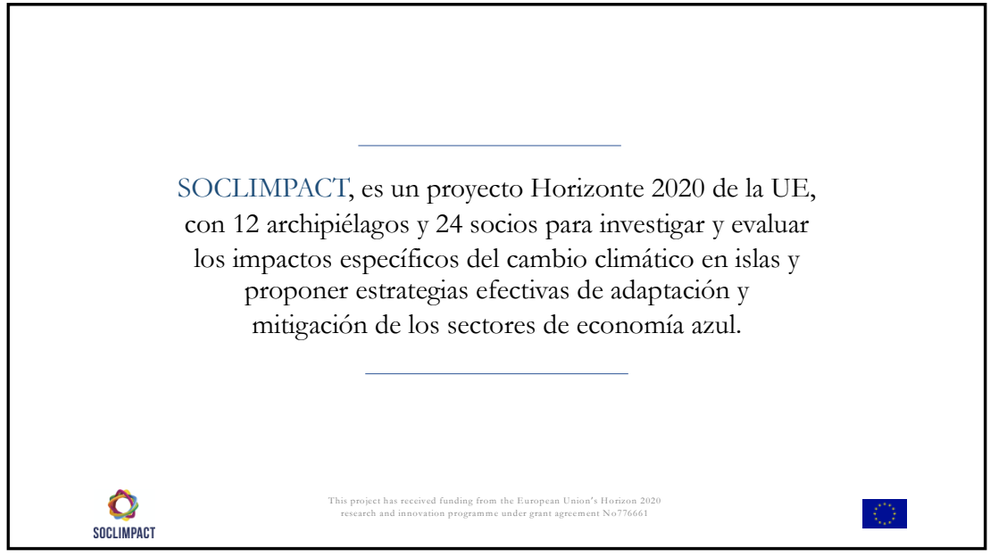
		and other grid components, logistics, supplies and personnel.						
E25	**Promotion of domestic and small-scale photovoltaic solar energy**	Massive promotion through various instruments: a) Direct subsidy of installations; b) A more favourable legislation than the current one for the net balance; c) Massive development of energy communities in all the public and private buildings to be adapted.	Local knowledge	**3**	**3**	**3**	**3**	**4**
E26	**Financial support for the energy rehabilitation of buildings**	Support for investment to rehabilitate old buildings with very low energy efficiency that cannot afford to insulate the house, with the aim of activating the energy rehabilitation of the urban park. In addition, this initiative will also be able to create employment.	Local knowledge	**3**	**2**	**3**	**3**	**4**
E27	**Mass development of the public transport network powered by renewable energies**	Improve the public transport network to make it much more effective and useful for citizens, in order to encourage its use. In particular, to develop the railway network (tramway networks), taking advantage of the existing infrastructure of the old railway network.	Local knowledge	**2**	**2**	**3**	**3**	**3**

E28	**Encourage electric individual transport and car-sharing**	As for individual electric mobility, promote the use of hydrogen-powered vehicles. Additionally, encourage the use of vehicle sharing, to avoid the need to acquire a vehicle to move around the islands. The concept of sharing includes cars, motorbikes and bicycles.	Local knowledge	**2**	**2**	**3**	**3**	**4**
E29	**Training development in installation and thermal insulation of buildings**	Training initiatives in installation and thermal insulation of buildings, in order to enhance the quality of the service of industrial tissue.	Local knowledge	**4**	**3**	**3**	**3**	**3**
E30	**Promoting storage systems for renewable energy installations**	This measure would seek to solve/ diminish surplus problems. The strategic importance of facilitating a proper integration of renewables, particularly photovoltaic energy, with the aim of promoting decarbonization in the islands.	Local knowledge	**3**	**3**	**3**	**3**	**4**

6.4 Interviews script

6.4.1 Tourism

1



2

Bienvenido/a…

- Al proceso de diseño de políticas públicas y de colaboración público privada para adaptar la actividad turística canaria a los riesgos derivados del cambio climático…
- Las opiniones bien informadas son clave para que las políticas estén bien diseñadas y sean eficaces…
- Canarias está construyendo su política para afrontar los retos y oportunidades del cambio climático, y el proyecto Soclimpact quiere contribuir aportando sus resultados y dando voz a las partes interesadas…
- Esta entrevista se estructura en dos partes, la primera para conocer su opinión sobre condicionantes del desarrollo del turismo en el SXXI y evaluar marcos de política posibles; y la segunda para que evalúe medidas alternativas relativas a fortalecer la industria turística frente a los impactos del CC.

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BLOQUE I

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4

Principales tendencias que definirán la evolución del Siglo

Previsiblemente, la evolución de la actividad turística a nivel global, se verá influenciada, entre otros procesos, por:

- El **crecimiento económico** global, del cuál el turismo es un componente fundamental y que al mismo tiempo afecta a la marcha de esta industria, y su distribución por regiones y países.
- La evolución de la **gobernanza global**, incluido el libre comercio y las barreras a los movimientos de mercancías, capitales y personas; la vigencia del multilateralismo vs repliegues nacionalistas; la emergencia de conflictos regionales y locales, incluso armados.
- El **cambio tecnológico**, su velocidad y dirección, especialmente en lo referido a las tecnologías de la información y la comunicación, y del transporte.
- La evolución de la **cohesión social**, de la distribución de la renta y de las políticas de bienestar, en el mundo, y en el entorno europeo.
- La evolución de las emisiones de **GEI** y del **cambio climático**, así como de los acuerdos globales con respecto al cuidado del clima, y de las políticas nacionales.

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5

El entorno del turismo de Canarias en el Siglo 21

Las tendencias que Vd. prevé en cada uno de estos procesos,
¿cómo cree que influirán en el turismo global
y de Canarias a lo largo del Siglo XXI?
(palabras clave)

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6

Preferencias sobre políticas climáticas

En virtud de cómo Vd. evalúe los problemas que puede representar el cambio climático para el turismo, **podría desear que se aplicaran unas u otras políticas** en esta materia.

En el marco de este Proyecto, entenderemos por **política** la *movilización de recursos financieros, y de capacidades técnicas y humanas, para el logro de objetivos concretos en materia de adaptación del turismo a las amenazas del cambio climático y de su contribución a la mitigación del mismo*; incluye todas las formas de **colaboración público-privada.**

A continuación, le pedimos que muestre su grado de acuerdo con 4 posibles **marcos de política** definidos para gestionar los impactos derivados del cambio climático, en general, y de aquellos que se ciernen sobre el turismo, en particular, que se resumen a continuación.

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Ordenar preferencias sobre políticas climáticas

Por favor, ordene las siguientes trayectorias posibles de política de acuerdo con sus preferencias, **numerándolas del 1 al 4**, siendo 1 su preferida.

TPC A

- **No precipitarse**!!! Mejor no hacer nada que hacerlo mal.
- Precipitación → + costes (irrecuperables → - competitividad.
- Hacer lo mínimo al mínimo coste → emergencias, si las hay…
- Esperar a qué otros hagan, aprender de sus errores …
- En este asunto, se va más cómodo en el vagón de cola.

TPC B

- El **crecimiento** es la mejor medicina para todo, incluido el cambio climático.
- Genera capacidades financieras → más inversión → economía a prueba de los impactos del Cambio climático.
- No a la adaptación que frene el crecimiento. No cambios estructurales.
- Descarbonización: aquella que conduzca a la generación de beneficios

TPC C

- La clave está en la **eficiencia** (en el uso de los RN y el MA).
- Eficiencia → incrementa base RN → incrementa opciones de futuro: mejor vía afrontar impacto CC.
- Priorizar el bienestar sostenible de la sociedad (antes que el crecimiento).

TPC D

- *Adaptación transformativa*: adaptación con **transformación estructural**
- Implica "TPC C" y además cambio en: i) preferencias de la sociedad por bienes más eco-amables; ii) cambio tecnológico forzado por incentivos para asegurar que nos ajustamos a los límites de la biosfera; iii) adaptar las organizaciones y el trabajo → mayor resiliencia de toda la sociedad al cambio climático.

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BLOQUE II

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9

Medidas para adaptar la industria al cambio climático en Canarias

A continuación, le mostramos 5 potenciales ámbitos de acciones que podrían implementarse para mejorar la resiliencia del turismo ante la amenaza del cambio climático.

Por favor, ordene de mayor a menor importancia cada ámbito de acciones, según su criterio:

1. Perfeccionar los **incentivos fiscales** para las empresas del sector (carga fiscal, figuras impos.)
2. Apoyo a la **investigación, desarrollo e innovación** que facilite la adaptación*
3. Apoyo a la **gestión** de los entornos del turismo (mercados, operadores, sociedad)
4. Apoyo a la **inversión privada** en adaptación y mitigación del cambio climático
5. Instrumentos de **planificación anticipativa y alerta temprana** frente a los riesgos
6. Otro ámbito, ¿cuál?:

1 = mayor importancia

5 = menor importancia

* En este contexto, incluye la mitigación para adaptarse a las preferencias de los mercados.

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Prioridades de política y horizontes temporales

Vd. puede considerar que unas medidas son más prioritarias que otras, y también que su importancia relativa puede cambiar a lo largo del tiempo. Para facilitar la comparación, le presentaremos pares de medidas, relativas a los 5-6 ámbitos presentados en la diapositiva anterior, para que las compare decidiendo sobre su prioridad e importancia relativa a medio y largo plazo.

Considere también que su preferencia por una medida frente a otra, podría depender del marco (TPC) desde el que estuviera comparándolas. Por favor, proceda a compararlas aportando una breve explicación de su decisión, relacionada con la evolución de las capacidades de adaptación de la sociedad a largo plazo.

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1. Capital financiero

A1	Instrumentos de política económica	Diseñados con el propósito de adaptar las decisiones individuales a los objetivos acordados colectivamente. Diferentes tipos de instrumentos, como: fijación de precios (por ejemplo, tarifas de agua), impuestos y tasas ambientales, subvenciones; comercio (por ejemplo, permiso negociable para la contaminación o la extracción de agua, mecanismos de compensación, pagos por servicios ambientales); y acuerdos voluntarios y planes de gestión de riesgos como los seguros.	VS	A2	Incentivos financieros para retirarse de las zonas de alto riesgo	Los incentivos financieros para retirarse de las zonas de alto riesgo se refieren a la creación de incentivos financieros para retirar o reubicar los asentamientos, la infraestructura y las actividades productivas de la ubicación original debido a su alta exposición a riesgos como las inundaciones, la elevación del nivel del mar y tormentas.

Por favor, señale la opción preferida:

Horizonte cercano (hasta 2030)		Horizonte intermedio (hasta 2050)		Horizonte lejano (hasta 2100)	
A9	A10	A9	A10	A9	A10
☐	☐	☐	☐	☐	☐

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2. Capital humano

A9	Diversificación de actividades y productos	Tiene como objetivo reducir la estacionalidad y la sobrecarga de las infraestructuras y los ecosistemas, valorizando otros infrautilizados. Si se hace tomando en cuenta los riesgos climáticos como olas de calor, erosión costera o la degradación de ecosistemas, podría ayudar a mantener el atractivo del destino.

VS

A10	Programas de sensibilización	Orientados al incremento de la conciencia sobre el cambio climático (valores específicos y necesidades de protección) entre todas las profesiones relacionadas con el turismo (manager generales, administradores de complejos, guías, recepcionistas, etc.) y de la población local en su conjunto.

Por favor, señale la opción preferida:

Horizonte cercano (hasta 2030)		Horizonte intermedio (hasta 2050)		Horizonte lejano (hasta 2100)	
A9	A10	A9	A10	A9	A10
☐	☐	☐	☐	☐	☐

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3. Capital social

A11	Economía circular local	La economía circular local es un sistema económico destinado a eliminar los desechos y el favorecer uso continuo de recursos, que ofrece un marco valioso para reducir las emisiones de carbono (descarbonización) y aumentar la resistencia al cambio climático y sus repercusiones.

VS

A12	Campañas de sensibilización de los turistas	Las campañas de sensibilización turística se centran en el cambio de comportamiento de los visitantes y tienen como objetivo aumentar el conocimiento del cambio climático y sus riesgos, y estimular cambios de comportamiento de los turistas (individuos y organizaciones). Pueden estar dirigidas a grupos específicos de visitantes o al conjunto de ellos.

Por favor, señale la opción preferida:

Horizonte cercano (hasta 2030)		Horizonte intermedio (hasta 2050)		Horizonte lejano (hasta 2100)	
A9	A10	A9	A10	A9	A10
☐	☐	☐	☐	☐	☐

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4. Capital natural

A13	Pesca local sostenible	La pesca local sostenible se refiere a la protección de derechos de pesca de los pescadores artesanales, que mantienen las poblaciones, utilizan métodos sostenibles y proveen material prima de alto valor culinario. Esta opción tiene por objeto añadir valor a los recursos y productos locales, proteger los servicios de los ecosistemas (incluida la fijación de carbono) y disminuir la dependencia externa.

VS

A14	Restricciones de agua, recortes de consumo y reciclaje de aguas residuales	Para hacer frente a las crisis de agua. La restricción (o el racionamiento) de ciertos usos del agua, como el riego del césped, el lavado de automóviles, el llenado de piscinas o la limpieza con mangueras de las zonas pavimentadas, puede ser necesario durante esos períodos. La depuración y reutilización de aguas residuales puede igualmente contribuir a aliviar la escasez en usos que no exigen un nivel de calidad del agua alto.

Por favor, señale la opción preferida:

Horizonte cercano (hasta 2030)		Horizonte intermedio (hasta 2050)		Horizonte lejano (hasta 2100)	
A9	A10	A9	A10	A9	A10
☐	☐	☐	☐	☐	☐

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5. Capital físico

A15	Alimentación de la playas (beach nourishment)	La alimentación de la playa (o reposición) es la colocación artificial de arena para compensar la erosión. La alimentación de las playas también suele tener por objeto mantener la anchura de la playa (con fines turísticos y recreativos). Se pueden utilizar varias técnicas de alimentación de las playas, con preferencia por aquellas que atienden y respetan los procesos de recirculación natural de la arena.

VS

A16	Desalación	La desalación puede contribuir a la adaptación en circunstancias de escasez de agua, actuales o futuros. Entre los ejemplos tecnológicos figuran las tecnologías de accionamiento eléctrico, como la ósmosis inversa, y las tecnologías de accionamiento térmico, basadas principalmente en procesos de destilación de vapor. Pueden ir asociadas a redes eléctricas distribuidas alimentadas por energías renovables.

Por favor, señale la opción preferida:

Horizonte cercano (hasta 2030)		Horizonte intermedio (hasta 2050)		Horizonte lejano (hasta 2100)	
A9	A10	A9	A10	A9	A10
☐	☐	☐	☐	☐	☐

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6. La gestión del riesgo a largo plazo

A17	Estructuras de protección costera	Incluyen espigones, rompeolas, arrecifes artificiales y malecones son diferentes tipos de estructuras artificiales, construidas en la línea de costa (o en los ríos), que están diseñadas para proteger la costa de la subida del nivel del mar o de las tormentas. Esas estructuras pueden utilizarse, por ejemplo, para derivar y retener sedimentos, proteger de la erosión, absorber la energía de las olas o permitir la navegación.

VS

A18	Sequía y planes de conservación del agua	Los planes contra la sequía y de conservación del agua, bien dirigidos al turismo o generals con participación del turismo, persiguen reducir las consecuencias económicas, sociales y ambientales de la escasez de agua, mediante la reducción de las pérdidas y mejoras en la eficiencia.

Por favor, señale la opción preferida:

Horizonte cercano (hasta 2030)		Horizonte intermedio (hasta 2050)		Horizonte lejano (hasta 2100)	
A9	A10	A9	A10	A9	A10
☐	☐	☐	☐	☐	☐

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7. Preparación

A19	Incorporación de la gestión del riesgo de desastres	Se despliega a lo largo de cinco etapas que incluyen la prevención, la protección, la preparación y la respuesta, la recuperación y el análisis. Entre los ejemplos figuran las intervenciones para limitar el desarrollo urbano en las zonas propensas a las inundaciones; la identificación de las zonas propensas a los peligros naturales; la elaboración de estrategias, disposiciones y procedimientos para hacer frente a las crisis; y las actividades de recuperación después de las emergencias.

VS

A20	Utilizar el agua para hacer frente a las olas de calor	El uso del agua para hacer frente a las olas de calor en las ciudades es un conjunto de inversiones en servicios e infraestructuras de abastecimiento de agua que tienen por objeto aumentar la capacidad de recuperación de las ciudades frente a las olas de calor. Incluye intervenciones como crear y/o reparar fuentes de agua potable y de refrigeración, canals principals y ramales de agua en zonas de ocio, fuentes de rociado de agua y mojar las calles, etc.

Por favor, señale la opción preferida:

Horizonte cercano (hasta 2030)		Horizonte intermedio (hasta 2050)		Horizonte lejano (hasta 2100)	
A9	A10	A9	A10	A9	A10
☐	☐	☐	☐	☐	☐

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8. Respuesta

A21	Planes de control de incendios	Acciones de gestión que tienen una amplia gama de aplicaciones, como la detección de alerta temprana, con rutas de escape y asesoramiento a los ciudadanos locales y a los turistas, la eliminación de incendios indeseados y perjudiciales, o el uso de incendios controlados para gestionar el combustible. Además ayudan a aumentar la comprensión de las interacciones del cambio climático con la cubierta vegetal y los regímenes de incendios.	VS	A22	Sistemas de atención de la salud	Los sistemas de prestación de servicios de atención de la salud son medidas preventivas y ajustes que es necesario introducir en los sistemas de atención de la salud, a saber, reforzar los aspectos menos preparados de su funcionamiento y/o logística, a fin de garantizar la eficacia y la eficiencia durante, por ejemplo, las situaciones de altas temperaturas y olas de calor, o brotes infecciosos.

Por favor, señale la opción preferida:

Horizonte cercano (hasta 2030)		Horizonte intermedio (hasta 2050)		Horizonte lejano (hasta 2100)	
A9	A10	A9	A10	A9	A10
☐	☐	☐	☐	☐	☐

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9. Recuperación y rehabilitación después de un desastre

A23	Fondos para la recuperación post-desastre	Fondos para facilitar que el turismo se recupere después de los desastres, mediante iniciativas que pongan en marcha la actividad rápidamente, al tiempo que reconstruyan con mejores cimientos (por ejemplo, reconstruir las infraestructuras críticas dañadas como puertos y carreteras o recuperar el paisaje de los incendios). El objetivo es reducir al mínimo los efectos económicos y sociales (que pueden incluir la pérdida futura del atractivo del destino turístico) posteriores a un desastre.	VS	A24	Planificación de la recuperación temprana previa al desastre	Incluyen el desarrollo de conocimientos, buenas prácticas y objetivos que tienen por objeto la mejora inmediata de las poblaciones afectadas, facilitando al mismo tiempo los ajustes necesarios para reducir el riesgo de futuros desastres. Ejemplos de buenas prácticas son la identificación de los ecosistemas críticos (servicios) que requieren una restauración inmediata o de las comunidades particularmente vulnerables; definición de procedimientos de intervención eficientes; …

Por favor, señale la opción preferida:

Horizonte cercano (hasta 2030)		Horizonte intermedio (hasta 2050)		Horizonte lejano (hasta 2100)	
A9	A10	A9	A10	A9	A10
☐	☐	☐	☐	☐	☐

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10. Servicios de aprovisionamimento

A3	Mejora de la gestión de las aguas subterráneas	Puede concretarse en: 1) conservar los aquíferos, limitando el uso del agua y optimizando su reutilización, y 2) restaurar o aumentar la capacidad de infiltración natural. Contribuyen a la adaptación en circunstancias de reducción de las precipitaciones y de intrusión de agua salada, agravadas por la sobreexplotación de las aguas subterráneas. Suelen incluir la recarga artificial y reducción de pérdidas en distribución.	VS	A4	Sistemas de vigilancia, modelización y previsión climática	Son sistemas de información que proporcionan información climática oportuna y fiable, y datos actualizados sobre ocurrencia y gravedad de los fenómenos extremos, sus posibles impactos y su duración. Se deben ajustar según los peligros climáticos relevantes, como los relacionados con la sequía, la vigilancia de la calidad del agua, la gestión de los recursos hídricos y la predicción y gestión de los riesgos de inundación.

Por favor, señale la opción preferida:

Horizonte cercano (hasta 2030)		Horizonte intermedio (hasta 2050)		Horizonte lejano (hasta 2100)	
A9	A10	A9	A10	A9	A10
☐	☐	☐	☐	☐	☐

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11. Servicios de regulación y mantenimiento

A5	Restauración y rehabilitación de dunas	Se refiere al fortalecimiento de las funciones de seguridad contra inundaciones y de depósito de arena de las dunas. También de su función recreativa. La erosión de las dunas se produce como resultado de la acción del viento, la erosión marina, las actividades humanas y la elevación del nivel del mar (SLR). Entre los posibles ejemplos técnicos se incluyen: la plantación de plantas, coberturas de paja y las vallas.	VS	A6	Rehabilitación y restauración de cuencas pluviales	Son medidas que ponen de relieve las funciones naturales de las cuencas y crean zonas de amortiguación con vegetación a lo largo de los cursos de agua. Mejora las condiciones microclimáticas, reduce la erosión y aumenta la recarga de las aguas subterráneas. En el caso del turismo, esta opción también aumenta las zonas de ocio disponibles, aumenta las zonas de confort térmico y la disponibilidad de agua.

Por favor, señale la opción preferida:

Horizonte cercano (hasta 2030)		Horizonte intermedio (hasta 2050)		Horizonte lejano (hasta 2100)	
A9	A10	A9	A10	A9	A10
☐	☐	☐	☐	☐	☐

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12. Servicios culturales

A7	Gestión adaptativa de los hábitats naturales	Se refiere a la preservación de los servicios de los ecosistemas que son esenciales para el bienestar humano, buena parte de ellos agravados por el cambio climático. Entre las medidas de gestión adaptativa figuran: mejorar la comprensión de la respuesta de las especies; dejar espacio a las dinámicas fluviales y costeras; ayudar al flujo de genes y a la movilidad de las especies; actualización constant de los objetivos y los instrumentos y planes de conservación.

VS

A8	Piscinas naturales	Las piscinas oceánicas son piscinas de agua de mar situadas junto al mar, donde las olas pueden penetrar. El ancho, la longitud y la profundidad de las piscinas oceánicas varía, dependiendo de su ubicación en la línea de costa. Son útiles en el contexto de la subida del nivel del mar, ya que sirven para proteger la costa y constituyen alternativas a las playas.

Por favor, señale la opción preferida:

Horizonte cercano (hasta 2030)		Horizonte intermedio (hasta 2050)		Horizonte lejano (hasta 2100)	
A9	A10	A9	A10	A9	A10
☐	☐	☐	☐	☐	☐

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Ordenar seis medidas concretas y proponer otras

Por favor, para finalizar proponga 6 medidas concretas urgentes ordenadas en función de su necesidad:

1			
2			
3			
4			
5		.	
6			

1 = mayor importancia

6 = menor importancia

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¡Muchas gracias por su participación!

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6.4.2 Maritime Transport

Diseño participativo de políticas públicas

La adaptación del transporte marítimo al cambio climático

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1

SOCLIMPACT, es un proyecto Horizonte 2020 de la UE, con 12 archipiélagos y 24 socios para investigar y evaluar los impactos específicos del cambio climático en islas y proponer estrategias efectivas de adaptación y mitigación de los sectores de economía azul.

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2

Bienvenido/a…

- Al proceso de diseño de políticas públicas y de colaboración público privada para adaptar el transporte marítimo canario a los riesgos derivados del cambio climático…
- Las opiniones bien informadas son clave para que las políticas estén bien diseñadas y sean eficaces…
- Canarias está construyendo su política para afrontar los retos y oportunidades del cambio climático, y el proyecto Soclimpact quiere contribuir aportando sus resultados y dando voz a las partes interesadas…
- Esta entrevista se estructura en dos partes, la **primera** para conocer cómo ordenaría la importancia de los diferentes **peligros** climáticos, zonas portuarias más **expuestas** y potenciales afecciones al **valor añadido** de la actividad portuaria; y la **segunda** para que exprese su **preferencia** con respecto a **opciones alternativas** de adaptación al cambio climático, en diferentes horizontes temporales.

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BLOQUE I

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4

Hazards

Algunos de los siguientes peligros para la operatividad de su puerto pueden exacerbarse con el cambio climático.

¿Podría por favor ordenar los peligros siguientes de mayor a menor de acuerdo con la información de la que dispone?

a	Fuertes vientos sostenidos y ráfagas de viento	Fuertes vientos capaces de impedir que ciertas operaciones se lleven a cabo con seguridad.	
b	Altura de las olas	Aumento de la altura de las olas, especialmente cuando coincide con la pleamar y en la época del año de mayores mareas.	
c	Subida del nivel del mar	Subida del nivel del mar, haciendo más dañinos los efectos del oleaje y de las marejadas, y pudiendo inundar zonas del recinto portuario.	
d	Lluvias torrenciales y marejadas ciclónicas	Capaces de producir inundaciones de zonas de operaciones portuarias.	
e	Episodios de calor extremo	Olas de calor que puedan afectar a la conservación de las mercancías y a las condiciones de trabajo de los operarios.	
	Otro hazard, ¿cuál?		

1 = mayor importancia

5 = menor importancia

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5

Estructuras y procesos vulnerables

En su puerto, previsiblemente unas estructuras y procesos pueden verse más afectados que otros como con secuencia del cambio climático y de la situación en la que actualmente se encuentran.

¿Podría ordenar las siguientes de mayor a menor vulnerabilidad a los impactos del cambio climático?

a	Estructuras de protección	Diques y escolleras que pueden ser superados por las olas.	
b	Atraque	Líneas de atraque cuya operatividad que pueden verse afectadas por la subida del nivel del mar y el oleaje.	
c	Zona de aproximación buques	La aproximación de buques al recinto portuario puede verse afectada por el oleaje, aun cuando el puerto pudiera permanecer operativo.	
d	Carga y descarga	Las operaciones de carga y descarga pueden verse afectadas por fuertes vientos, por calor extremo o por inundaciones.	
e	Áreas de almacenamiento	Superficies destinadas al almacenamiento de mercancías y servicios administrativos, entre otros, pueden verse afectadas por inundaciones.	
	Otra estructura o proceso, ¿cuál?		

1 = mayor importancia

5 = menor importancia

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6

Efectos económicos

Los diferentes impactos del cambio climático sobre la operativa portuaria pueden afectar al valor añadido de la actividad portuaria, por diferentes motivos.

¿Podría por favor ordenar de mayor a menor los motivos que podrían inducir pérdida de valor agregado de la actividad portuaria?

a	Reestructuración del tráfico marítimo y las operaciones portuarias	Costes de reestructuración de tráfico y de las operaciones portuarias, afectados por fenómenos climáticos extremos.	
b	Pérdida de tráfico marítimo por rutas alternativas	Pérdida de tráfico marítimo por desvío a rutas alternativas climáticamente más seguras.	1 = mayor importancia
c	Pérdida de tráfico marítimo por reducción de la producción de mercancías comercializadas	Pérdida de tráfico marítimo por reducción de la producción de mercancías comercializadas a través de transporte marítimo (indirecto).	↕
d	Pagos a terceros en compensación de pérdidas o gastos en seguros por pérdidas de terceros	Pago a terceros en compensación de pérdidas, o gasto en seguros de cobertura de pérdidas de terceros, debido a factores climáticos.	5 = menor importancia
e	Gastos en reparaciones de estructuras dañadas	Gastos en reparaciones de estructuras portuarias dañadas por diferentes manifestaciones de clima extremo (vientos, oleaje, lluvias torrenciales, marejadas, ciclones, etc.)	
	Otro efecto económico, *¿cuál?*		

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BLOQUE II

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8

Prioridades de política y horizontes temporales

Vd. puede considerar que unas medidas son más prioritarias que otras, y también que su importancia relativa puede cambiar a lo largo del tiempo. Por ello, le presentaremos pares de medidas relativas a los 5 bloques presentados en la diapositiva anterior para que las compare decidiendo sobre su prioridad e importancia relativa a medio y largo plazo.

Considere también que su preferencia por una medida frente a otra, podría depender del marco (TPC) desde el que estuviera comparándolas. Por favor, proceda a compararlas aportando una breve explicación de su decisión relacionada con la evolución de las capacidades de adaptación de la sociedad a largo plazo.

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1. Capital financiero

A1	Mejora de los esquemas de aseguramiento de los puertos	Los seguros para los puertos incluyen planes de distribución de riesgos que tienen por objeto ayudar a los operadores portuarios a responder a los riesgos climáticos que pueden reducir. El seguro subcontrata los riesgos a un tercero a cambio de una compensación financiera regular.

VS

A2	Incentivos financieros para retirarse de las zonas de alto riesgo	Creación de incentivos financieros para retirar o reubicar los asentamientos, la infraestructura y las actividades productivas de la ubicación original debido a su alta exposición a riesgos como las inundaciones, la elevación del nivel del mar y las tormentas.

Por favor, señale la opción preferida:

Horizonte cercano (hasta 2030)		Horizonte intermedio (hasta 2050)		Horizonte lejano (hasta 2100)	
A9	A10	A9	A10	A9	A10
☐	☐	☐	☐	☐	☐

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2. Capital humano

A9	Campañas de sensibilización para promover cambios de comportamiento	Las campañas de sensibilización para el cambio de comportamiento tienen por objeto aumentar los conocimientos de las personas y las organizaciones sobre el cambio climático y el riesgo que afronta el sector del transporte marítimo. Esto facilitaría la aceptación social e institucional de la inversión que los puertos requieren para adaptarse al cambio climático	VS	A10	Formación para la capacitación en el sector portuario	Las medidas de adaptación son ejecutadas en última instancia por el capital humano del Puerto. Por tanto, la formación de los operarios es fundamental para que las medidas planeadas de adaptacion al cambio climatico se lleven a cabo de manera eficaz y eficiente.

Por favor, señale la opción preferida:

Horizonte cercano (hasta 2030)		Horizonte intermedio (hasta 2050)		Horizonte lejano (hasta 2100)	
A9	A10	A9	A10	A9	A10
☐	☐	☐	☐	☐	☐

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3. Capital social

A11	Mejorar las condiciones de los bienes perecederos frente a climas extremos	Preparar los puertos para que los bienes perecederos puedan conservarse en mejores condiciones en contextos de climas extremos. El objetivo es adaptar las condiciones a las características del clima y los cambios que éste pueda soportar.	VS	A12	Economía y empleos resilientes al clima	Hacer la economía y los empleos más resilientes al clima implica que los procesos de comercio dependan menos de las operaciones "Just in Time" (JIT), y que deben aumentarse los stocks estratégicos para hacer frente a posibles interrupciones en los suministros, derivadas de fenomenos climáticos, y reducer los riesgos de desabastecimiento.

Por favor, señale la opción preferida:

Horizonte cercano (hasta 2030)		Horizonte intermedio (hasta 2050)		Horizonte lejano (hasta 2100)	
A9	A10	A9	A10	A9	A10
☐	☐	☐	☐	☐	☐

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4. Capital natural

A13	Sistemas de refrigeración, enfriamiento y ventilación para confort humano	Mejorar la eficiencia de los sistemas de refrigeración, enfriamiento y ventilación para reducir los costes asociados al calor extremo, y mantener las operaciones durante las olas de calor. El confort térmico humano proporcionado por una ventilación y refrigeración eficientes es relevante para garantizar la salud de los pasajeros y la seguridad y productividad de los trabajadores portuarios.

VS

A14	Limitar el desarrollo portuario en las zonas de baja altitud inundables	Limitar el desarrollo portuario y el asentamiento de estructuras en zonas bajas significa reducer las zonas portuarias expuestas a la subida del nivel del mar e inundaciones. Este debe ser un criterio fundamental de la planificación de los desarrollos portuarios.

Por favor, señale la opción preferida:

Horizonte cercano (hasta 2030)		Horizonte intermedio (hasta 2050)		Horizonte lejano (hasta 2100)	
A9	A10	A9	A10	A9	A10
☐	☐	☐	☐	☐	☐

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5. Capital físico

A15	Mejora de la solidez de los buques	Mejorar la resistencia de los buques a las tormentas marinas, disminuyendo el ruido y aumentando la eficiencia. Las cargas inducidas por las olas en las estructuras de los barcos son una preocupación importante en el proceso de diseño del casco. Los armadores deberían preferir diseños que permitan regímenes de olas más exigentes (por ejemplo, que incluyan la capacidad de supervivencia frente a las olas gigantescas).

VS

A16	Aumentar la velocidad operacional y la flexibilidad en los puertos	Tiene por objeto aumentar el atractivo del transporte marítimo a fin de captar más movimiento de carga y de pasajeros. Ello puede promover un cambio modal hacia el transporte marítimo y crear nuevas oportunidades, incluidas las relacionadas con las exportaciones y el turismo. También reduce los efectos de las olas de calor en las mercancías y las personas, y ayuda a la descarbonización de la economía.

Por favor, señale la opción preferida:

Horizonte cercano (hasta 2030)		Horizonte intermedio (hasta 2050)		Horizonte lejano (hasta 2100)	
A9	A10	A9	A10	A9	A10
☐	☐	☐	☐	☐	☐

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6. La gestión del riesgo a largo plazo

A17	Puertos y actividades portuarias a prueba de cambio climático	Las inversiones tienen en cuenta las proyecciones de cambio climático en el entorno para gestionar los riesgos futuros en las infraestructuras portuarias y mejorar las condiciones de seguridad operacional. Pueden incluir la adaptación o reconfiguración de los rompeolas y otras estructuras para evitar sobrecargas e inundaciones debidas a tormentas de mar, fuertes precipitaciones, calor extremo, vientos fuertes y oleaje extremo.

VS

A18	Incorporar la expansión/ reasignación de zonas portuarias en la planificación urbana	Considerar la expansion y reasignación de espacios de la actividad portuaria en planificación urbana tomando en consideración los riesgos derivados del cambio climático, de modo que se faciliten las decisions de las autoridades portuarias a la hora de planificar desarrollos y reasignar áreas para responder a las amenazas del cambio climático.

Por favor, señale la opción preferida:

Horizonte cercano (hasta 2030)		Horizonte intermedio (hasta 2050)		Horizonte lejano (hasta 2100)	
A9	A10	A9	A10	A9	A10
☐	☐	☐	☐	☐	☐

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7. Preparación

A19	Refuerzo de la inspección, reparación y mantenimiento de las infraestructuras	El refuerzo continuo de la inspección, la reparación y el mantenimiento de las infraestructuras tiene por objeto adaptar la vigilancia a un nuevo contexto climático. Los cambios en la frecuencia y/o la intensidad de las tormentas, o la variabilidad de las temperaturas, por ejemplo, pueden tener repercusiones en la infraestructura, aumentando la degradación de los materiales y exigiendo nuevos planes de mantenimiento.

VS

A20	Sistemas de Alerta Temprana y monitoreo del cambio climático	Los sistemas de alerta temprana (EWS) son sistemas de información que evalúan los riesgos climáticos y transmiten esa información a los responsables de la toma de decisiones, a las empresas de servicios públicos y al público en general en tiempo real. Los operadores de transporte deben integrar esta herramienta en los procedimientos para proteger la seguridad de las personas y los bienes en los recintos portuarios.

Por favor, señale la opción preferida:

Horizonte cercano (hasta 2030)		Horizonte intermedio (hasta 2050)		Horizonte lejano (hasta 2100)	
A9	A10	A9	A10	A9	A10
☐	☐	☐	☐	☐	☐

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8. Respuesta

A21	Sistemas de Transporte Inteligente (STI)	Los sistemas de transporte inteligentes (STI) son tecnologías que transmiten a los buques datos automatizados y adaptados, y mensajes relacionados con la seguridad, relativos a los peligros climáticos y otra información pertinente. Los STI utilizan normas de comunicación e información que son uniformes y ampliamente aceptadas por todos los puertos, lo que favorece su adopción.	VS	A22	Prepararse para los retrasos o cancelaciones del servicio	Tiene por objeto promover la creación de nuevos procedimientos, opciones y canales alternativos para la venta de mercancías y el transporte de pasajeros, así como una mejor comunicación para hacer frente a los retrasos o cancelaciones. Contribuye a la mejora de la reputación del puerto y aumenta las preferencias de los clients por el mismo.

Por favor, señale la opción preferida:

Horizonte cercano (hasta 2030)		Horizonte intermedio (hasta 2050)		Horizonte lejano (hasta 2100)	
A9	A10	A9	A10	A9	A10
☐	☐	☐	☐	☐	☐

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9. Recuperación y rehabilitación después de un desastre

A23	Rutas e infraestructuras de reserva en condiciones climáticas extremas	Las rutas e infraestructuras de reserva durante las condiciones meteorológicas extremas tienen por objeto crear una respuesta posterior a los desastres que garantice alternativas disponibles cuando los puertos principales estén dañados o sean inaccesibles debido a fenómenos meteorológicos extremos. Incluyen puertos alternativos de menor tamaño, más sencillos y que se usan para otros fines, pero con una ubicación y orientación diferentes, y vías de acceso alternativas.	VS	A24	Fondos para la recuperación posterior a un desastre	Se trata de fondos de recuperación para que el sector del transporte marítimo se recupere después de los desastres, mediante iniciativas que pongan en marcha rápidamente la economía y viabilicen la reconstrucción de las infraestructuras críticas dañadas, como puertos y carreteras. El objetivo es reducir al mínimo los efectos económicos y sociales que pueden producirse en un contexto post-desastre.

Por favor, señale la opción preferida:

Horizonte cercano (hasta 2030)		Horizonte intermedio (hasta 2050)		Horizonte lejano (hasta 2100)	
A9	A10	A9	A10	A9	A10
☐	☐	☐	☐	☐	☐

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10. Servicios de aprovisionamimento

A3	Estructuras de protección costera respetuosas con la vida marina	Las estructuras de protección costera amigables con la vida marina son estructuras de protección costera construidas con materiales que maximizan la fijación de los organismos marinos. Esta opción reduce los impactos del cambio climático en los ecosistemas locales, proporciona depuración de los desechos de agua (hechos por organismos marinos) y bioindicadores de la calidad del agua dentro de los puertos.

VS

A4	Infraestructuras combinadas para la protección y el aprovechamiento de la energía de las olas	Las infraestructuras de protección combinada y de energía de las olas es una medida energética que combina las estructuras de protección del mar con la producción de energía de las olas. Esto puede crear economías de escala, aumentar la protección costera y disminuir aún más la propagación de las olas dentro del puerto durante las operaciones normales.

Por favor, señale la opción preferida:

Horizonte cercano (hasta 2030)		Horizonte intermedio (hasta 2050)		Horizonte lejano (hasta 2100)	
A9	A10	A9	A10	A9	A10
☐	☐	☐	☐	☐	☐

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11. Servicios de regulación y mantenimiento

A5	Incentivar la propulsión híbrida o eléctrica de los buques	La propulsión híbrida y totalmente eléctrica de los buques es respetuosa con el medio ambiente marino, disminuye las emisiones y puede aumentar la maniobrabilidad de los buques, útil en puertos pequeños y condiciones meteorológicas difíciles (p.e. propulsores acimutales eléctricos). Las maniobras a baja velocidad con motores convencionales crean contaminación del aire y del agua, ruido y consumo de combustible.

VS

A6	Estructuras de protección costera	Los espigones, rompeolas, arrecifes artificiales y malecones son diferentes tipos de estructuras artificiales, construidas en la línea de costa, diseñadas para protegerla de la subida del nivel del mar y de las tormentas. Esas estructuras pueden utilizarse, por ejemplo, para derivar y atrapar sedimentos, proteger de la erosión, absorber la energía de las olas o permitir la navegación.

Por favor, señale la opción preferida:

Horizonte cercano (hasta 2030)		Horizonte intermedio (hasta 2050)		Horizonte lejano (hasta 2100)	
A9	A10	A9	A10	A9	A10
☐	☐	☐	☐	☐	☐

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Seis nuevas medidas concretas

Por favor, ordene de mayor a menor importancia de las siguientes acciones para mantener la operatividad de los puertos de Canarias frente a fenómenos climáticos extremos, según su criterio:

1			
2			
3			
4			
5			
6			

1 = mayor importancia

6 = menor importancia

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¡Muchas gracias por su participación!

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6.4.3 Energy

Diseño participativo de políticas públicas

La adaptación del sector energético al cambio climático

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1

SOCLIMPACT, es un proyecto Horizonte 2020 de la UE, con 12 archipiélagos y 24 socios para investigar y evaluar los impactos específicos del cambio climático en islas y proponer estrategias efectivas de adaptación y mitigación de los sectores de economía azul.

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Bienvenido/a…

- Al proceso de diseño de políticas públicas y de colaboración público privada para adaptar el sector energético canario a los riesgos derivados del cambio climático…
- Las opiniones bien informadas son clave para que las políticas estén bien diseñadas y sean eficaces…
- Canarias está construyendo su política para afrontar los retos y oportunidades del cambio climático, y el proyecto Soclimpact quiere contribuir aportando sus resultados y dando voz a las partes interesadas…
- Esta entrevista se estructura en dos partes, la primera para conocer su opinión sobre condicionantes del desarrollo del sector energético en el SXXI y marcos de política preferidos; y la segunda para que evalúe medidas alternativas relativas a fortalecer el sector energético frente a los impactos del CC.

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BLOQUE I

SOCLIMPACT

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Principales tendencias que definirán la evolución del Siglo

Previsiblemente, la evolución del sector de la energía a nivel global, se verá influenciada, entre otros procesos, por:

- El **crecimiento económico** global, del cuál la energía es un vector fundamental, y su distribución por regiones y países.
- La evolución de la **gobernanza global**, incluido el libre comercio y las barreras a los movimientos de mercancías, capitales y personas; la acción de las instituciones multilaterales; la emergencia y desarrollo de conflictos regionales o locales, especialmente en zonas ricas en materias primas energéticas.
- El **cambio tecnológico**, su velocidad y dirección, especialmente en lo referido a las tecnologías de producción y acumulación de energía y de gestión de las redes eléctricas.
- La evolución de la **cohesión social**, de la distribución de la renta y de las políticas de bienestar, en el mundo, que incluyen las condiciones de acceso a la producción y consumo de la energía..
- La evolución de las emisiones de **GEI** y del **cambio climático**, así como de los acuerdos globales con respecto al cuidado del clima.

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El entorno del sector energético canario en el Siglo 21

Las tendencias que Vd. prevé en cada uno de estos procesos, ¿cómo cree que influirán en el sector energético global y en el sector energético canario del Siglo XXI?

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Preferencias sobre políticas climáticas

En virtud de cómo Vd. evalúe los problemas que puede representar el cambio climático para el sector energético, **podría desear que se aplicaran unas u otras políticas** en esta materia.

En el marco de este Proyecto, entenderemos por **política** la *movilización de recursos financieros, y de capacidades técnicas y humanas, para el logro de objetivos concretos en materia de adaptación del sector energético a las amenazas del cambio climático y su contribución a la mitigación del mismo*; incluye todas las formas de **colaboración público-privada.**

A continuación, le pedimos que muestre su grado de acuerdo con 4 posibles **marcos de política** definidos para gestionar los impactos derivados del cambio climático, en general, y de aquellos que se ciernen sobre el sector energético, en particular, que se resumen a continuación.

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Ordenar preferencias sobre políticas climáticas

Por favor, ordene las siguientes trayectorias posibles de política de acuerdo con sus preferencias, **numerándolas del 1 al 4**, siendo 1 su preferida.

TPC A

- **No precipitarse**!!! Mejor no hacer nada que hacerlo mal.
- Precipitación → + costes (irrecuperables → - competitividad.
- Hacer lo mínimo al mínimo coste → emergencias, si las hay
- Esperar a qué otros hagan, aprender de sus errores …
- En este asunto, se va más cómodo en el vagón de cola.

TPC B

- El **crecimiento** es la mejor medicina para todo, incluido el cambio climático.
- Genera capacidades financieras → más inversión → economía a prueba de los impactos del Cambio climático.
- No a la adaptación que frene el crecimiento. No cambios estructurales.
- Descarbonización: aquella que conduzca a la generación de beneficios

TPC C

- La clave está en la **eficiencia** (en el uso de los RN y el MA).
- Eficiencia → incrementa base RN → incrementa opciones de futuro: mejor vía afrontar impacto CC.
- Priorizar el bienestar sostenible de la sociedad (antes que el crecimiento).

TPC D

- *Adaptación transformativa*: adaptación con **transformación estructural**
- Implica "TPC C" y además cambio en: i) preferencias de la sociedad por bienes más eco-amables; ii) cambio tecnológico forzado por incentivos para asegurar que nos ajustamos a los límites de la biosfera; iii) adaptar las organizaciones y el trabajo → mayor resiliencia de toda la sociedad al cambio climático.

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BLOQUE II

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9

Medidas para adaptar la industria al cambio climático

A continuación, le mostramos 5 potenciales ámbitos de acciones que podrían implementarse para mejorar la resiliencia del sector energético al cambio climático.

Por favor, ordene de mayor a menor importancia cada ámbito de acciones, según su criterio:

1. Más potentes **incentivos financieros y fiscales** para las empresas del sector
2. Apoyo a la **investigación, desarrollo e innovación** que facilite la adaptación
3. Apoyo a la mejora de la **gestión** de los procesos productivos y de los entornos
4. Apoyo a la **inversión privada** para fortalecer la industria frente al cambio climático
5. Instrumentos de **planificación anticipativa y alerta temprana** frente a los riesgos

1 = mayor importancia

5 = menor importancia

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Prioridades de política y horizontes temporales

Vd. puede considerar que unas medidas son más prioritarias que otras, y también que su importancia relativa puede cambiar a lo largo del tiempo. Por ello, le presentaremos pares de medidas, relativas a los 5 bloques presentados en la diapositiva anterior, para que las compare decidiendo sobre su prioridad e importancia relativa a medio y largo plazo.

Considere también que su preferencia por una medida frente a otra, podría depender del marco (TPC) desde el que estuviera comparándolas. Por favor, proceda a compararlas aportando una breve explicación de su decisión, relacionada con la evolución de las capacidades de adaptación de la sociedad a largo plazo.

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1. Capital financiero

A1	**Apoyo financiero para edificios con baja demanda energética**	Planes financieros en forma de préstamos, subvenciones o desgravaciones fiscales son formas de apoyar la reducción de las necesidades energéticas de los edificios nuevos o existentes, logrando que aborden el cambio climático de una manera más eficiente. Reduce la demanda energética para confort térmico (aire acondicionado, calefacción).

VS

A2	**Apoyo financiero para el control inteligente de la energía en casas y edificios**	Uso eficiente y automatizado de la energía que permite el ahorro y crea sinergias con los servicios públicos. Por ejemplo, coordinar la apertura automatizada de los conductos de ventilación con el funcionamiento del aire acondicionado, evitando el consumo de energía cuando sea posible. Reduce los costes de la climatización

Por favor, señale la opción preferida:

Horizonte cercano (hasta 2030)		Horizonte intermedio (hasta 2050)		Horizonte lejano (hasta 2100)	
A9	A10	A9	A10	A9	A10
☐	☐	☐	☐	☐	☐

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2. Capital humano

A9	Empleos y negocios verdes	La promoción de empleos y negocios verdes consiste en capacitar a las personas y apoyar a las empresas verdes para que apliquen soluciones energéticas en toda la economía, tanto en la mitigación como en la adaptación. Un ejemplo de ello puede ser el apoyo a proyectos de investigación para ayudar a las empresas a ocuparse de las nuevas tecnologías pertinentes para la acción climática.	VS	A10	Servicio de información pública sobre la acción climática	Proporcionar al público en general información sobre las opciones de adaptación y mitigación disponibles para sus actividades y negocios. Incluye la difusión de información y el asesoramiento sobre las soluciones y ayudas disponibles. Este tipo de información es pertinente, por ejemplo, para apoyar a las viviendas, los hoteles o el comercio a adaptarse al cambio climático.

Por favor, señale la opción preferida:

Horizonte cercano (hasta 2030)		Horizonte intermedio (hasta 2050)		Horizonte lejano (hasta 2100)	
A9	A10	A9	A10	A9	A10
☐	☐	☐	☐	☐	☐

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3. Capital social

A11	Producción y consumo en pequeña escala (prosumidores)	Promover la cooperación para la creación de economías de escala tanto en la producción como en el consumo de energía. Esto permite un mayor uso de los recursos renovables locales y la recuperación de energía residual, importante en eventos como las olas de calor.	VS	A12	Plataforma de información de riesgos	Promover la comunicación entre el público en general y los órganos de la administración en relación sobre riesgos relacionados con el cambio climático. El público en general informa directamente de los riesgos a medida que toma conciencia de ellos (inestabilidad de acantilados, árboles que caen sobre las líneas de energía, los arbustos secos que pueden arder por las líneas de energía, etc.

Por favor, señale la opción preferida:

Horizonte cercano (hasta 2030)		Horizonte intermedio (hasta 2050)		Horizonte lejano (hasta 2100)	
A9	A10	A9	A10	A9	A10
☐	☐	☐	☐	☐	☐

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4. Capital natural

A13	Sistemas de almacenamiento de energía	El desarrollo de sistemas de almacenamiento de energía puede proporcionar una alternativa cuando las principales fuentes de energía fallan y necesitan tiempo para recuperarse. Esto permite una red de energía más resistente, a la vez que permite la descarbonización y la nivelación de los picos a un costo controlado (incluye baterías eléctricas, depósitos térmicos (calor), los bancos de hielo (frío) o la altura del agua (bombeo invertido).	VS	A14	Recogida y almacenamiento de cargas de combustible forestal	La recolección y el almacenamiento de cargas de combustible forestal tienen por objeto promover y regular la recolección y el almacenamiento de madera y material combustible para reducir el peligro de incendios forestales. Los materiales recolectados pueden utilizarse en aplicaciones de energía como pellets, biogás u otras soluciones energéticas.

Por favor, señale la opción preferida:

Horizonte cercano (hasta 2030)		Horizonte intermedio (hasta 2050)		Horizonte lejano (hasta 2100)	
A9	A10	A9	A10	A9	A10
☐	☐	☐	☐	☐	☐

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5. Capital físico

A15	SeaWater Air Conditioning (SWAC)	La medida del aire acondicionado de agua de mar es un diseño de sistema de energía alternativa que utiliza agua fría de las profundidades del océano para proporcionar un enfriamiento más eficiente, descarbonizado y fiable. Este sistema está conectado a intercambiadores de calor para el proceso de enfriamiento o para proporcionar agua de condensación en los sistemas de aire acondicionado. Sustituye a otras unidades cuyo rendimiento se degrada en las olas de calor.	VS	A16	Gestión de la Demanda (DSM) de la Energía	Es una estrategia operacional que coordina mejor a los productores y consumidores de energía. Es posible utilizar más energía renovable, al tiempo que se garantiza la fiabilidad del servicio de energía y el control de los costos. La DMS equilibra la demanda en horas punta y en horas de menor demanda, lo cual es importante, por ejemplo, durante las olas de calor.

Por favor, señale la opción preferida:

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A9	A10	A9	A10	A9	A10
☐	☐	☐	☐	☐	☐

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6. La gestión del riesgo a largo plazo

A17	Revisar los códigos de construcción de la infraestructura energética	Tiene por objeto proteger el sistema energético contra el clima mediante la revisión de los códigos e infraestructuras reglamentarias teniendo en cuenta la distribución espacial de los riesgos climáticos. Incluye el establecimiento de nuevos procedimientos, prácticas de mantenimiento, cambios operacionales, adaptación y el uso de servicios climáticos y cartográficos como los producidos por el Servicio de Gestión de Emergencias de Copérnico (EMS).

VS

A18	Mejorar los sistemas de refrigeración por evaporación	Mejorar los sistemas de refrigeración por evaporación que dependen de un determinado rango de temperatura del aire y de la disponibilidad de agua es necesario dado que este tipo de sistemas de refrigeración es una tecnología que puede verse afectada por el cambio climático y se ve comprometida debido a las olas de calor y a la escasez de agua.

Por favor, señale la opción preferida:

Horizonte cercano (hasta 2030)		Horizonte intermedio (hasta 2050)		Horizonte lejano (hasta 2100)	
A9	A10	A9	A10	A9	A10
☐	☐	☐	☐	☐	☐

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7. Preparación

A19	Sistemas de alerta temprana (EWS)	Los Sistemas de Alerta Temprana son un sistema de información que evalúa los riesgos climáticos y proporciona información en tiempo real a los responsables de la toma de decisiones, las empresas, los servicios públicos y el público en general. Los datos climáticos que se utilizan para controlar y supervisar la infraestructura energética pueden ser transmitidos al EWS. Vigilar la evolución de los impactos relacionados con el clima en el sector de la energía aumenta los conocimientos necesarios para tomar decisiones de adaptación al clima a largo plazo.

VS

A20	Fiabilidad de la red	La mejora de la fiabilidad de la red tiene por objeto encontrar y mejorar los componentes críticos y aumentar la resistencia del sistema energético a los riesgos climáticos. Esto puede incluir circuitos o componentes redundantes que proporcionen un despacho alternativo de energía, mejoras en los equipos (por ejemplo, mejor refrigeración para hacer frente a las olas de calor) o reducción de la potencia (por ejemplo, disminución de la potencia de los transformadores de energía para que no se sobrecalienten durante las olas de calor).

Por favor, señale la opción preferida:

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A9	A10	A9	A10	A9	A10
☐	☐	☐	☐	☐	☐

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8. Respuesta

A21	Estudiar y desarrollar interconexio-nes de las redes de energía	Las conexiones de la red de energía tienen por objeto desarrollar las interconexiones entre las islas y/o con el continente permitiendo la creación de economías de escala, mejoras en la fiabilidad del sistema energético y una mayor penetración de las fuentes de energía renovables (FER).	VS	A22	Instalaciones independientes de la energía (generadores)	Las instalaciones independientes de energía (generadores) permiten que los edificios creen temporalmente su propio suministro de energía. En caso de que se produzca un fallo en el suministro de energía (corte de corriente), las instalaciones esenciales continúan funcionando y pueden optimizarse con diseños de cogeneración (Combined Heat and Power) y otras soluciones de generación de energía descentralizada.

Por favor, señale la opción preferida:

Horizonte cercano (hasta 2030)		Horizonte intermedio (hasta 2050)		Horizonte lejano (hasta 2100)	
A9	A10	A9	A10	A9	A10
☐	☐	☐	☐	☐	☐

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9. Recuperación y rehabilitación después de un desastre

A23	Microrredes de recuperación de energía	Las microrredes de recuperación de energía son elementos operativos de las redes de energía que dependen de la generación distribuida para restaurar los sistemas de los cortes de energía y para estabilizar la red. Esto permite una recuperación flexible y más rápida de los cortes de energía causados por eventos de apagón (por ejemplo, la caída de árboles en las líneas de energía), el exceso de demanda (por ejemplo, durante las olas de calor) u otras causas.	VS	A24	Capacidad local de recuperación de cortes de energía	Consiste en aumentar y mejorar la capacidad de las islas para recuperarse de cortes de energía causados o empeorados por eventos climáticos extremos, como tormentas de viento severo, que pueden llevar al aislamiento de las islas y exacerbar los obstáculos logísticos. Para facilitar una rápida recuperación, es útil contar con más energía de reserva móvil, reemplazos de líneas eléctricas y otros componentes de la red, logística, suministros y personal.

Por favor, señale la opción preferida:

Horizonte cercano (hasta 2030)		Horizonte intermedio (hasta 2050)		Horizonte lejano (hasta 2100)	
A9	A10	A9	A10	A9	A10
☐	☐	☐	☐	☐	☐

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10. Servicios de aprovisionamimento

A3	Eficiencia energética en la gestión del agua en zonas urbanas	Consiste en la adaptación del diseño y la construcción urbana para la conservación del agua que evita el uso de la energía en situaciones de escasez. Por ejemplo, el Diseño Urbano Sensible al Agua (WSUD) tiene como objetivo planificar la conservación del agua y el almacenamiento de las aguas pluviales con la integración de elementos de diseño urbano. Esto tanto para minimizar los impactos hidrológicos en el medio ambiente como el uso energético asociado al suministro de agua.

VS

A4	Tubos y tuberías subterráneas en la planificación urbana	Los tubos y tuberías subterráneas se utilizan para calentar o enfriar el ambiente en todo el mundo y son más resistentes al cambio climático. Estos sistemas pueden ser del tipo de Intercambiador de Calor del Aire de la Tierra (EAHE) y de Bomba de Calor de Fuente Terrestre (GSHP). Ambos sistemas utilizan tubos o tuberías que normalmente necesitan ser enterrados a una distancia del edificio o la casa. La medida considera esta necesidad, y permite y fomenta el uso de dicho espacio en la planificación urbana.

Por favor, señale la opción preferida:

Horizonte cercano (hasta 2030)		Horizonte intermedio (hasta 2050)		Horizonte lejano (hasta 2100)	
A9	A10	A9	A10	A9	A10
☐	☐	☐	☐	☐	☐

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11. Servicios de regulación y mantenimiento

A5	Energía de la biomasa de los residuos domésticos	Las plantas de energía de biomasa queman los residuos domésticos, los residuos de los parques y jardines públicos y los lodos generados por las plantas de tratamiento de aguas residuales. Los pueblos y ciudades también pueden realizar la producción urbana y los bosques recreativos, que pueden utilizarse para producir biomasa para plantas de cogeneración (Combinación de calor y energía) así como de tri-generación (Combinación de calor y energía en frío).

VS

A6	Corredores verdes urbanos	Las zonas verdes urbanas disminuyen la temperatura del aire en una ciudad y, por lo tanto, reducen las necesidades de energía. El aire caliente tiende a transportar la contaminación y las partículas a capas más altas de la atmósfera, causando una nube de contaminación. La creación de corredores verdes también promueve la biodiversidad, aumenta el valor turístico y disminuye la cantidad de agua que se evacua durante las tormentas.

Por favor, señale la opción preferida:

Horizonte cercano (hasta 2030)		Horizonte intermedio (hasta 2050)		Horizonte lejano (hasta 2100)	
A9	A10	A9	A10	A9	A10
☐	☐	☐	☐	☐	☐

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12. Servicios culturales

A7	**Huertos urbanos**	Las parcelas de jardín educativo son sitios donde la gente, especialmente los niños, pueden cultivar con voluntarios una tarde a la semana después de la escuela. La cosecha puede llevarse a casa. Esto crea bienestar mientras que tener productos frescos locales reduce el consumo de energía y la contaminación. También se usan para educar a la gente sobre otras medidas de acción climática, directa e indirectamente relacionadas con la energía, tales como los residuos, el compostaje, la retención de agua y los corredores verdes.

VS

A8	**Piscinas climatizadas con calor residual de las centrales eléctricas**	Las centrales eléctricas necesitan refrigeración y su calor residual puede ser utilizado en piscinas para uso público y turismo. Este tipo de diseño de recuperación de calor se llama Combinación de Calor y Energía (CHP). Las piscinas proporcionan un disipador de calor para las centrales eléctricas que aumenta la eficiencia. Muy útil durante las olas de calor.

Por favor, señale la opción preferida:

Horizonte cercano (hasta 2030)		Horizonte intermedio (hasta 2050)		Horizonte lejano (hasta 2100)	
A9	A10	A9	A10	A9	A10
☐	☐	☐	☐	☐	☐

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Seis nuevas medidas concretas

Además de las opciones de adaptación vistas arriba, por favor, proponga 6 nuevas o relacionadas con las ya expuestas, que considere prioritarias para Baleares, definidas de forma concreta. Por favor, ordénelas de mayor a menor prioridad:

1		☐
2		☐
3		☐
4		☐
5		☐
6		☐

1 = mayor importancia

6 = menor importancia

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¡Muchas gracias por su participación!

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Downscaling climate impacts and decarbonisation pathways in EU islands, and enhancing socioeconomic and non-market evaluation of Climate Change for Europe, for 2050 and beyond

SoClimPact project has received funding from the European Union's Horizon 2020 Research and Innovation Programme under Grant Agreement No 77661

This project has received funding from the European Union's Horizon 2020 research and innovation programme under Grant Agreement No776661

Work Package 7:

This is a result of Tasks 7.3. This deliverable will include the agendas, the list of participants, and the workshops outputs including the decisions taken.

Deliverable 7.3.

Workshop Report – Canary Islands

Island Focal Point coordinated by ULPGC

Matías Manuel González Hernández, Yen Elizabeth Lam, Ainhoa Bilbao Altés

Final version - 18/12/2020

1 Introduction

This document presents the results of the stakeholders' consultation process to design the **SOCLIMPACT Adaptation Pathways Workshops in the Canary Islands region**. This process is included in SOCLIMPACT Task 7.3 - Engage islands' stakeholders in the design of alternative pathways. According to the project Description of Action is expected that these online workshops use the background material prepared in Task 7.2/D7.2 and include the main results from previous WPs.

In the consultation process, the following objectives are expected to be covered:

7. **Identify and present the characterized packages of adaptation and risk management options** available for each archipelago/island.
8. **Develop detailed archipelago/island integrated adaptation pathways**, in three timeframes: Short term (up to 2030), Mid-century (up to 2050) and End-century (up to 2100).
9. **Evaluate** and rank pathways for Blue Economy sectors.

In the consultation process of the Canary Islands, instead of holding a webinar and collecting the different opinions by means of a questionnaire, the personal interview approach was considered to be the most appropriate to obtain the views of the most representative stakeholders of the four sectors of the blue economy. In addition, this approach made it possible to understand the reasoning behind each choice and, at the same time, to clarify any doubts or misinterpretations that the questions may have caused during the exercise, in order to better qualify the information collected.

The original plan was to conduct the interviews in person, but due to the Covid-19 restrictions, the interviews had to be carried out online. The interviews were held between 1st October 2020 and 9th December 2020, where experts from the four sectors of the blue economy were involved. The interviews were performed taking into consideration the specific requirements of the region and the resources available.

Prior to the interviews, several webinars were held with the aim of informing about the impacts of climate change in both Spanish archipelagos (Canary and Balearic Islands). The first one was the launch webinar, which took place on July 21st, 2020, where the impacts of climate change and how to deal with these risks were presented. The second, was a series of three more specific webinars focusing on different aspects of the energy sector, which took place between 21st and 25th September 2020. In the first webinar, the challenge of involving the most representative stakeholders through a webinar was observed.

In parallel to the interviews, the Slack platform was developed to encourage wider participation of relevant stakeholders, not just the key informants. Where different channels of conversation were created to discuss the different impacts that each of the four sectors may suffer. However, despite the effort, the expected success in terms of stakeholder participation was not achieved.

The 24 options/measures available per sector were characterized by the IFP using the five criteria defined. In addition, up to six additional adaptation options per island and per sector were added by the LWG (class of adaptation "Local Knowledge"). The "Local Knowledge" options for the Canary Islands were developed considering the opinion of experts in each sector.

The report follows what was defined in the proposal by presenting the online interview materials, namely: (1) decisions taken; (2) agendas and (3) list of participants.

The **Adaptation Pathways methodology applied in SOCPLIMPACT was based in the framework developed by Suckall et al.2018 and considered the three main strategic vectors for climate resilience: (1) vulnerability reduction -** Five capitals of Sustainable Livelihoods Approach (SLA)**; (2)**

Disaster Risk Reduction – developed throughout Hyogo and Sendai Frameworks; **(3) Social-Ecological Resilience** – that emerge from the Millennium Ecosystem Assessment (MEA) and Common International Classification of Ecosystem Services (CICES).

The **Adaptation Pathways** aim to capture the policy preferences in time and the relevancy of the context traduced in investment and commitment (Suckall et al., 2018). These Adaptation Pathways Trajectories (APT) (Table 1) were delineated as a set of adaptation classes each one with two options/measures to choose from. Each individual stakeholder choices contribute to create a policy pathway together with the other choices made by different stakeholders. If most of the stakeholders chose one option, then that measure was incorporated in the island adaptation pathway for that specific class in each APT, per sector. The result of the series of choices in the three timeframes defines the pathway. If there is a tie between two options, then they will both be included and become part of the adaptation pathway in each time frame. The options were included in the pathway when they were selected more than 50% in each time frame in each APT. Local Knowledge measures were included if they were chosen by at least 20% of all stakeholders.

APT	Make your choice	Summary
APT A **Minimum Intervention (MI)** ***low investment, low commitment to policy change***	**APT A - Pathway**	This policy trajectory assumes a no-regrets strategy where the lowest cost adaptation policies are pursued to protect citizens from some climate impacts. This APT addresses those areas where maximum impact can be achieved for the lowest cost.
APT B **Economic Capacity Expansion (ECE)** ***high investment, low commitment to policy change***	**APT B - Pathway**	This policy trajectory focuses primarily on encouraging climate-proof economic growth but does not seek to make significant changes to the current structure of the economy. In this APT a high level of investment is required to prepare the economy for future change, but adaptation policy does not aim to reorient the economy or create significant change.
APT C **Efficiency Enhancement (EE)** ***medium investment, medium commitment to policy change***	**APT C - Pathway**	This policy direction is based on an ambitious strategy that promotes adaptation consistent with the most efficient management and exploitation of the current system, looking at ways of distributing labour, balancing livelihood choices, and best utilising ecosystem services to enhance livelihoods and wellbeing under climate change.
APT D **System Restructuring (SR)** ***high investment, high commitment to policy change*** **PROTECT, ACCOMMODATE and RETREAT**	**APT D - Pathway**	This policy direction embraces a pre-emptive fundamental change at every level in order to completely transform the current social-ecological and economic systems and thus changing the social and physical functioning of archipelago/islands sectors. In this APT there is a guiding belief that significant/radical landscape and societal modifications are justified to create long term system restructuring despite the short-term costs that may be accrued, among some social groups or economic sectors.

Table 1 – Adaptation Policy Trajectory (APT) narratives

Pathway options are grouped around three objectives: (1) actions to reduce socio-economic vulnerability; (2) actions that address disaster risk reduction; and (3) actions that affect social-ecological resilience. Adaptation policy under **vulnerability reduction**, **disaster risk reduction**, and **social-ecological resilience** were developed considering classes of adaptation (Figure 1) under which the participants decide which are the most relevant options for the Canary Islands region.

For **vulnerability reduction** five classes were considered: (1) Financial capital; (2) Human capital; (3) Social capital; (4) Natural capital; and (5) Physical capital. For **Disaster Risk Reduction** four classes were considered: (6) managing long term risk; (7) preparedness; (8) response; (9) post disaster recovery and rehabilitation. For **Social-Ecological Resilience** three classes were considered: (10) Post disaster recovery and rehabilitation; (11) Provisioning services; and (12) Regulating and Maintenance Services (Figure 5 - The 12 classes of adaptation are structured in three broader objectives (Vulnerability reduction, Disaster Risk reduction and Ecosystem and social resilience) and linked to each APT narrative.

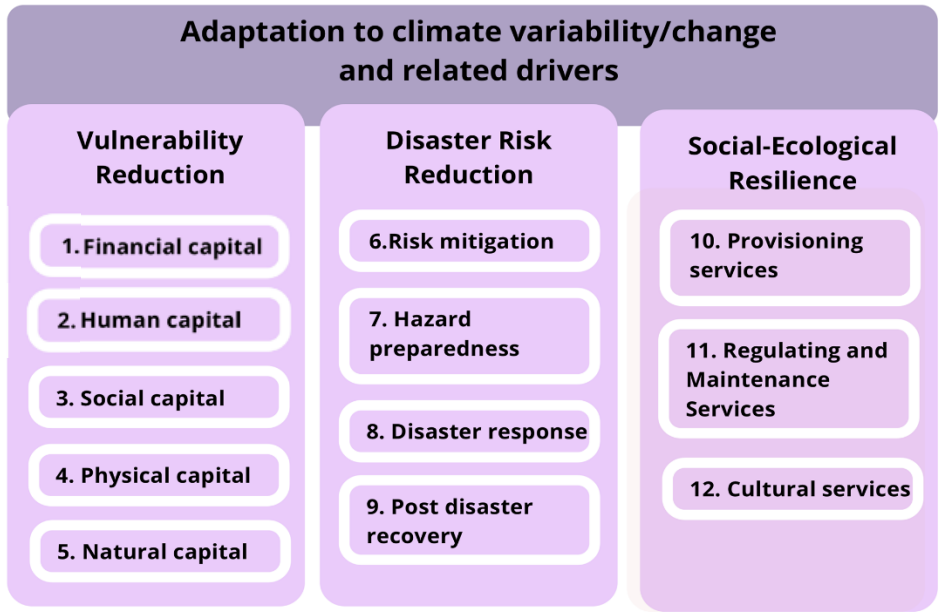

Figure 104 - The 12 classes of adaptation in the figure are structured in three broader objectives (Vulnerability reduction, Disaster Risk reduction and Ecosystem and social resilience).

The results of the Adaptation Pathways are presented in this report in two different outputs per sector: **(1) Selected Adaptation Pathways; and (2) Sustainability Performance.**

The (**1) Selected Adaptation Pathways** outputs aim to capture the acceptance of each adaptation option by calculating the options (number of times) selected within the maximum number of times they can be selected (Ratio – Selected/Maximum). This considers the number of times the option was selected by all stakeholders in all four APTs and three timeframes.

The **(2) Sustainability performance** outputs aim to characterize each pathway through the evaluation of the options chosen in each APT. The options selected in each APTs are evaluated considering a set of criteria: Cost Efficiency; Environmental protection; Mitigation (GHG emissions) win-wins and trade-offs; Technical applicability; Social acceptability (Table 2).

Criteria	Description	
Cost Efficiency	Ability to efficiently address current or future climate hazards/risks in the most economical way	Higher score = higher cost efficiency
Environmental protection	Ability to protect the environment, now and in the future	Higher score = higher environmental protection
Mitigation (GHG emissions) win-wins and trade-offs	Current ability to meet (win-win) or not (trade-off) the island/archipelago's mitigation objectives	Higher score = higher mitigation win-wins and lower trade-offs
Technical applicability	Current ability to technically implement the option/measure in the island/archipelago	Higher score = higher technical applicability
Social acceptability	Current social acceptability of the option/measure in the island/archipelago	Higher score = higher social acceptability

Table 2 – Description of the criteria used to evaluate the adaptation pathways performance.

The results are presented in a spider diagram and is the average of all options chosen for the participants in each APT pathway.

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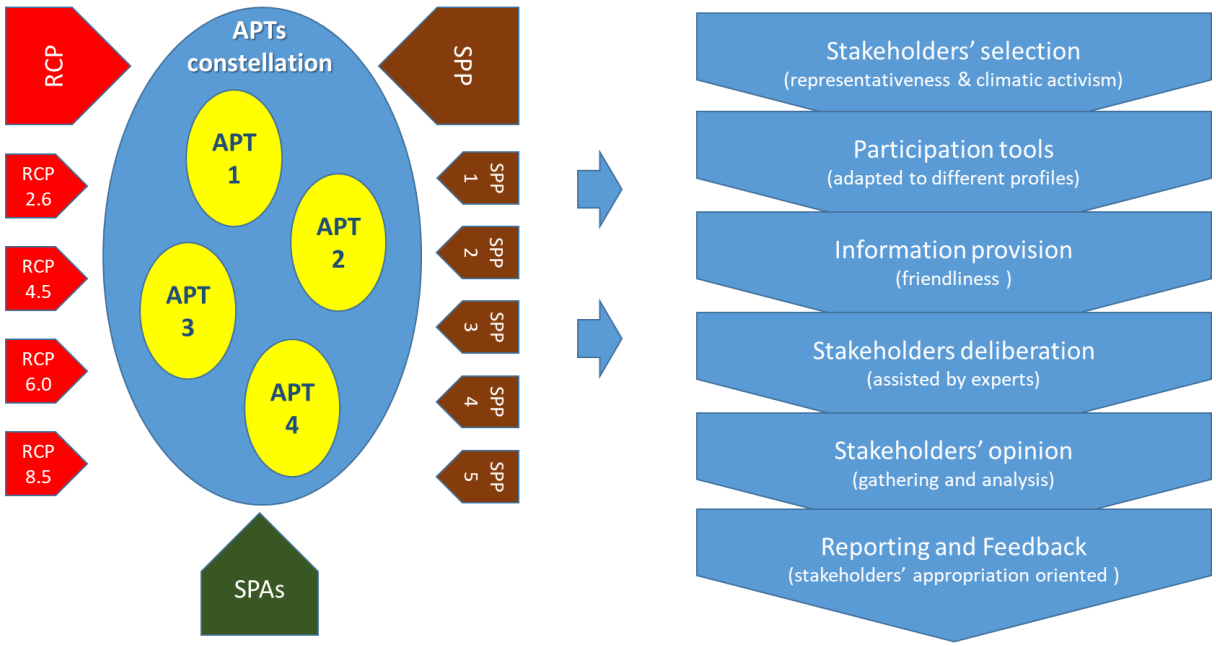
2 Methodology

2.1 Theoretical framework and participation process

The participatory process of the Canary Islands, which involved stakeholders in defining the adaptation pathway to climate change for blue economy sector, was undertaken within the theoretical framework depicted in figure 2 (left side) and was developed following the steps shown in figure 2 (right side).

The theoretical framework based on the combination of RCPs, SSPs and SPAs to obtain an ordered range of *adaptation policy trajectories* (APTs) has already been presented earlier in this Deliverable. Through the definition of APTs, the constellation of opinions and evaluations can be systematised and sorted to provide a clearer and more useful stakeholder input in order to better feed the decision-making process. During the participation process all participants were invited to reveal their preferences regarding the set of adaptation policy trajectories they were faced with. For those who did not, their preferences were deduced from their opinions and assessments expressed during the interview.



RCP: Representative Concentration Pathways
SPP: Shared Socio-economic Pathways
SPA: Shared climate Policy Assumptions

Figure 2. Theoretical framework and participation process. (Source: own elaboration)

Stakeholders selection was mainly aimed at involving the most representative people from companies, entrepreneurial associations, public administrations and research boards related to the blue economy sectors on the respective islands. Yet, the most active individuals in the fight against climate change in the concerned industries and those leading environmental innovation, decarbonisation and adaptation measures at the enterprise level were also invited to participate. Thus, a mixed criterion of representativeness and pro-activism helped to define the list of participants. With regard to the public administration, instead of focusing on the heads of the concerned departments, efforts to involve participants were directed mainly at the regional government's ecological transition department, which is coordinating the design of the climate policy for the archipelago.

The participation process and tools were adapted to the specificities of the different groups of participants. Usually, the highest representatives in the industry showed a low willingness to participate in collective processes that compromised several hours in the morning and early afternoon. Our response was to develop

a plurality of tools to adapt the participatory process to the availability schemes of the participants. As a result, a triple-fold participation tool was designed. More details on this point will be presented in association with figure 3 below.

In addition, the participation process was designed to encourage deliberation and exchange of opinions amongst participants. Thus, an information phase was followed by a deliberation phase one which lead to a phase of opinion gathering and assessment. Given that climate change issues have not been part of participants' daily assessment and discussion, and that well-founded views on climate change issues were probably still lacking, the deliberation phase was called to be of critical relevance in order to obtain well-founded opinions and facilitate consensual perspectives and proposals on this relevant issue.

Finally, while this report is being delivered, a sectoral webinar is being planned to gather the results of the participatory process of the informants and to refine the collective definition of the adaptation options presented at the beginning of the process. This process will coincide with the development of the Deliverable 7.4 in which islands' reports will link the entire set of research results and the participatory definition of the adaptation policy trajectories for the SOCLIMPACT islands.

2.2 The set of participation tools

As already mentioned, the participation tools were adapted to the specific requirements of the participating groups in order to involve the highest representatives of companies, associations, administrations and research teams. Figure 3 depicts the tools used in the phases through which the participation process was deployed.

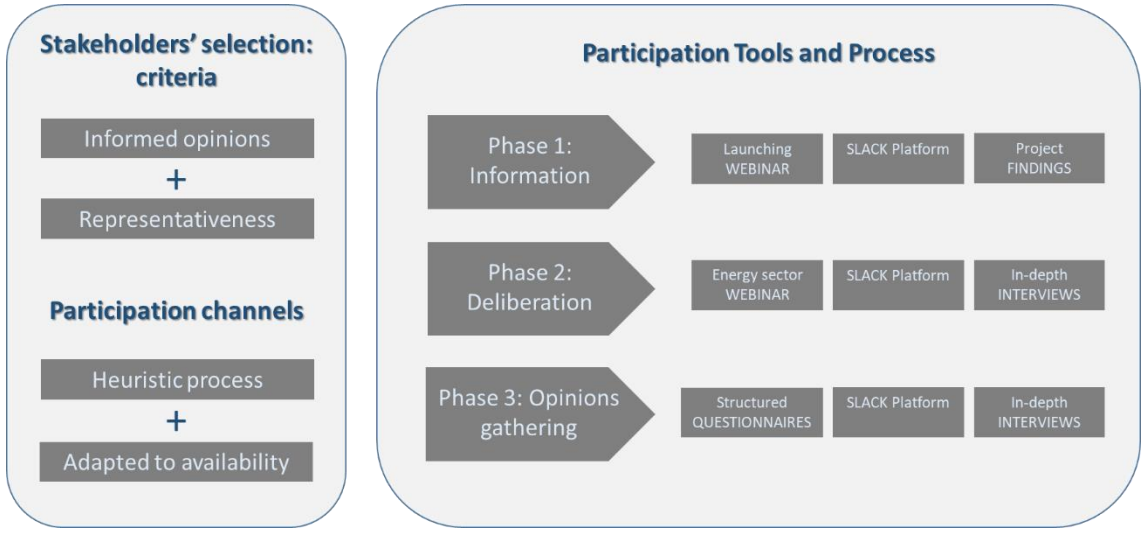


Figure 3. Tools for participation. (Source: own elaboration)

Figure 3, on the left, shows the aims of the design of the participation process: to gather informed and representative opinions through a process capable of adapting the tools to the availability and preferences of the key informants and to obtain not just scores from comparisons, Likert-type scales and ordering; but also the reasoning behind those scores by making explicit the information being considered and the arguments being used to deliver the scores.

Phase 1 began with a launch of a Multi-Sectoral Webinar that provided updated climatic information on the past events and the forecast for the 21st century for the Canary and Balearic Islands, with the participation of the Spanish Meteorological Agency and outstanding researchers in the fields of climatology,

ecology, marine physics and marine biology. Selected stakeholders and the general public were called to attend and participate in the web seminar. The video recording of the event has been available ever since. Additionally, the main findings of the project (based on the deliverable 7.2) were translated into a user-friendly format and then disseminated amongst the selected stakeholders and hosted: either through the project's website - www.soclimpact.net – (Figure 4), or through the Slack discussion platform specifically created to give support to the participation process (Figure 5).

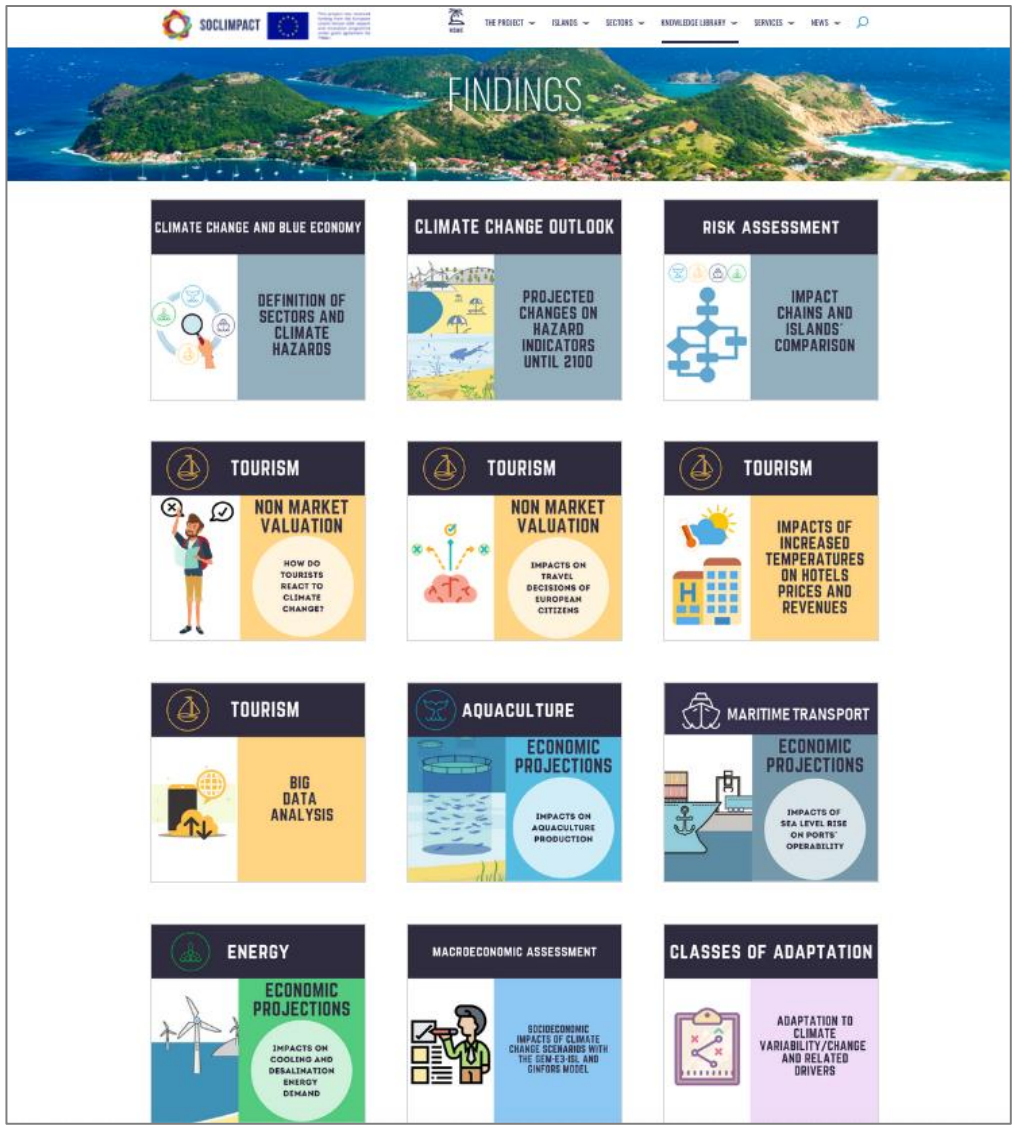


Figure 4 - Findings of the project shared with stakeholders

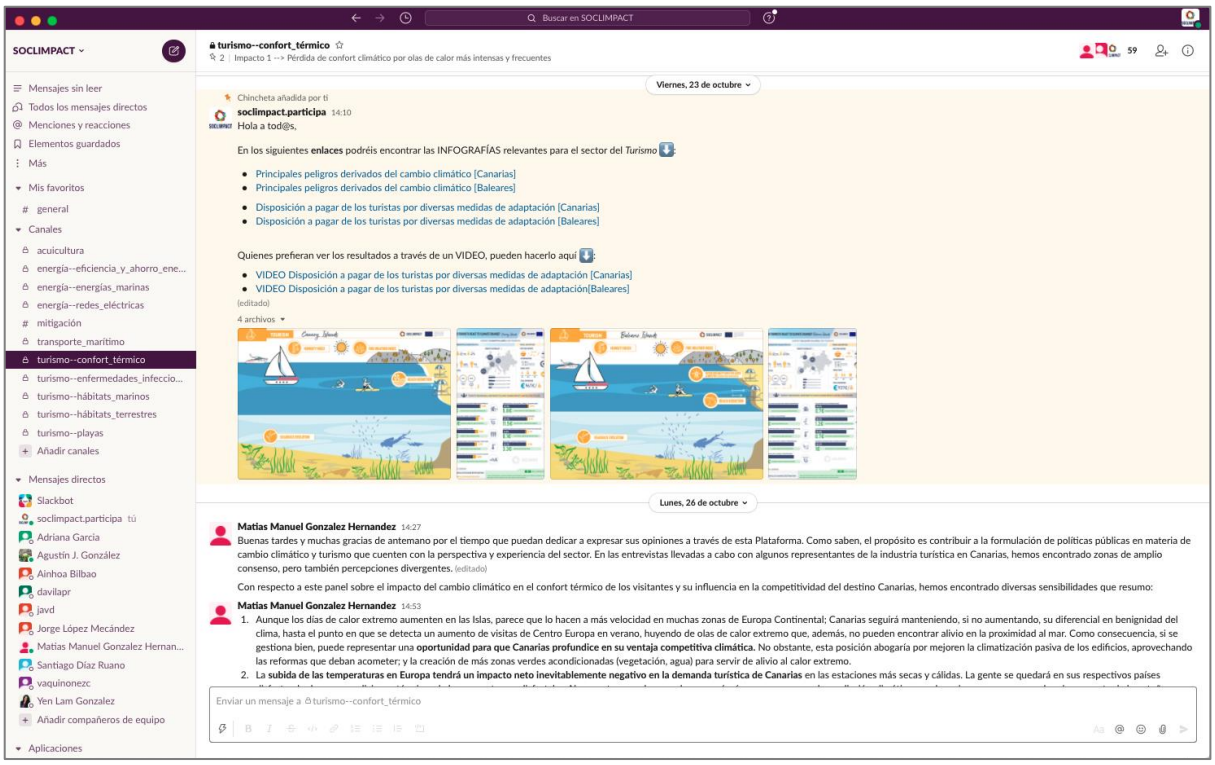


Figure 5 - Visual representation of one of the Slack platform canals

Phase 2 was intended to provide an in-depth understanding of the relevance that stakeholders give to climate change issues, the information they currently have on climate change, the relevance that weather events and forecasts play in their planning and managing activities, and the opinions they have built on the actions to be taken to adequately address climate change issues. Favourable conditions allowed the celebration of three specific webinars on the energy sector and the threats it will face due to the impacts of climate change.

The Slack platform was expected to be a channel to foster debates on climate change hotspots and the blue economy sectors on the islands. Four Slack rooms were set up, one for each sector, and five other inside-rooms were additionally prepared within the tourism sector room to host the debate on the 5 main impact chains stablished by SOCLIMPACT in the previous research phases. No more than 20 participations were collected through this channel, probably due to failures in facilitation techniques. Finally, in-depth interviews allowed for the collection of many valuable qualitative information that would be very useful to qualify the scores provided by the informants through questionnaires.

Phase 3 consisted of obtaining and systematising opinions on preferences for alternative adaptation options for the sectors of the blue economy studied in three different time horizons: up to 2030, up to 2050 and up to 2100. The questionnaires were filled out both through self-completed interviews and in the frame of in-depth interviews. The scores gathered in relation to perceptions of climate hazards and risks, the evaluation of adaptation options based on 5 relevant criteria and the choices between alternative adaptation options by paired comparison over the short-, medium- and long-term scenarios were organised in tables to present a synthetic picture of the stakeholders' opinions. These tables are presented and discussed in the following section. In addition, all interviews were supported by a presentation that served as a script, in which respondents could read and understand the questions through the visual design that was created to facilitate the exercise (see Appendix 6.4).

3 Interviewed stakeholders

As mentioned above, a total of 20 interviews were conducted. Emphasis should be placed on the importance of the selection of interviews for this analysis, since the opinion of the most relevant stakeholders from each of the four sectors of the blue economy has been gathered. The profile of each interviewee will now be detailed, categorised by sector.

All interviews were recorded with the consent of the interviewees.

3.1 Tourism

Name	Organization	Position
Irene Talg	Hotel Tigaiga	Director of Quality and Environmental Management
Manuel Florido Mayor	Santa Mónica Suites Hotel	Director
Enrique Padrón Fumero	Ashotel	Director of Innovation and Sustainable Development
	Tourist Innovation Factory of the Canary Islands (FIT)	Manager
Carlos Fernández Hernández	University of La Laguna (ULL)	Professor of the Department of Applied Economics and Quantitative Methods
	Isla Bonita rural tourism association	European Projects Director
	ECOINTUR association (Eco-development, tourism and social innovation)	Project Coordinator
Pablo Lorenzo	Lopesan	Corporate Director of Investments, Maintenance and Quality
Toms Smulders	Association of Non-Hotel Accommodation Businesses (AEAT)	President
	Federation of Hotel and Tourism Businesses of Las Palmas (FEHT)	Vice-president
Nicolás Villalobos Mestres	Be Cordial Hotels & Resorts	CEO
Juan Pablo González Cruz	Ashotel	Manager
José Luis Echevarria	Limonium Canarias	Director
	Association of Active Tourism Companies of the Canary Islands (Activa Canarias)	President
	National Association of Active Tourism Companies (ANETA)	Secretary
Sergio Moreno Gil	Canarian Government	Vice-counsellor for tourism
	University of Las Palmas de Gran Canaria (ULPGC)	Professor / Marketing Unit Director at TiDES Tourism Research Centre / UNESCO Chair of Tourism
Raúl Hernández Martín	University of La Laguna (ULL)	Academic director of the chair of tourism
		Professor
Noemi Padrón Fumero	University of La Laguna (ULL)	Professor of the Department of Applied Economics and Quantitative Methods

Table 3 – List of stakeholders interviewed for the tourism sector.

As the tourism sector is the largest and most important for the islands, more interviews were carried out for this sector than for the others. A total of 12 interviews were conducted with high representatives of the main tourism associations and firms in the Canary Islands. In addition to several people from the academic sector who are experts in this field.

3.2 Maritime Transport

Name	Organization	Position
Antonia Bordón Guerra	Las Palmas Port Authority	Head of Infrastructure Department

Table 4 – List of stakeholders interviewed for the maritime transport sector.

For the maritime transport sector, despite the dedicated effort, only one interview was conducted. Although it is worth noting the significance of the person interviewed, being a relevant figure in the port authority. Attempts were also made to contact representatives of shipping companies and recreational marinas.

3.3 Energy

Name	Organization	Position
Santiago Diaz Ruano	Canary Islands Institute of Technology (ITC)	Department of Renewable Energies project technician
Jose Luis Porta	E22 Energy Storage Solutions	Business Development Director
Roque Calero	University of Las Palmas de Gran Canaria (ULPGC)	Professor ULPGC
Alex Mira Brazo	Naturgy	Renewables Energy Development

Table 5 – List of stakeholders interviewed for the energy sector.

For the energy sector, 4 interviews were conducted, including the first director of the ITC (Canary Islands Institute of Technology): Roque Calero, kind of "father" of the renewable energies in the Canaries. In addition to interviewing two profiles from the research field, two people from the private sector, especially from the field of renewable energies, were also interviewed. It is worth noting that Naturgy is a Spanish gas and electricity multinational, one of the largest Spanish companies, with a business unit focused on renewable energies.

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3.4 Aquaculture

Name	Organization	Position
Jose Luis Guersi	CETECIMA (Marine Science Technology Centre)	President
Gustavo Larrazabal	Aquanaria	Managing director
Javier Ojeda	APROMAR (Spanish Aquaculture Business Association)	President
	Federation of European Aquaculture Producers	General secretary
	EU Aquaculture Advisory Council (AAC)	President
	UNE. Technical Committee for Standardisation 173/SC	President
	Fisheries and Aquaculture Technology Platform (PTEPA)	Vice-president

Table 6 – List of stakeholders interviewed for the aquaculture sector.

For the aquaculture sector, 3 interviews were conducted to the highest representatives of the aquaculture sector in the Canaries, two of them having also representativeness at Spanish and European level.

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4 Sector Adaptation Pathways

Each interviewee was asked to choose different time frames between two adaptation options for a total of 24 options, and then to prioritize between 6 specific options from local knowledge. Each interviewee only responded according to their own point of view, as it seemed to us that if they responded by placing themselves in a different APT than what they believed, the responses might be biased and not reflect reality. Consequently, in some sectors there will be empty columns, due to the fact that we did not find interviewees who fit all the profiles (in particular the case of APT A).

4.1 Tourism

Tourism pathways are based on choices made by 4 expert island stakeholders. As a total of 12 interviews were conducted, more information will be generated from these.

4.1.1 Selected Adaptation Pathways

ID	Name	Class number	APT A			APT B			APT C			APT D		
			S	M	L	S	M	L	S	M	L	S	M	L
T1	Economic Policy Instruments (EPIs)	1					B						D	
T2	Financial incentives to retreat from high-risk areas	1					B						D	
T9	Activity and product diversification	2		A			B			C			D	
T10	Public awareness programmes	2		A			B			C			D	
T11	Local circular economy	3								C				
T12	Tourist awareness campaigns	3								C				
T13	Local sustainable fishing	4								C			D	
T14	Water restrictions, consumption cuts and grey-water recycling	4								C			D	
T15	Beach nourishment	5					B							
T16	Desalination	5					B							
T17	Coastal protection structures	6		A			B			C			D	
T18	Drought and water conservation plans	6		A			B			C			D	
T19	Mainstreaming Disaster Risk Management (DRM)	7								C				
T20	Using water to cope with heat waves	7								C				
T21	Fire management plans	8		A										
T22	Health care delivery systems	8		A										
T23	Post-Disaster recovery funds	9		A									D	
T24	Pre-disaster early recovery planning	9		A									D	
T3	Adaptation of groundwater management	10		A			B			C			D	
T4	Monitoring, modelling and forecasting systems	10		A			B			C			D	
T5	Dune restoration and rehabilitation	11					B			C				
T6	River rehabilitation and restoration	11					B			C				
T7	Adaptive management of natural habitats	12								C				
T8	Ocean pools	12								C				
T25	Passive, low carbon adaptation of tourist buildings	Local		A			B			C			D	
T26	Zero sewage discharge to the sea	Local		A			B			C			D	
T27	Distributed electric grids powered by renewables	Local		A			B			C			D	
T28	Forest fire prevention	Local		A			B			C			D	
T29	Bottom-up managed marine protected micro-areas	Local		A			B			C			D	
T30	Residual organic matter composting to reduce methane emissions	Local		A			B			C			D	

Figure 6 - Adaptation options for the tourism sector. Options are identified with an ID number, full name, and class of adaptation number. Adaptation objectives are identified in each option by colour: ***vulnerability reduction (red), Disaster Risk Reduction (blue); Social-Ecological Resilience (green);*** *Local Knowledge adaptation options (grey). Each ATP (APT A; APT B; APT C; APT D) is represented in three timeframes: S - Short term (up to 2030), M- Medium term (up to 2050), L - Long term (until 2100). Bold letters in each ATP indicate the option was available to be selected. Highlighted options indicate the measure was selected in each ATP and timeframe: ATP A – Minimum Intervention (light blue); ATP B – Economic Capacity Expansion (light green); ATP C – Efficiency Enhancement (Light orange) and ATP D – System Restructuring (light purple). Space with colour: option was selected for the timeframe: Short term, Medium term, or Long term. Bold letter: option is available in the APT.*

The adaptation options and choices for the tourism sector are summarized in Figure 6.

Vulnerability Reduction

The first class of adaptation considered under the reduction of socio-economic vulnerability is *Financial Capital*. In this case, the adaptation option *Financial incentives to retreat from high-risk areas (T2)* has only been selected under APT B in the medium- and long-term. Conversely, the adaptation option *Economic Policy Instruments (EPIs)* (T1) has been chosen under APT B in the short-term (up to 2030), and under APT D in all timeframes: under the believe that the adaptation option T2 does not solve the problem. This is explained by the difference in vision in each APT: since APT B, which instead of reorienting the economy and making it more resilient (as APT D), focuses more on large investment to prepare the economy for future changes.

When considering *Human Capital*, all the Adaptation Policy Trajectories are analysed, and two adaptation measures are possible: *Activity and product diversification* (T9) and *Public awareness programmes* (T10). Here there is also a clear difference between the different APTs. For APT C and D, investment in public awareness can be appropriate for the short-term since these awareness programmes also diversify, but then the importance of activities and products diversification gain importance in the mid and long-term. Whereas, for APT A and B it is just the opposite, where it is believed that there will be no diversification without awareness. Diversification will be brought about by the training of human capital.

The same pattern occurs for *Social Capital* class, where *Tourist awareness campaigns (T12)* were selected for the short-term in opposition to *Local circular economy (T11)* which gain relevance in the middle and long-term. On this one, the adaptation options are available only under the APT C – Efficiency Enhancement. Showing the importance of awareness, as the beginning of many things. But also, how awareness is also the result of other kinds of actions.

Regarding the fourth class, *Natural Capital*, the APTs considered are C and D. From the two options available, *Local sustainable fishing* (T13) and *Water restrictions, consumption cuts and grey-water recycling* (T14), the chosen one under both APTs and in all timeframes is the latter. The pathways developed consider the growing evolution of the climate change risks in particular for the Canary Islands: the urgency to respond to water scarcity, one of the biggest issues in the archipelago.

The final class included actions to reduce socio-economic vulnerability is *Physical Capital*. In this case, only the APT B – Economic Capacity Expansion is considered. While *Desalination* (T16) is selected in the short- and medium-term, *Beach nourishment* (T15) is the preferred option for the timeframe up to 2100 (long-term). Again, the issue of water scarcity is made clear here, whereas by the middle of the century progress will have been made in this area, and beaches will have to be nourished at the end of the century due to the impacts of climate change and rising sea levels.

Disaster Risk Reduction

For *Disaster Risk Reduction*, and to manage long term risk, the decisions need to be sensible to the level of investment and reflect the climate change risk identified for the region. In *Managing long term risk, Coastal protection (T17)* is the most important for the region throughout the scenarios. However, for APT D, *Drought and water conservation plans (T18)* are vital and a priority in the short term; although, it has to be mentioned that both measures are seen as equally important on this APT. In contrast to ATP A and B, include T18 on the long term.

The Efficiency Enhancement scenario (ATP C) is the only scenario which considers the *Preparedness* class. In all the time frames, *Mainstreaming DRM (T19)* was selected in detriment of *Using water to cope with heat waves (T20)*. Being a more global and generic measure, and therefore more important.

For the *Disaster response* class, the risks related with fire – *Fire management plans (T21)* - were considered high in all time periods in the Canary Islands, in contrast to *Health care delivery systems (T22)*. The pathway clearly reflects the climate-risk context of the region.

In *Post disaster recovery*, to address DRR on the tourism sector, in both APTs (A and D), the *Pre-disaster early recovery planning (T24)* was selected for all time frames, since many future problems could be solved this way and there is still a lot to do in this sense. Except for APT A where in the short-term *Post-disaster recovery funds (T23)* was selected, mainly due to the low probability of T24 effectiveness in the short term. Being necessary to continue to promote planning and allocate funds to develop climate change resilience in the region.

Social-Ecological Resilience

For *Provisioning services*. *Adaptation of groundwater management (T3)* is urgent for the sector in the short-term, however, incorporating *Monitoring, modelling and forecasting systems (T4)* for the medium and longer term it is important, since there is still a lot to do in this field. This does not mean that adaptation option T3 is not important, but this is because even if groundwater management is done badly, it is being done; in contrast to the other measure (T4), where there is still more to be done.

Regulating and maintenance services, is considered only for APT B and C scenarios, where the priority for *Dune restoration and rehabilitation* (T5) is shown. The tourism sector will benefit from the maintenance of dunes as this has a positive impact on tourism, since one of the biggest attractions of the destination are its beaches. However, for APT B, *River rehabilitation and restoration* (T6) is selected for mid and long term; showing again the importance of water for this region.

Cultural services are only considered for the APT C - Efficiency Enhancement (medium investment and medium commitment to policy change scenario). In this case, the region considered to dedicate efforts in all time frames to preserve and minimize the impacts on biodiversity and ecosystems, while also preserving the attractiveness of the region (*Adaptive management of natural habitats* - T7). As opposed to *Ocean pools* (T8), since T7 is more general, which includes the latter.

Local Knowledge adaptation options

The specific adaptation options for the tourism sector include solutions of various kinds. Where the problem of sewage throughout the archipelago can be clearly seen, being *Zero sewage discharge to the sea* (T26) the most urgent adaptation option selected in all APTs. Then if we take APT C and D, the issue of the huge energy consumption the tourism sector has becomes clear, as *Distributed electric grids powered by renewables* (T27) is also selected as urgent. Showing the need this sector has to transform its energy into renewable sources. The problem of wildfires is mainly due to the lack of management and prevention of them. The measure *Forest fire prevention* (T28) emphasises the importance of prevention rather than action to extinguish the fire, which would be a much more effective measure. This one is clearly emphasized in all APTs. Then, *Bottom-up managed marine protected micro-areas* (T29) appear to be important, due to the value the coastal resources have for the islands both, for their inhabitants and for the attractiveness to tourists. Even if it has been selected for the long term, the issue of waste is also a major problem on the islands, especially the challenge of properly managing organic waste. In particular, in APT A and B, *Residual organic matter composting to reduce methane emissions (T30)* has been highlighted for the short and medium term. Ultimately, even if *Passive, low carbon adaptation of tourist buildings* (T25) has not been selected in any scenario, it does not mean it is not important, but having to choose among six options for three scenarios, shows the priority other measures have.

4.1.2 Sustainability Performance

Figure 7 - Pathways evaluation for tourism sector considering: Cost Efficiency; Environmental protection; Mitigation (GHG emissions) win-wins and trade-offs; Technical applicability; Social acceptability. The policy pathways scenarios: APT A - Minimum Intervention; APT B - Economic Capacity Expansion (ECE); APT C- Efficiency Enhancement (EE); APT D - System Restructuring (SR), for different timeframes: short, medium, and long term

The performance of the four ATP scenarios for tourism sector are the ones that vary more between them (compared to the other sectors) during the three timeframes considered, even if they still keep some sort of similarity. In general, scenarios show a high level of cost efficiency, environmental protection and technical applicability, and medium mitigation win-wins and trade-off. While social acceptability has the lowest performance and varies most among the different APTs.

For middle term, pathway scenarios perform quite similar. However, for short-term and end of the century differences are more visible. In the short-term, the minimum intervention scenario (APT A) and the economic capacity expansion scenario (APT B) tend to have socially acceptable options and adaptation solutions with technical applicability, and lower mitigation win-wins and trade-offs. However, the efficiency enhancement scenario (APT C) and the system restructuring scenario (APT D) tend to have higher cost-efficiency, higher environmental protection and higher mitigation win-wins and trade-offs. In the case of the mid-century (up to 2050), the structure of the spider diagram is similar, but the difference between ATPs decreases. Finally, at the end of the century, the APT A has higher scores on social acceptability, environmental protection and mitigation win-wins and trade-offs than the rest of APTs. APT B scores lowest in all criteria used to evaluate the adaptation pathways performance, while APT D scores highest in technical applicability.

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4.2 Maritime Transport

Maritime transport pathways are based on choices made by 1 expert island stakeholders.

4.2.1 Selected Adaptation Pathways

ID	Name	lass numbe	APT A			APT B			APT C			APT D		
			S	M	L	S	M	L	S	M	L	S	M	L
MT1	Insurance mechanisms for ports	1					B						D	
MT2	Financial incentives to retreat from high-risk areas	1					B						D	
MT9	Awareness campaigns for behavioural change	2		A			B			C			D	
MT10	Social dialogue for training in the port sector	2		A			B			C			D	
MT11	Diversification of trade using climate resilient commodities	3								C				
MT12	Climate resilient economy and jobs	3								C				
MT13	Refrigeration, cooling and ventilation systems	4								C			D	
MT14	Restrict development and settlement in low-lying areas	4								C			D	
MT15	Sturdiness improvement of vessels	5					B							
MT16	Increase operational speed and flexibility in ports	5					B							
MT17	Climate proof ports and port activities	6		A			B			C			D	
MT18	Consider expansion/retreat of ports in urban planning	6		A			B			C			D	
MT19	Reinforcement of inspection, repair and maintenance of infrastructures	7								C				
MT20	Early Warning Systems (EWS) and climate change monitoring	7								C				
MT21	Inteligent Transport Systems (ITS)	8		A										
MT22	Prepare for service delays or cancellations	8		A										
MT23	Backup routes and infrastructures during extreme weather	9		A									D	
MT24	Post-Disaster recovery funds	9		A									D	
MT3	Marine life friendly coastal protection structures	10		A			B			C			D	
MT4	Combined protection and wave energy infrastructures	10		A			B			C			D	
MT5	Hybrid and full electric ship propulsion	11					B			C				
MT6	Coastal protection structures	11					B			C				
MT7	Integrate ports in urban tissue	12								C				
MT8	Ocean pools	12								C				
MT25	Adapt infrastructure to climate threats	Local		A			B			C			D	
MT26	Improve and ensure operational safety in ship repair	Local		A			B			C			D	
MT27	Develop the potential of maritime navigation between the Canary Islands	Local		A			B			C			D	
MT28	Strengthen and improve the bunkering facilities	Local		A			B			C			D	
MT29	To plan the expansion of the port linked to the locational rent of the islan	Local		A			B			C			D	
MT30	Encourage the adaptation of recreational marinas to the main climate cha	Local		A			B			C			D	

Figure 8 - Adaptation options for the Maritime Transport sector. Options are identified with an ID number, full name, and class of adaptation number. Adaptation objectives are identified in each option by colour: ***vulnerability reduction (red),*** *Disaster* ***Risk Reduction (blue); Social-Ecological Resilience (green);*** *Local Knowledge adaptation options (grey). Each ATP (APT A; APT B; APT C; APT D) is represented in three timeframes: S - Short term (up to 2030), M- Medium term (up to 2050), L - Long term (until 2100). Bold letters in each ATP indicate the option was available to be selected. Highlighted options indicate the measure was selected in each ATP and timeframe: ATP A (light blue); ATP B (light green); ATP C (Light orange) and ATP D (light purple). Space with colour: option was selected for the timeframe: Short term, Medium term, or Long term. Bold letter: option is available in the APT.*

The adaptation options and choices for the maritime transport sector are summarized in Figure 8.

Since only one interview was conducted, and as mentioned above, each respondent only answered in regard to their own point of view, for the maritime transport only APT C (Efficiency Enhancing) will be analysed. This scenario (medium investment and medium change in policy commitment) is characterized by the flexibility of actions along the time.

Vulnerability Reduction

In this case, the Canarian maritime transport sector is quite clear on its priorities, selecting most of the measures for all time frames. When considering *Social dialogue for training in the port sector (MT10)* is selected, since it is much more important for the port to train the port sector on how to act, which gives security, rather than creating *Awareness campaigns for behavioural change (MT9)*.

Regarding *Social capital*, the *Diversification of trade using climate resilient commodities (MT11)* is preferred over *Climate resilient economy and jobs (MT12)*,

In terms of *Natural Capital*, *Refrigeration, cooling and ventilation systems (MT13)* are preferred over *Restrict development and settlement in low-lying areas (MT14)*, since keeping passengers, employees and goods in good thermal conditions is of vital importance for the operation and good service of the port.

Disaster Risk Reduction

For *Management of long-term disaster risks, Climate proof ports and port activities (MT17)* is clearly seen as the priority. Climate change risks have to be analysed, to better adapt and prepare for those impacts. All investments must take climate change into account before moving forward with them.

In terms of *Preparedness,* it is of great urgency to implement *Early Warning Systems (EWS) and climate change monitoring (MT20)*, being one of the most important measures to be implemented. Being the most immediate and easy thing to implement. Having that information, enables to make a decision on how to deal with these changes and act on the different infrastructures depending on what that alert tells.

Social-Ecological Resilience

Provisioning services will focus initially on *Marine life friendly coastal protection structures (MT3)* and for the long-term *Combined protection and wave energy infrastructures (MT4)*. Protecting marine life is essential, but then it is important to ensure that this infrastructure can be made productive from the investments that are made.

In terms of *Regulating and maintenance services,* it will be a combination of both options. However, *Coastal protection structures (MT6)* are selected for the short term since *Hybrid and full electric ship propulsion (MT5)* is not realistic in the short term. However, to lessen the fuel used by ships is crucial.

In regard to *Cultural services,* the sector will seek to better *Integrate ports in urban tissue (MT7)* over construction of new Ocean pools (MT8) as the latter is not seen as a relevant aspect for this sector.

Local Knowledge adaptation options

Local knowledge options are mainly focused on coastline and infrastructure protection, reflecting how having safe and operational ports is of paramount importance for the Canarian maritime transport sector: *Adapt infrastructure to climate threats (MT25)* and *Encourage the adaptation of recreational marinas to the main climate change hazards (MT30)*. By adapting mooring structures and related services, especially the electrical connection to ships during the stay in port (cold ironing), to climatic threats, and particularly to the rise in sea level, so as to enable the Canary Islands to maintain and improve their position in international recreational cruise traffic. Same for recreational marinas.

After the tourism sector (direct and indirect), only the sub-sectors that we include in the blue economy, especially port activity and maritime transport have a significant weight in the region's GDP (around 7%). This means that preparing and strengthening these sectors in the face of the threat of climate change is key for the Islands. Therefore, *To plan the expansion of the port linked to the locational rent of the island in areas not exposed to risks (MT29)* is also important from the point of view of diversification of the Canarian economy, since

the actions that strengthen the competences of the Canary Islands in the territorial waters (as defined in the new Statute) are of fundamental importance. Planning with climate security (areas not exposed to risks) the expansion of the port area to accommodate new and more activity related to the opportunities offered by the special regimes of the Canary Islands (RUP, ZEC, Registry of ships (REBECA); with special attention to mobility and the relationship between the port and the city.

Then, *Improve and ensure operational safety in ship repair (MT26)* aims to improve and guarantee the operational safety of ship repair activity against climatic events, including shipyards and workshops with deep-sea repair capacity. Also, to transfer knowledge and capacities for the adaptation to climate change of nearby West African ports, which will guarantee their future connectivity with the Canary Islands and the development of the potential of maritime navigation between the Canary Islands and North West Africa: *Develop the potential of maritime navigation between the Canary Islands and North-West Africa (MT27)*. Lastly, *Strengthen and improve bunkering facilities (MT28*), since the bunkering activity is one of the most important activities the Canarian ports, in order to favour the transition to the use of new fuels and the electrical connection to the ships. This initiative would include cutting edge solutions in the adoption of bunkering facilities to power renewable energy-based technologies.

4.2.2 Sustainability Performance

Figure 9 - Pathways evaluation for Maritime Transport sector considering: Cost Efficiency; Environmental protection; Mitigation (GHG emissions) win-wins and trade-offs; Technical applicability; Social acceptability. The policy pathways scenarios: APT A - Minimum Intervention; APT B - Economic Capacity Expansion (ECE); APT C- Efficiency Enhancement (EE); APT D - System Restructuring (SR), for different timeframes: short, medium, long term

The only pathway selected in the Maritime Transport sector in the Canary Islands is APT C (Efficiency Enhancement). All four adaptation pathways for the Canarian maritime transport sector reveal a similar structure during the three timeframes considered, according to the answer obtained. Social acceptability shows the highest score, while technical applicability and cost efficiency show medium score, and environmental protection and mitigation win-wins and trade-offs the lowest. Moreover, except for the cost efficiency criterion, all the criteria score equal or lower over time.

4.3 Energy

Energy pathways are based on choices made by 4 expert island stakeholders.

4.3.1 Selected Adaptation Pathways

ID	Name	Class number	APT A			APT B			APT C			APT D		
			S	M	L	S	M	L	S	M	L	S	M	L
E1	Financial support for buildings with low energy needs	1					B						D	
E2	Financial support for smart control of energy in houses and buildings	1					B						D	
E9	Green jobs and businesses	2		A			B			C			D	
E10	Public information service on climate action	2		A			B			C			D	
E11	Small scale production and consumption (prosumers)	3								C				
E12	Risk reporting platform	3								C				
E13	Energy storage systems	4								C			D	
E14	Collection and storage of forest fuel loads	4								C			D	
E15	SeaWater Air Conditioning (SWAC).	5					B							
E16	Demand Side Mangement (DSM) of Energy	5					B							
E17	Review building codes of the energy infrastructure	6		A			B			C			D	
E18	Upgrade evaporative cooling systems	6		A			B			C			D	
E19	Early Warning Systems (EWS)	7								C				
E20	Grid reliability	7								C				
E21	Study and develop energy grid connections	8		A										
E22	Energy-independent facilities (generators)	8		A										
E23	Energy recovery microgrids	9		A									D	
E24	Local recovery energy outage capacity	9		A									D	
E3	Energy efficiency in urban water management	10		A			B			C			D	
E4	Underground tubes and piping in urban planning	10		A			B			C			D	
E5	Biomass power from household waste	11					B			C				
E6	Urban green corridors	11					B			C				
E7	Educational garden plots	12								C				
E8	Heated pools with waste heat from power plants	12								C				
E25	Hydrogen as energy vector	Local		A			B			C			D	
E26	Renewable technology hybridization	Local		A			B			C			D	
E27	Low and high enthalpy geothermal energy	Local		A			B			C			D	
E28	Shared self-consumption facilities	Local		A			B			C			D	
E29	Promote cogeneration	Local		A			B			C			D	
E30	Micro smart grids	Local		A			B			C			D	

Figure 10 - Adaptation options for the Energy sector. Options are identified with an ID number, full name, and class of adaptation number. Adaptation objectives are identified in each option by colour: ***vulnerability reduction (red),*** *Disaster* ***Risk Reduction (blue); Social-Ecological Resilience (green);*** *Local Knowledge adaptation options (grey). Each ATP (APT A; APT B; APT C; APT D) is represented in three timeframes: S - Short term (up to 2030), M- Medium term (up to 2050), L - Long term (until 2100). Bold letters in each ATP indicate the option was available to be selected. Highlighted options indicate the measure was selected in each ATP and timeframe: ATP A (light blue); ATP B (light green); ATP C (Light orange) and ATP D (light purple). Space with colour: option was selected for the timeframe: Short term, Medium term, or Long term. Bold letter: option is available in the APT.*

The adaptation options and choices for the energy sector are summarized in Figure 10. At first glance, it can be noted that the *APT A – Minimum Intervention* has not been supported by any of the experts.

Vulnerability Reduction

The first class of adaptation considered under the reduction of socio-economic vulnerability is *Financial Capital*. In this case, the adaptation option *Financial support for smart control for energy in houses and buildings* (E2) has been selected in both APTs (B and D) for all time frames, over *Financial support for buildings with low energy*

needs (E1). Since the Canaries are already immersed in the E1, energy efficiency certificates are already required for buildings. What is needed is financial support with regard to the digitalisation of buildings (intelligent buildings), in order to modify the structure of an existing building to lower the energy demand.

When considering *Human Capital*, the three Adaptation Policy Trajectories analysed, agreeing on the importance of *Green jobs and businesses (E9)*. These being able to support the Canaries reliance on adaptation energy issues while serving as a form of economic diversification, reducing the actual dependency on the Tourism sector. In contrast, except for APT B in the long term, *Public information service on climate action (E10)* is not part of the pathways since it is assumed that there is and will be a sufficient level public information in the island for it to pursue climate action.

The same pattern occurs for *Social Capital* class, where *Small scale production and consumption (E11)* were selected in all time frames in opposition to *Risk reporting platform (E12)*, with the idea of empowering local consumers before large companies, in order to be more resilient to the effects of climate change. On this one, the adaptation options are available only under the APT C – Efficiency Enhancement.

Regarding the fourth class, *Natural Capital*, the APTs considered are C and D. From the two options available, *Energy storage systems (E13)* was chosen over *Collection and storage of forest fuel loads (E14)* in all time frames. Even if forest fires are an issue in the Canaries, the benefits of clearing forest fuel loads are still not so clear, since plant cover has a mission and it is also essential for the forest. However, in APT C it is selected as urgent in the short term due to the big issue wildfires are in the archipelago. Energy storage is crucial for energy services reliability and decarbonization objectives, since it will be key to the development and penetration of renewable energy.

The final class included actions to reduce socio-economic vulnerability is *Physical Capital*. In this case, only the APT B – Economic Capacity Expansion is considered. Here again, *Demand Side Management (DMS) of Energy (E16)* is the preferred option in all time frames, over *Sea Water Air Conditioning (SWAC) (E15)*. Energy demand management (E16) is key in the archipelago. Even if it can be used when needed, energy storage is inefficient, since batteries often cost more than the renewable technology itself. Therefore, it is crucial to efficiently manage the energy demand.

Disaster Risk Reduction

For Disaster Risk Reduction, and to *Manage long term risk*, the decisions need to be sensible to the level of investment and reflect the climate change risk identified for the region. Except for APT D that clearly selects *Upgrade evaporative cooling systems (E18)* for all time frames, both APT B and C, consider *Review building codes of the energy infrastructure (E17)* as a priority in the short and medium term, and E18 for the long term.

The Efficiency Enhancement scenario (ATP C) is the only scenario which considers the *Preparedness* class. In all the time frames, *Grid reliability (E20)* was selected in detriment of *Early Warning Systems (EWS))*, since it is more important that the energy system is resilient to climate risk. However, in some way, both are related.

In *Post disaster recovery*, to address DRR on the energy sector, in APT D, the *Energy recovery microgrids (E23)* was selected for all time frames over *Local recovery energy outage capacity (E24)*. Micro grids are very important to recover power. Indeed, E23 encompasses E24.

Social-Ecological Resilience

For *Provisioning services*. *Energy efficiency in urban water management (E3)* is urgent for the sector in all time frames, as it is more oriented to other environments where thermal consumption does exist. Showing again, the need to respond to the growing problem of water scarcity in the archipelago. Underground piping for cooling can be a difficult energy resource concept to grasp and to account for in energy planning. However,

APT B which selects *Underground tubes and piping in urban planning (E4)* for the longer term, perhaps because of the future improvement of this technology.

Regulating and maintenance services, is considered only for APT B and C scenarios. Where the priority for *Biomass power from household waste (E5)* is shown, with the aim of taking advantage of all that can be done without affecting the ecosystem. Then, for the medium and long term *Urban green corridors (E6)* are selected, in order to decrease energy efficiency, which cannot be done overnight, whereas the first one can.

Cultural services are only considered in APT C - Efficiency Enhancement (medium investment and medium commitment to policy change scenario). In this case, it is considered to dedicate efforts in the short and medium term into *Educational garden plots (E7),* and then in the long-term *Heated pools with waste heat from power plants (E8).* Even if E7 has a more social part, and not so much the energy part, it is preferred since the Canaries are getting rid of thermal generation, and it remains to be seen if there is another way of generating electricity other than by thermal means.

Local Knowledge adaptation options

The specific adaptation options for the energy sector include solutions of various kinds. If we take APT C and D, *Promote cogeneration (E29)* and *Micro smart grids (E30)* are categorized as urgent. These show the importance of having a greater resilience, since in the event of possible power failures in the electrical system, they will always have a guaranteed power supply. Then the *Low and high enthalpy geothermal energy (E27)* which also gives stability to the electrical network. This is explained by the fact that the Canary Islands are isolated energy systems, each island generating its own electricity. Therefore, these measures are of the utmost importance, to prevent run out of energy.

The difference comes in APT D which aims to transform the current social-ecological and economic system, supports *Shared self-consumption facilities (E28).* To encourage the shared use of facilities in order to share costs and maximize the efficiency and management capacity of these facilities. While APT C, focuses on *Hydrogen as energy vector (E25)*, with the aim of using the renewable effluents for hydrogen production. The hydrogen could then be used after storage in high-pressure tanks as vehicle fuel, especially for heavy mobility. In contrast, APT B selects this measure (E25) as the priority. Followed by *Renewable technology hybridization (E26)* to assure a balanced electrical system and guarantee quality supply. For example, if photovoltaic technology means that energy is only available during daylight hours, other technologies such as wind power should be used proportionally to cover what photovoltaic technology cannot. Lastly, *Micro smart grids (E30),* with the aim of providing greater resilience; since in the event of possible power failures in the electrical system, they will always have a guaranteed power supply.

4.3.2 Sustainability Performance

Figure 11 - Pathways evaluation for Energy sector considering: Cost Efficiency; Environmental protection; Mitigation (GHG emissions) win-wins and trade-offs; Technical applicability; Social acceptability. The policy pathways scenarios: APT A - Minimum Intervention; APT B - Economic Capacity Expansion (ECE); APT C- Efficiency Enhancement (EE); APT D - System Restructuring (SR), for different timeframes: short, medium, long term

All four pathways in the Energy sector have a similar evaluation across all timeframes. In the energy sector, the analysis showed no differences in the scoring of criteria as a reflection of the different ATP narratives.

The cost efficiency of the pathways is the same in all APTs. The environmental protection has an overall low value but with differences in APT D (lowest value). Mitigation performance is higher for APT D in the short-term, but similar for the rest; although this difference increases by the end of the century, having a higher score for APTs D and C. Technical Applicability and Social Acceptability are similar across all APTs and have an intermediate value, with the former presenting small differences by mid-century in APT B.

4.4 Aquaculture

Aquaculture pathways are based on choices made by 2 expert island stakeholders.

4.4.1 Selected Adaptation Pathways

ID	Name	Class number	APT A			APT B			APT C			APT D		
			S	M	L	S	M	L	S	M	L	S	M	L
A1	Financial schemes, insurance and loans	1					B						D	
A2	Tax benefits and subsidies	1					B						D	
A9	Awareness campaigns for behavioural change	2		A			B			C			D	
A10	Efficient feed management	2		A			B			C			D	
A11	Addressing consumer and environmental concerns at the local level	3								C				
A12	Promote cooperation to local consumption	3								C				
A13	Integrated multi-trophic aquaculture (IMTA)	4								C			D	
A14	Short-cycle aquaculture	4								C			D	
A15	Recirculation Aquaculture Systems (RAS)	5					B							
A16	Submersible cages	5					B							
A17	Climate proof aquaculture activities	6		A			B			C			D	
A18	Risk-based zoning and site selection	6		A			B			C			D	
A19	Disease prevention methods	7								C				
A20	Environmental monitoring and Early Warning Systems (EWS)	7								C				
A21	Mainstreaming Disaster Risk Management (DRM)	8		A										
A22	Contingency for emergency management, earlyharvest and/or reloca	8		A										
A23	Recovery Post-Disaster plans	9		A									D	
A24	Recovery Post-Disaster funds	9		A									D	
A3	Feed production	10		A			B			C			D	
A4	Species selection	10		A			B			C			D	
A5	Selective breeding	11					B			C				
A6	Best Management Practices	11					B			C				
A7	Create educational visits	12								C				
A8	Promote aquaculture cuisine	12								C				
A25	Increase POSEI and REF incentives	Local		A			B			C			D	
A26	Knowledge transfer and financial support of emerging industries	Local		A			B			C			D	
A27	Review and streamline administrative processes	Local		A			B			C			D	
A28	Promote tourist and non-tourist consumption	Local		A			B			C			D	
A29	Favor the development of off-shore aquaculture	Local		A			B			C			D	
A30	Reformulate the POEM (Zoning)	Local		A			B			C			D	

Figure 12 - Adaptation options for the Aquaculture sector. Options are identified with an ID number, full name, and class of adaptation number. Adaptation objectives are identified in each option by colour: ***vulnerability reduction (red),*** *Disaster* ***Risk Reduction (blue); Social-Ecological Resilience (green);*** *Local Knowledge adaptation options (grey). Each ATP (APT A; APT B; APT C; APT D) is represented in three timeframes: S - Short term (up to 2030), M- Medium term (up to 2050), L - Long term (until 2100). Bold letters in each ATP indicate the option was available to be selected. Highlighted options indicate the measure was selected in each ATP and timeframe: ATP A (light blue); ATP B (light green); ATP C (Light orange) and ATP D (light purple). Space with colour: option was selected for the timeframe: Short term, Medium term, or Long term. Bold letter: option is available in the APT.*

The adaptation options and choices for the tourism sector are summarized in Figure 12. At first glance, it can be noted that the *APT A (Minimum Intervention)* and *APT D (System restructuring)* have not been supported by any of the experts.

Vulnerability Reduction

The first class of adaptation considered under the reduction of socio-economic vulnerability is *Financial Capital*. In this case, there is only APT B scenario, the adaptation option *Tax benefits and subsidies (A2)* has been selected in all time frames, over *Financial schemes, insurance and loans (A1),* because it helps investment. When companies are profitable, they need to innovate and grow. In the Canary Islands there are good tax benefits for reinvestment. Which has brought about tremendous economic development.

When considering *Human Capital*, the two Adaptation Policy Trajectories analysed, agree on the importance of *Awareness campaigns for behavioural change (A9),* over *Efficient feed management (A10)* due to the challenge it represents. Aquaculture is based on a biased and deteriorated public perception, due to of preconceived ideas. The industry is already immersed in a communication plan to change this perception.

The same pattern occurs for *Social Capital* class, where *Addressing consumer and environmental concerns at the local level (A11)* was selected in all time frames in opposition to *Promote cooperation to local consumption (A12)*, since local consumption will not be enough due to the small population, with the idea that aquaculture will progress with exports.

Regarding the fourth class, *Natural Capital*, APT C, from the two options available, *Short-cycle aquaculture (A14)* was chosen over *Integrated multi-trophic aquaculture (A13)* in all time frames. In the private sector efficiency is what matters, so if cycles are shortened, the sector will be more efficient and make it more productive. In addition, A13 does not make much sense in the Canary Islands, because the carrying capacity will never be reached, given that it is an open ocean.

The final class included actions to reduce socio-economic vulnerability is *Physical Capital*. In this case, only the APT B – Economic Capacity Expansion is considered. Here again, *Submergible cages (A16)* is the preferred option without any doubt in all time frames, over *Recirculation Aquaculture Systems (RAS) (A15)).* Aquaculture is the future if we want to have more fish available to feed the world population.

Disaster Risk Reduction

For Disaster Risk Reduction, and to *Manage long term risk*, the decisions need to be sensible to the level of investment and reflect the climate change risk identified for the region. For both APT B and C, consider *Climate proof aquaculture activities (A17)* as a priority in the short-term, since it is easier to fight the open sea and the big waves, than to be close to the land. Then *Risk-based zoning and site selection (E18)* for medium and long-term; since from the point of view of risk, when we concentrate a herd of animals, it is conducive to natural enemies. These exert a greater health risk than economic benefits; so, the more dispersion the better.

The Efficiency Enhancement scenario (ATP C) is the only scenario which considers the *Preparedness* class. In all the time frames, *Disease prevention methods (A19)* was selected in detriment of *Environmental monitoring and Early Warning Systems (EWS) (A20)* from the private sector's point of view. But from the public point of view the A20 is a necessity, public institutions have to invest in it.

Social-Ecological Resilience

For *Provisioning services*. For APT C, *Species selection (A4)* is urgent for the sector in all time frames, However, APT B which selects *Feed production (A3)* for the short and medium-term, since it has been found that nutrients that fish need can be transformed, finding new alternatives. Whereas E4 for the longer term, with the idea of replacing inefficient species.

Regulating and maintenance services, is considered only for APT B and C scenarios. Where the priority for *Selective breeding (A5)* is shown. Mainly due to the fact that it contributes to development, enables to be more efficient and more economical. This is common business practice, but it is still in its infancy and a lot to improve. A lot will be invested in the coming decades. In contrast, APT C that selects *Best management practices (A6)* as a priority in the short-term, since they are not exclusive.

Cultural services are only considered for the APT C - Efficiency Enhancement (medium investment and medium commitment to policy change scenario) - . In this case, it is considered to dedicate efforts in in the short and medium term into *Create educational visits (A7)* and then in the long-term *Promote aquaculture cuisine (A8*). Both measures will go hand in hand; it is very important that the A8 is known, but social acceptance is above that (A9). Without social acceptance there is nothing to do in the Canary Islands. A8 is vital, since the public the perception is biased, but in the chefs, there is a lot of environmental awareness, which will create awareness around consuming local products.

Local Knowledge adaptation options

The specific adaptation options for the aquaculture sector include solutions of various kinds. If we take APT C, *Reformulate the POEM (A30)* is identified as the most important. With the aim to address the impact of climate change, the criteria for determining areas to be used in the future need to be improved and expanded: planning. Increasing depth reduces impact, improves habitats, and increases production. Followed by *Review and streamline administrative processes (A27),* since improving governance is key to addressing the impact of climate change. Reviewing and streamlining administrative procedures will help minimize the impact on production volumes. Lastly*, Favour the development of offshore aquaculture (A29*), which means introducing a cultivation system that does not exist on the islands. It improves the resistance to catastrophic weather episodes as a result of climate change and consequently contributes to reducing the environmental impact, favouring an increase in production.

Regarding APT B, *Increase POSEI and REF incentives (A25*) is selected as the most urgent, as they are incentives that compensate for the distance and insularity. Followed by *Knowledge transfer and financial support of emerging industries (A26)* and *Promote tourist and non-tourist consumption (A28)*. On the one hand, with the aim of enabling local production of raw materials and juveniles, and the introduction of new species more resilient to climate change and its effects. On the other hand, to increase consumption on the islands which will help to reduce emissions, enhance the zero km concept, contributes to the development of food sovereignty with high quality protein, and strengthen social cohesion. Lastly, both APTs match in the long-term measure, A29.

4.4.2 Sustainability Performance

Figure 13 - Pathways evaluation for Aquaculture sector considering: Cost Efficiency; Environmental protection; Mitigation (GHG emissions) win-wins and trade-offs; Technical applicability; Social acceptability. The policy pathways scenarios: APT A - Minimum Intervention; APT B - Economic Capacity Expansion (ECE); APT C- Efficiency Enhancement (EE); APT D - System Restructuring (SR), for different timeframes: short, medium, long term

The pathways selected in the Aquaculture sector in the Canary Islands, APT B (Economic Capacity Expansion) and APT C (Efficiency Enhancement) have a similar evaluation across all timeframes. Moreover, the analysis showed no significant differences in the scoring of criteria as a reflection of these two different ATP narratives.

The cost efficiency of the pathways is the same in all APTs, and the one with highest score, along with social acceptability and technical applicability. Environmental protection and mitigation win-wins and trade-offs the ones with medium score, which decreases slightly over time in the latter case. However, not many differences between APTs are made clear.

5 Discussion and next steps

Outcomes obtained from the participatory process on the definition of adaptation options for the Blue Economy sectors in the Canary Islands show that while some sectors exhibit deeper levels of reflection and opinions' definition, with high level of consensus regarding the adaptation pathways to be adopted in the Archipelago over the next decades (aquaculture and energy), maritime transport, in spite of the relevance of the role performed by the public administration, is still in a very early stage of the process of adaptation policy definition and the tourism sector depicts a very heterogeneous picture that predicts a difficult process for consensus building.

However, the current European and national context, characterised by the urgency in the definition of economic reconstruction plans driven by the ecological transition, including decarbonisation and digitalisation, points out to a process acceleration. In the same pathway, the regional Government is now pushing forward a set of normative initiatives that include:

- a strategy to power energy transition to renewables, together with an action plan;
- a law for biodiversity protection, that updates the current regulation by first time linking species survival to climate change, also including adaptation initiatives;
- the strategy for a circular economy, that includes specific guidelines on sustainable management of residual organic matter along different stages: sewage sludge, big generators and households' generation.
- modifications on the current land management law, to promote actions in the wildlife sanctuaries to improve their GHG absorption balance and in the ecological restauration associated to private initiatives.
- and a climate change law, which is the bow clef of the whole regulation system, containing the regulations and incentives that should promote behavioural changes of social agents towards a decarbonised society, by at least accomplishing the European goals for 2030 and 2050 or advance further, and facilitate the adoption of adaptation measures by the most exposed socioeconomic agents and governmental departments.

Over the last two months, SOCLIMPACT Island Focal Points have been maintaining several meetings with high representatives of the Canary Islands Government; this process has had a relevant milestone with the celebration of a meeting with the General Secretary of the Ecological Transition and Climate Change Abatement Issues of the Canary Government, on December 17th, with the following aims:

- To carry out an ordered transfer of the results of the SOCLIMPACT Project to the different technical boards within the regional boards that are called to use the generated knowledge and information to support their decision making; This will be implemented through the celebration of a set of technical tables between SOCLIMPACT researchers and Government technical staff members.
- To plan a collaborative action to enable the REIS platform developed by SOCLIMPACT in an effective tool for regional information exchange and collaborative formulation of climate policies for the European Islands. Regarding this, regional Government representative expressed the Government interest in leading that process by contacting and facilitating agreements amongst the whole islands participating in SOCLIMPACT and more.
- In the same arena, over the next weeks a working group will explore the way of inserting the tool to assist climate policy design, developed by SOCLIMPACT, into the regional information system which host relevant territorial and digitalised layers of information on GIS format; and using this process to re-launch this information system as a key element of an improved decision-making system in all matters related to ecosystems, biodiversity and climate change in the Islands. This should be materialised in an agreement between the ULPGC, leader of SOCLIMPACT Project, and the regional Government dependent agency called *Grafcan* (https://www.grafcan.es/). This agreement could be signed before the end of SOCLIMPACT Project, in March 2021.

Finally, SOCLIMPACT outcomes will contribute to feed the current and future research and decision-making action into the framework of Projects in which the Canary partners of SOCLIMPACT are already involved (MAC-CLIMA, https://mac-clima.energiagrancanaria.com/proyecto/), and other projects currently under formulation.

6 Annexes - Canary Islands

6.1 List of all interviewed stakeholders

Name	Organization	Position	Sector
Irene Talg	Hotel Tigaiga	Director of Quality and Environmental Management	Tourism
Manuel Florido Mayor	Santa Mónica Suites Hotel	Director	Tourism
Enrique Padrón Fumero	Ashotel	Director of Innovation and Sustainable Development	Tourism
	Tourist Innovation Factory of the Canary Islands (FIT)	Manager	
Carlos Fernández Hernández	University of La Laguna (ULL)	Professor of the Department of Applied Economics and Quantitative Methods	Tourism
	Isla Bonita rural tourism association	European Projects Director	
	ECOINTUR association (Eco-development, tourism and social innovation)	Project Coordinator	
Pablo Lorenzo	Lopesan	Corporate Director of Investments, Maintenance and Quality	Tourism
Toms Smulders	Association of Non-Hotel Accommodation Businesses (AEAT)	President	Tourism
	Federation of Hotel and Tourism Businesses of Las Palmas (FEHT)	Vice-president	
Nicolás Villalobos Mestres	Be Cordial Hotels & Resorts	CEO	Tourism
Juan Pablo González Cruz	Ashotel	Manager	Tourism
José Luis Echevarría	Limonium Canarias	Director	Tourism
	Association of Active Tourism Companies of the Canary Islands (Activa Canarias)	President	

	National Association of Active Tourism Companies (ANETA)	Secretary	
Sergio Moreno Gil	Canarian Goverment	Vice-counsellor for tourism	Tourism
	University of Las Palmas de Gran Canaria (ULPGC)	Professor / Marketing Unit Director at TiDES Tourism Research Centre / UNESCO Chair of Tourism	
Raúl Hernández Martín	University of La Laguna (ULL)	Academic director of the chair of tourism	Tourism
		Professor	
Noemi Padrón Fumero	University of La Laguna (ULL)	Professor of the Department of Applied Economics and Quantitative Methods	Tourism
Antonia Bordón Guerra	Las Palmas Port Authority	Head of Infrastructure Department	Maritime transport
Santiago Diaz Ruano	Canary Islands Institute of Technology (ITC)	Department of Renewable Energies project technician	Energy
Jose Luis Porta	E22 Energy Storage Solutions	Business Development Director	Energy
Roque Calero	University of Las Palmas de Gran Canaria (ULPGC)	Professor ULPGC	Energy
Alex Mira Brazo	Naturgy	Renewables Energy Development	Energy
Jose Luis Guersi	CETECIMA (Marine Science Technology Centre)	President	Aquaculture
Gustavo Larrazabal	Aquanaria	Managing director	Aquaculture
Javier Ojeda	APROMAR (Spanish Aquaculture Business Association)	President	Aquaculture
	Federation of European Aquaculture Producers	General secretary	
	EU Aquaculture Advisory Council (AAC)	President	
	UNE. Technical Committee for Standardisation 173/SC	President	
	Fisheries and Aquaculture Technology Platform (PTEPA)	Vice-president	

6.2 Webinars

6.2.1 1st Webinar (21st July 2020)

6.2.1.1 Objective

How to face the risks of climate change in the Canary and Balearic Islands

6.2.1.2 Agenda

- ✓ Impacts and vulnerability of the Balearic Islands to climate change: evidence from the SOCLIMPACT project

  Gabriel Jordá Sanchez - Balearic Islands Oceanographic Centre and University of the Balearic Islands
- ✓ Impacts, risks and action in facing global change: a challenge for governance

  Javier Irastegui - Institute of Oceanography and Global Change (IOCAG) of the University of Las Palmas de GC, IPCC partner
- ✓ Rising sea levels: the case of las Canteras

  Alonso Hernández Guerra - Institute of Oceanography and Global Change (IOCAG) of the University of Las Palmas de GC
- ✓ Climate change, currents, nutrients and marine life

  Santiago Hernández León - Institute of Oceanography and Global Change (IOCAG) of the University of Las Palmas de GC
- ✓ Global change in the islands: climate, pouring, coastal infrastructures and marine ecosystems

  Fernando Tuya Cortes - ECOAQUA University Institute, University of Las Palmas de GC

6.2.1.3 Poster


SOCLIMPACT
This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 776661.
WEBINAR
JULIO
21
15:30 h.
Martes
¿Cómo enfrentar los riesgos del
CAMBIO CLIMÁTICO
en las islas?
EVIDENCIAS DE
Canarias y Baleares
IMPACTOS Y VULNERABILIDAD DE LAS ISLAS BALEARES AL CAMBIO CLIMÁTICO: EVIDENCIAS DEL PROYECTO SOCLIMPACT.
Gabriel Jordá Sanchez, Centro Oceanográfico de Baleares y Universidad de Islas Baleares.
IMPACTOS, RIESGOS Y ACCIÓN ANTE EL CAMBIO GLOBAL: UN RETO PARA LA GOBERNANZA.
Javier Aristegui, Instituto de Oceanografía y Cambio Global (IOCAG) de la Universidad de Las Palmas de GC, colaborador IPCC.
LA SUBIDA DEL NIVEL DEL MAR: EL CASO DE LAS CANTERAS.
Alonso Hernández Guerra, Instituto de Oceanografía y Cambio Global (IOCAG) de la Universidad de Las Palmas de GC.
CAMBIO CLIMÁTICO, CORRIENTES, NUTRIENTES Y VIDA MARINA.
Santiago Hernández León, Instituto de Oceanografía y Cambio Global (IOCAG) de la Universidad de Las Palmas de GC.
EL CAMBIO GLOBAL EN LAS ISLAS: CLIMA, VERTIDOS, INFRAESTRUCTURAS LITORALES Y ECOSISTEMAS MARINOS.
Fernando Tuya Cortes, Instituto Universitario ECOAQUA, Universidad de Las Palmas de GC.
Follow our Live session
www.soclimpact.net

6.2.2 2nd Webinar series (21st September)

6.2.2.1 Objective

Marine Energy in the context of Climate Change

6.2.2.2 Agenda

- ✓ Brief introduction
- ✓ Context of marine energies in the insular territories of the Canary Islands

  Gonzalo Piernavieja Izquierdo - R+D+i Coordinator of the Canary Islands Technological Institute (ITC)
- ✓ Scenarios of climate change in the Canary Islands and marine energy as a key to its mitigation

  Santiago Díaz Ruano - Head of section of the RE department of the Canary Islands Technological Institute (ITC)
- ✓ The need for marine energy in island territories

  Matt Folley - Director of Applied Renewables Research, Ltd.
- ✓ Large-scale deployment of marine energy as a key to the decarbonization of island energy systems

  Pedro Mayorga Rubio - CEO EnerOcean

6.2.2.3 Poster


SOCLIMPACT
The SoClimPact project has received funding from the European Union´s Horizon 2020 Research and Innovation Programme under Grant Agreement No 776661
WEBINAR
SEPTIEMBRE
21
10:00-11:30
HORA CANARIA
(LUNES)
LAS ENERGÍAS MARINAS
en el contexto del cambio climático.
CONTEXTO DE LAS ENERGÍAS MARINAS EN LOS TERRITORIOS INSULARES DE CANARIAS
Gonzalo Piernavieja Izquierdo. Coordinador del I+D+i del Instituto Tecnológico de Canarias
ESCENARIOS DEL CAMBIO CLIMÁTICO EN CANARIAS Y LAS ENERGÍAS MARINAS COMO CLAVE PARA SU MITIGACIÓN.
Santiago Díaz Ruano. Jefe de sección del departamento de EERR del Instituto Tecnológico de Canarias
LA NECESIDAD DE LAS ENERGÍAS MARINAS EN TERRITORIOS INSULARES.
Matt Folley. Director de Applied Renewables Research, Ltd.
DESPLIEGUE A GRAN ESCALA DE ENERGÍAS MARINAS COMO CLAVE PARA LA DESCARBONIZACIÓN DE SISTEMAS ENERGÉTICOS INSULARES
-Pedro Mayorga Rubio. CEO EnerOcean
PARTICIPA en directo
INSCRÍBETE AQUÍ
GoToMeeting
www.soclimpact.net

6.2.3 2nd Webinar series (23rd September)

6.2.3.1 Objective

Resilience of electrical infrastructure to climate change related events

6.2.3.2 Agenda

- ✓ Brief introduction
- ✓ Capacity of electricity networks to adapt to situations caused by climate change

  Adrián Castellanos Perdomo – Renewable energies department technician of the Canary Islands Technological Institute (ITC)
- ✓ Distributed generation as a model of adaptation to climate change

  Daniel Henríquez Álamo - Head of section of the RE department of the Canary Islands Technological Institute (ITC)
- ✓ Challenges facing the Spanish island electricity systems in the context of the energy transition and climate change

  Pablo Santos Arozarena – Operations Department of Red Electrica de España

6.2.3.3 Poster


SOCLIMPACT
The SoClimPact project has received funding from the European Union's Horizon 2020 Research and Innovation Programme under Grant Agreement No 776661
WEBINAR
SEPTIEMBRE
23
10:00-11:00 H
(MIÉRCOLES)
Resiliencia de las
INFRAESTRUCTURAS ELÉCTRICAS
a eventos derivados del cambio climático.
CAPACIDAD DE ADAPTACIÓN DE LAS REDES ELÉCTRICAS A LAS SITUACIONES PROVOCADAS POR EL CAMBIO CLIMÁTICO.
Jesús de León Izquier. Jefe de sección del departamento de EERR del Instituto Tecnológico de Canarias, S.A.
LA GENERACIÓN DISTRIBUIDA COMO MODELO DE ADAPTACIÓN AL CAMBIO CLIMÁTICO.
Daniel Henríquez Álamo. Jefe de sección del departamento de EERR del Instituto Tecnológico de Canarias, S.A.
RETOS A LOS QUE SE ENFRENTAN LOS SISTEMAS ELÉCTRICOS INSULARES ESPAÑOLES EN EL CONTEXTO DE LA TRANSICIÓN ENERGÉTICA Y EL CAMBIO CLIMÁTICO
Pablo Santos Arozarena. Departamento de operación de Red Eléctrica de España.
PARTICIPA en directo
INSCRÍBETE AQUÍ
GoToMeeting
www.soclimpact.net

6.2.4 2nd Webinar series (25th September)

6.2.4.1 Objective

Climate change mitigation actions based on the commitment to energy efficiency and sustainable construction

6.2.4.2 Agenda

- ✓ Brief introduction
- ✓ Climate change mitigation actions in energy-intensive sectors in island territories

  Pilar Navarro Rivero - Head of section of the RE department of the Canary Islands Technological Institute (ITC)
- ✓ Climate change and sustainable building action plans

  Celia Bueno Vega - Head of section of the RE department of the Canary Islands Technological Institute (ITC)
- ✓ Description and current status of clean energy for EU islands

  Luís García Benedicto – Head of the IDAE's demand management and renewable energy network integration department.

6.2.4.3 Poster


SOCLIMPACT
The SoClimPact project has received funding from the European Union´s Horizon 2020 Research and Innovation Programme under Grant Agreement No 776661
WEBINAR
SEPTIEMBRE
25
10:00-11:00 H
(VIERNES)
ACCIONES DE MITIGACIÓN
del cambio climático basadas en la apuesta por la eficiencia energética y la edificación sostenible
ACCIONES DE MITIGACIÓN DEL CAMBIO CLIMÁTICO EN SECTORES DE USO INTENSIVO DE LA ENERGÍA EN LOS TERRITORIOS INSULARES.
Pilar Navarro Rivero. Jefa de Sección del departamento de EERR del Instituto Tecnológico de Canarias, S.A.
PLANES DE ACCIÓN DE CAMBIO CLIMÁTICOS Y EDIFICACIÓN SOSTENIBLE
Celia Bueno Vega. Jefa de Sección del departamento de EERR del Instituto Tecnológico de Canarias, S.A.
DESCRIPCIÓN Y SITUACIÓN ACTUAL DEL CLEAN ENERGY FOR EU ISLANDS
Luís García Benedicto. Jede del Departamento de Gestión de la Demanda e Integración de Renovables en Red del IDAE
PARTICIPA en directo
INSCRÍBETE AQUÍ
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This project has received funding from the European Union's Horizon 2020 research and innovation programme under Grant Agreement No776661

6.3 Adaptation Options Evaluation

6.3.1 Tourism

Options Characterization				Criteria				
ID	Name	Description	Class of adaptation	Cost Efficiency	Environmental protection	Mitigation (GHG emissions) win-wins and trade-offs	Technical applicability	Social Acceptability
T1	**Economic Policy Instruments (EPIs)**	Economic Policy Instruments (EPIs) are incentives designed and implemented with the purpose of adapting individual decisions to collectively agreed goals. Different type of instruments can be aplied, like: pricing (e.g. water tariffs), environmental taxes and charges, subsidies; trading (e.g tradable permit for pollution or water abstraction, compensation mechanisms, payments for environmental services); and voluntary agreements and risk management schemes such as insurances.	1. Financial capital	4	3	3	3	1
T2	**Financial incentives to retreat from high-risk areas**	Financial incentives to retreat from high-risk areas refers to the creation of financial incentives to retreat or relocate settlements, infrastructure and productive activities from the original location due to their high exposure to risks such as flood, sea-level rise and storm surges.	1. Financial capital	2	1	2	2	1

T3	**Adaptation of groundwater management**	Adaptation of groundwater management can be used to (1) conserve groundwater reservoirs, limiting water use and optimizing water reuse, and (2) restore or increase natural infiltration capacity. Both contribute to adaptation in circumstances of reduced precipitation and sea saltwater intrusion aggravated with groundwater over-exploitation. Different packages of interventions usually inlcude: freshwater injection, modifying pumping practice, delayed inflow, artificial recharge or efficient use of freshwater.	10. Provisioning services	**3**	**3**	**3**	**2**	**2**
T4	**Monitoring, modelling and forecasting systems**	Monitoring, modelling and forecasting systems are information system that provide timely and reliable climate information, as well as up-to-date data on the occurrence and severity of extreme events, possible impacts and their duration. Different systems can be implemented to respond to different climate hazards, such as drought-related, water quality monitoring, water resources management and predicting and managing flood risks.	10. Provisioning services	**4**	**3**	**3**	**4**	**2**
T5	**Dune restoration and rehabilitation**	Dune restoration and rehabilitation refers to the strengthening of the flood safety and sand reservoir functions of dunes. Dune erosion happens as a result of wind action, marine erosion, human activities and Sea Level Rise (SLR). Possible technics examples include: grass planting, thatching and fencing.	11. Regulating and Maintenance Services	**4**	**4**	**2**	**3**	**3**

T6	**River rehabilitation and restoration**	River rehabilitation and restoration are measures that emphasise the natural functions of rivers and create vegetated buffer zones alongside watercourses. This contributes to the improvement of micro-climatic conditions, reduces run-off and erosion, and increases groundwater recharge. For Tourism, this option also increases available leisure areas, increases thermal comfort areas and the availability of water.	11. Regulating and Maintenance Services	**3**	**4**	**3**	**2**	**1**
T7	**Adaptive management of natural habitats**	Adaptive management of natural habitats refers to the preservation of ecosystem services which are essential for human well-being. Human activities induce pressure and impacts on biodiversity and ecosystems that tend to be aggravated by climate change. Adaptive management measures include: understanding species response; make space for the development of rivers and coasts; aid gene flow; species translocation; targets and conservation mechanisms/plans.	12. Cultural services	**4**	**4**	**4**	**1**	**2**
T8	**Ocean pools**	Ocean pools are seawater pools located by the sea where waves can wash into the pool. The width, length and depth of ocean pools varies and often depends on their location on the coastline. These recreational structures are useful on SLR context, doubling as an additional protection of the coast and creating alternatives to beach leisure areas.	12. Cultural services	**3**	**2**	**2**	**4**	**4**
T9	**Activity and product diversification**	Activity and product diversification include actions to diversify the tourism activities and products and aim to reduce seasonality and overload in infrastructures and ecosystems. Shifting the dependency from 'sun, sea and sand' products to alternative leisure activities can reduce the impacts of heat waves, coastal erosion or ecosystem degradation, and thus help to maintain destination attractiveness.	2. Human capital	**3**	**2**	**2**	**3**	**3**

T10	**Public awareness programmes**	Public awareness programmes establish targeted programmes that raise awareness about climate change (specific values and protection needs) among guides, site managers and local communities.	2. Human capital	**3**	**3**	**3**	**2**	**2**
T11	**Local circular economy**	Local circular economy is an economic system aimed at eliminating waste and the continual use of resources that offers a valuable framework for reduced carbon emissions from materials (decarbonization) and increased resilience to climate change and its impacts.	3. Social capital	**3**	**4**	**4**	**2**	**3**
T12	**Tourist awareness campaigns**	Tourist awareness campaigns target behavioural change of visitors and aim to increase tourists (individuals and organisations) knowledge about climate change and the risk faced by tourism destinations. These campaigns can be targeted to regions affected by a particular climate threat, specific groups of visitors or the general tourism sector as a whole.	3. Social capital	**3**	**3**	**3**	**3**	**3**
T13	**Local sustainable fishing**	Local sustainable fishing refers to the promotion of fishing zones/rights for local small-scale fishers maintaining stocks and using sustainable methods. This option aims to add value to local resources and products, protect ecosystems services and decrease external dependency.	4. Natural capital	**1**	**3**	**1**	**2**	**3**
T14	**Water restrictions, consumption cuts and grey-water recycling**	Restrictions can be applied to allow water administration services to cope with water crises. Restriction (or rationing) of certain uses of water such as irrigation of lawns, car washing, filling swimming pools or hosing down pavement areas may be necessary during these times. Grey-water recycling (or reclamation) is the reuse of non-drinkable water (usually treated waste water) to cover water use needs that don't demand such a high-quality standard.	4. Natural capital	**3**	**3**	**3**	**2**	**1**

T15	**Beach nourishment**	Beach nourishment (or replenishment) is the artificial placement of sand to compensate for erosion. Beach nourishment also often aims at maintaining beach width (for tourism and recreational purposes). Several beach nourishment techniques can be used including beach, backshore and shoreface nourishment, and large scale coastal nourishment (e.g. using sand motors).	5. Physical capital	**2**	**1**	**1**	**3**	**2**
T16	**Desalination**	Desalination is the process of removing salt from sea or brackish water to make it useable for a range of purposes including drinking, and can contribute to adaptation in circumstances of current or future water scarcity problems. Technological examples include electrically driven technologies, like reverse osmosis, and thermally driven technologies, based mainly on vapor distillation processes.	5. Physical capital	**2**	**2**	**1**	**4**	**4**
T17	**Coastal protection structures**	Coastal protection structures such as groynes, breakwaters, artificial reefs and seawalls are different types of artificial structures, built in the shoreline (or rivers), which are designed to protect the coast from SLR or storms. Those structures can be used to, for example, drift and trap sediments, protect from erosion, absorb wave energy, or allow navigation.	6. Managing long term risk	**3**	**1**	**1**	**4**	**3**
T18	**Drought and water conservation plans**	Drought and water conservation plans refer to tourism-lead adaptation and/or involvement in drought management plans with the aim to reduce the economic, social, and environmental consequences of drought and water scarcity, and to reduce the loss of water and improve efficiency in the sector.	6. Managing long term risk	**4**	**3**	**3**	**2**	**2**

T19	**Mainstreaming Disaster Risk Management (DRM)**	Mainstreaming Disaster Risk Management (DRM) aims to plan and organize DRM along five stages including prevention, protection, preparedness, and response, recovery and review. Examples include interventions to limit urban development in flood prone areas; identify natural hazard prone areas; develop strategies, arrangements, and procedures to address crises; and post-emergency recovery activities.	7. Preparedness	**4**	**2**	**2**	**1**	**2**
T20	**Using water to cope with heat waves**	Water use to cope with heat waves in cities are a set of investments in water supply services and infrastructures that aim to increase urban resilience regarding heat waves. Different packages of grey interventions are usually applied, as for example: creating and/or repairing fountains for drinking water and cooling; water spray fountains; and wetting streets.	7. Preparedness	**3**	**2**	**2**	**3**	**3**
T21	**Fire management plans**	Fire management plans are management actions have wide range of application such as early warning detection, with escape routes and advice to local citizens and tourists, mobilization and suppression of unwanted and damaging fires, or use of fire to manage fuel. Additionally, these plans help to increase the understanding of the interactions of climate change with vegetation cover and fire regimes.	8. Response	**3**	**4**	**4**	**3**	**4**
T22	**Health care delivery systems**	Health care delivery systems are pre-emptive actions and adjustments that need to be made to health care systems, namely reinforcing less prepared aspects of its operation and/or logistics, in order to guarantee effectiveness and efficiency during, for example, high temperature and heat-wave situations.	8. Response	**3**	**1**	**1**	**3**	**4**

T23	**Post-Disaster recovery funds**	Post-Disaster recovery funds is the creation of recovery funds for the Tourism sector to recover after disasters, through initiatives that get the economy up and running quickly while building-back-better (e.g. rebuild damaged critical infrastructures such as ports and roads or recorver the landscape from fires). The aim is to minimize the economic and social impacts (which may include future loss of the touristic destination attractiveness) that can occur in a post-disaster context.	9. Post disaster recovery and rehabilitation	**2**	**1**	**1**	**3**	**4**
T24	**Pre-disaster early recovery planning**	Pre-disaster early recovery planning processes include the development of knowledge, good practices and objectives that aim to improve the living conditions of the affected communities, while facilitating the adjustments necessary to reduce the risk of future disasters. Examples of good practices are may include identifying critical ecosystems (goods and services) that require immediate restoration after a disaster or particularly vulnerable communities.	9. Post disaster recovery and rehabilitation	**4**	**4**	**2**	**2**	**4**
T25	**Passive, low carbon adaptation of tourist buildings to longer extreme heat periods**	Funding and tecnichal assistance for the adoption of biclimatic architecture criteria in reformed and newly built tourist buildings; regulation forcing it should be delivered together with economic incentives, socioally justified by the positive externality of contributiong a more environmental friendly image of the destination. This option is preferred to encouraging further investment in air conditioning, which implies an increase in GHG emissions.	Local knowledge	**3**	**3**	**4**	**3**	**3**

T26	**Zero sewage discharge to the sea**	This measure means to enhance sewage treatment system throughout the islands with two important, climate related purposes. First, mitigate the impact of seawater heating on the seagrass meadows, in turn crucial to sustain the entire marine ecosystems. Second, contribute to water supply with a lesser energy-demanding water source than desalination.	Local knowledge	**3**	**4**	**3**	**4**	**3**
T27	**Distributed electric grids powered by renewables**	Develope distributed electric grids based on renewable sources (pv, wind) to power desalination plants and tourist firms consortia, to reduce electricity cost and emissions, and increase the stability of the general electric grid while increasing renewables participation in the electric mix.	Local knowledge	**4**	**4**	**4**	**3**	**4**
T28	**Forest fire prevention**	Incentivate forest traditional cattle-based uses to reduce forest flamability and maintenance of farming activities in the periphery of forest masses, thus performing as firewalls. Social abandone of traditional uses and upper-land agriculture has lead to recent 6ª generation, inextinguishable forest fires that destroy endemic terrestrial biodiversity and precious landscapes, and put in risk residents' and tourists' lives.	Local knowledge	**3**	**4**	**4**	**3**	**3**
T29	**Bottom-up managed marine protected micro-areas**	Stakeholders-led deals to improve the management of marine areas affected by overfishing and habitat degradation to favour habitat rehabilitation and create sinergies amongst sustainable fishing, ecofriendly tourist activities (diving, snorkeling, bottom-glass boating...) and land-based activities (local product-based gastronomy, ictioethnology interpretation paths, etc.).	Local knowledge	**3**	**4**	**3**	**3**	**3**

T30	**Residual organic matter composting to reduce methane emissions, restorate degraded landscapes and enhance soil fertility**	Sewage sludge, organic waste from agriculture and the organic fraction of the MSW are currently disposed in poorly managed landfills, releasing methane to the atmosphere while agricultural soil shows extreme organic poorness and exhausted quarries degrade lanscapes. Composting would contribute to link tourism to decarbonization, local food options and lanscapes rehabilitation.	Local knowledge	**4**	**4**	**4**	**4**	**3**

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6.3.2 Maritime Transport

Options Characterization				Criteria				
ID	Name	Description	Class of adaptation	Cost Efficiency	Environmental protection	Mitigation (GHG emissions) win-wins and trade-offs	Technical applicability	Social Acceptability
MT1	**Insurance mechanisms for ports**	Insurance mechanisms for ports include risk-sharing schemes that aim to assist port operators in responding to the climate risks they are enabled to reduce. Insurance outsources the risks to a third party in exchange for a regular financial compensation.	1. Financial capital	**3**	**3**	**2**	**3**	**4**
MT2	**Financial incentives to retreat from high-risk areas**	Financial incentives to retreat from high-risk areas refers to the creation of financial incentives to retreat or relocate settlements, infrastructure and productive activities from the original location due to their high exposure to risks such as flood, sea-level rise and storm surges.	1. Financial capital	**3**	**3**	**2**	**3**	**2**
MT3	**Marine life friendly coastal protection structures**	Marine life friendly coastal protection structures are coastal protection structures constructed with materials that maximize the fixation of marine organisms. This option reduces climate change impacts on local ecosystems, provides water waste depuration (made by marine organisms) and water quality bio-indicators inside the ports.	10. Provisioning services	**2**	**4**	**3**	**2**	**4**

MT4	**Combined protection and wave energy infrastructures**	Combined protection and wave energy infrastructures is an energy measure that combines sea protection structures with wave energy production. This can create economies of scale, increase coastal protection and further decrease wave propagation inside the port during normal operations.	10. Provisioning services	**3**	**2**	**4**	**2**	**3**
MT5	**Hybrid and full electric ship propulsion**	Hybrid and full electric ship propulsion is environmentally friendly for marine life, decreases carbon emissions and can increase ship manoeuvrability which is useful in small ports and under difficult weather conditions. Low speed manoeuvring with conventional engines creates air and water pollution, noise and fuel consumption. Electrically driven propulsion can address these issues while increasing manoeuvrability using for instance azimuth thrusters.	11. Regulating and Maintenance Services	**3**	**3**	**3**	**2**	**4**
MT6	**Coastal protection structures**	Coastal protection structures such as groynes, breakwaters, artificial reefs and seawalls are different types of artificial structures, built in the shoreline (or rivers), which are designed to protect the coast from SLR or storms. Those structures can be used to, for example, drift and trap sediments, protect from erosion, absorb wave energy, or allow navigation.	11. Regulating and Maintenance Services	**3**	**2**	**2**	**4**	**3**
MT7	**Integrate ports in urban tissue**	Integrate ports into the urban tissue opening port areas to other activities, namely cultural, while gaining room in the urban landscape. This allows some port activities to be pooled from low-laying areas while leisure and cultural activities can access more waterfront space.	12. Cultural services	**2**	**2**	**2**	**3**	**3**

MT8	**Ocean pools**	Ocean pools are situated by the sea where waves can wash into the pool. The width, length and depth of ocean pools varies and often depends on their location on the coastline. These recreational structures are a response to SLR, protect the coast and create alternatives to beach leisure areas.	12. Cultural services	**3**	**2**	**2**	**3**	**4**
MT9	**Awareness campaigns for behavioural change**	Awareness campaigns for behavioural change aim to increase individuals and organisations' knowledge about climate change and the risk faced by the maritime transport sector. These campaigns can be targeted to regions affected by a particular climate threat, specific groups of infrastructures or the general transport sector as a whole.	2. Human capital	**2**	**2**	**2**	**4**	**3**
MT10	**Social dialogue for training in the port sector**	Social dialogue for training in the port sector refers to social and educational issues related with the gender equality and attracting the young to the sector, while tackling climate change. It relies on social dialogue between workers and employees to define common guidelines for training. It considers key challenges that ports are facing and how the industry is adapting to change and preparing for the future.	2. Human capital	**3**	**2**	**2**	**4**	**3**
MT11	**Diversification of trade using climate resilient commodities**	Diversification of trade using climate resilient commodities aims to reduce dependency on trade of perishable goods and critical services, create larger stocks of goods that are climate resilient and consider were changing trading systems to endure changes in climate is economically feasible, strategically justifiable and equitable.	3. Social capital	**3**	**3**	**3**	**2**	**4**

MT12	**Climate resilient economy and jobs**	Climate resilient economy and jobs aims to shift the economy and jobs towards a more climate resilient society. Perishable goods and some critical services rely heavily on the marine transport which can be affected by unpredictable extreme weather events. To address this the economy needs to adapt by shifting to products and services that depend less on Just In Time (JIT) operations, using for instance larger stocks.	3. Social capital	**2**	**3**	**4**	**2**	**2**
MT13	**Refrigeration, cooling and ventilation systems**	Improve the efficiency of refrigeration, cooling and ventilation systems in order to reduce costs in warmer weather and maintain operations during heat waves. Human thermal comfort provided by efficient ventilation and cooling is relevant to ensure the health and safety of passengers and port workers. Refrigeration is relevant for managing goods that need low temperatures.	4. Natural capital	**3**	**2**	**2**	**4**	**4**
MT14	**Restrict development and settlement in low-lying areas**	Restrict development and settlement in low-lying areas means to assure that ports are not further developed in low-laying areas exposed to SLR. Planning must consider the long-term potential risks.	4. Natural capital	**2**	**2**	**2**	**3**	**2**
MT15	**Sturdiness improvement of vessels**	Improve the strength of vessels to sea storms while decreasing the noise and increasing efficiency. Wave-induced loads on the ship structures are a major concern in hull design process. Ship owners should prefer designs that allow for more demanding wave regimes (for instance including the survivability to rouge waves).	5. Physical capital	**3**	**2**	**3**	**2**	**3**

MT16	**Increase operational speed and flexibility in ports**	Increase operational speed and flexibility in ports aims to increase the attractiveness of ship transport in order to capture more freight and passenger movement. This can promote a modal shift towards shipping and create new opportunities including those related with exports and tourism. Faster operations also reduce the effects of heat waves on goods and people as well as decarbonise the economy.	5. Physical capital	**2**	**2**	**3**	**2**	**2**
MT17	**Climate proof ports and port activities**	Climate-proof ports and port activities refers to investments that consider specific climate change projections to manage future risks in port infrastructures and improve operational safety conditions. These can include retrofitting or reconfiguring breakwaters and other port structures to avoid overtops and flooding due to storm surges, heavy precipitation, extreme heat, strong winds events and extreme swell conditions. The Copernicus Emergency Management Services (EMS) services can provide regarding climate change and disaster risk reduction.	6. Managing long term risk	**3**	**2**	**2**	**3**	**3**
MT18	**Consider expansion/retreat of ports in urban planning**	Consider expansion/retreat of ports in urban planning means to consider the expansion or reallocation of areas for future maritime transport infrastructures due to climate change risks. The urban planning and expansion should consider the potential requirements for port expansion/retreat options.	6. Managing long term risk	**3**	**3**	**2**	**3**	**3**

MT19	**Reinforcement of inspection, repair and maintenance of infrastructures**	A continuous reinforcement of inspection, repair and maintenance of infrastructures aims to adapt monitoring to a new climate context. Changes in the frequency and/or intensity of storms, SLR or temperature, for example, may have impacts in infrastructure, increasing degradation of the materials and requiring new maintenance plans.	7. Preparedness	**4**	**3**	**2**	**3**	**4**
MT20	**Early Warning Systems (EWS) and climate change monitoring**	Early Warning Systems (EWS) is an information system with several components that assesses climate risks and relays that information to decision makers, companies utilities and the general public in real time. Transport operators should integrate this tool in procedures in order to protect the safety of people and goods. The collected data can also be used to study the evolution of climate impacts as time progresses, for instance the impact of heat waves and storms in operations.	7. Preparedness	**4**	**3**	**2**	**4**	**3**
MT21	**Intelligent Transport Systems (ITS)**	Intelligent Transport Systems (ITS) are technologies that relay automated and tailored data and safety-related messages to ships, regarding climate hazards and other relevant information. ITS use communication and information standards that are uniform and widely accepted by other ports that the island is linked to.	8. Response	**3**	**2**	**3**	**3**	**2**
MT22	**Prepare for service delays or cancellations**	Prepare for service delays or cancellations aims to promote the creation of new procedures, alternative options and channels to sell goods and transport passengers, as well as better communication to deal with delays or cancellations. Dealing with more frequency and/or intensity of storms (which will happen in some regions) improves port reputation and customer preferences.	8. Response	**3**	**2**	**2**	**2**	**3**

MT23	**Backup routes and infrastructures during extreme weather**	Backup routes and infrastructures during extreme weather aims to creates a post disaster response that ensures available alternatives when the main ports are damaged or inaccessible due to extreme weather events. It considers alternative ports and access roads. Alternative ports can be smaller in size, simpler and be used for other purposes, but should have a different location and orientation from the main ones.	9. Post disaster recovery and rehabilitation	**3**	**2**	**2**	**4**	**3**
MT24	**Post-Disaster recovery funds**	Post-Disaster recovery funds is the creation of recovery funds for the maritime transport sector to recover after disasters, through initiatives that get the economy up and running quickly while building-back-better (e.g. rebuild damaged critical infrastructures such as ports and roads). The aim is to minimize the economic and social impacts that can occur in a post-disaster context.	9. Post disaster recovery and rehabilitation	**3**	**3**	**2**	**3**	**4**
MT25	**Adapt infrastructure to climate threats**	Adapt mooring structures and related services, especially the electrical connection to ships during the stay in port (cold ironing), to climatic threats, and particularly to the rise in sea level, so as to enable the Canary Islands to maintain and improve their position in international recreational cruise traffic.	Local knowledge	**3**	**3**	**4**	**4**	**4**
MT26	**Improve and ensure operational safety in ship repair**	To improve and guarantee the operational safety of ship repair activity against climatic events, including shipyards and workshops with deep-sea repair capacity.	Local knowledge	**3**	**2**	**2**	**4**	**3**

MT27	**Develop the potential of maritime navigation between the Canary Islands and North-West Africa**	To transfer knowledge and capacities for the adaptation to climate change of nearby West African ports, which will guarantee their future connectivity with the Canary Islands and the development of the potential of maritime navigation between the Canary Islands and North West Africa.	Local knowledge	**4**	**2**	**3**	**4**	**3**
MT28	**Strengthen and improve the bunkering facilities**	To reinforce and improve, in the face of possible climatic events, the bunkering installations which are of strategic importance for the expansion of the port economy of the islands. This initiative would include cutting edge solutions in the adoption of bunkering facilities to power renewable energy based technologies.	Local knowledge	**3**	**2**	**3**	**4**	**2**
MT29	**To plan the expansion of the port linked to the locational rent of the island in areas not exposed to risks**	To plan with climate security (areas not exposed to risks) the expansion of the port area to accommodate new and more activity related to the opportunities offered by the special regimes of the Canary Islands (RUP, ZEC, Registry of ships (REBECA)); with special attention to mobility and the relationship between the port and the city.	Local knowledge	**3**	**3**	**2**	**3**	**4**
MT30	**Encourage the adaptation of recreational marinas to the main climate change hazards**	To stimulate, accompany and encourage the adaptation of recreational marinas to the main climate change hazards, in order to guarantee the operation and future expansion of recreational sailing.	Local knowledge	**3**	**2**	**2**	**3**	**3**

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6.3.3 Energy

Options Characterization				Criteria				
ID	**Name**	**Description**	**Class of adaptation**	**Cost Efficiency**	**Environmental protection**	**Mitigation win-wins and trade-offs**	**Technical applicability**	**Social Acceptability**
E1	**Financial support for buildings with low energy needs**	Financial schemes in the form of loans, subsidies or tax reliefs are ways to support the reduction of energy needs of new or existing buildings, making them address climate change in a more efficient manner. For example, architecture and construction materials that rely on passive thermal comfort reduce the use of energy for human comfort, so less air-conditioning is necessary in the cooling season.	1. Financial capital	**4**	**4**	**4**	**4**	**3**
E2	**Financial support for smart control of energy in houses and buildings**	The support of smart control of energy in houses and buildings allows for an efficient and automated use of energy that enables savings and creates synergies with utilities. For example, such a system could coordinate the automated opening vents with the air conditioning operation, avoiding energy consumption when possible. This will allow for the adaptation of buildings at a controlled cost, while complying with mitigation goals.	1. Financial capital	**3**	**3**	**3**	**4**	**4**
E3	**Energy efficiency in urban water management**	Energy efficiency in urban water management is the adaptation of urban design and construction for water conservation that avoids energy use under scarcity scenarios. For instance, Water Sensitive Urban Design (WSUD) aims to plan water conservation and storm water storage with integration with elements of urban design. This both to minimises hydrological impacts on the	10. Provisioning services	**3**	**2**	**4**	**3**	**3**

		environment and the associated energy use of water supply.						
E4	**Underground tubes and piping in urban planning**	Underground tubes and piping are used for space heating/cooling across the globe and are more resilient to climate change. These systems can be Earth Air Heat Exchanger (EAHE) and Ground Source Heat Pump (GSHP) types. Both systems use tubes or pipes that usually need to be buried beyond the footprint of the building or house. The measure considers this need, and both allows and encourages the use of such space in urban planning.	10. Provisioning services	**1**	**1**	**2**	**2**	**1**
E5	**Biomass power from household waste**	Biomass power plants burn household waste, waste from parks and public gardens and sludge generated by sewage treatment plants. Towns and cities can also realise urban production and recreational woods, which can be used for producing biomass for co-generation (Combine Heat and Power) as well as tri-generation (Combined Cold Heat and Power) plants.	11. Regulating and Maintenance Services	**3**	**4**	**3**	**4**	**3**
E6	**Urban green corridors**	Urban green areas decrease the air temperature in a city and thus decrease energy needs. Warm air tends to transport pollution and particulate matter to higher layers of atmosphere, causing a cloud of smog. Creating green corridors also promotes biodiversity, increases the touristic value and decreases water run-off during storms.	11. Regulating and Maintenance Services	**2**	**4**	**4**	**3**	**4**

E7	**Educational garden plots**	Educational garden plots are sites where people, especially children, can garden with volunteers one afternoon a week after school. The harvest can be taken home. This creates well-being while having local fresh produce reduces the energy consumption and pollution. These garden plots can be further exploring to educate people about other climate action measures, directly and indirectly related with energy such as waste to energy, composting, water retention and green corridors.	12. Cultural services	**2**	**4**	**3**	**3**	**3**
E8	**Heated pools with waste heat from power plants**	Power plants need cooling and their waste heat can be used in swimming pools for public use and tourism. This creates an attractive leisure activity in off-peak winter times which diversifies the touristic offer and promote community well-being. This type of heat recovery design is called Combined Heat and Power (CHP). Pools provide a heat sink for the power plants which increases efficiency and is useful during heat waves.	12. Cultural services	**1**	**1**	**3**	**2**	**2**
E9	**Green jobs and businesses**	The promotion of green jobs and businesses consists in training people and supporting green businesses to implement energy solutions across the economy, both in mitigation and adaptation. One example can be the support of research projects to help businesses deal with new technologies relevant to climate action.	2. Human capital	**4**	**4**	**3**	**2**	**4**
E10	**Public information service on climate action**	Public information service on climate action aims to provide the general public with information about adaptation and mitigation options available for their activities and businesses. This includes information dissemination and counselling about available solutions and the public support. This type of information is relevant, for example, to support dwellings, hotels or commerce to adapt to climate change.	2. Human capital	**4**	**2**	**3**	**4**	**3**

E11	**Small scale production and consumption (prosumers)**	Small scale production and consumption (prosumers) aims to promote cooperation by creating economies of scale both in the production and consumption of energy. This allows for a greater use of local renewable resources and waste energy recovery which allow for a better resilience when dealing with climate change events such as heat waves.	3. Social capital	**4**	**3**	**3**	**4**	**3**
E12	**Risk reporting platform**	Risk reporting platform intends to promote the communication between the general public and the administration bodies concerning the risks related with climate change. It is a platform were the general public reports directly the risks as they become aware of. These can be for example related with cliff instability, trees falling over energy lines, uncleared bushes that can be ignited by power lines or unstable structures that may fall due to strong winds.	3. Social capital	**3**	**2**	**3**	**4**	**3**
E13	**Energy storage systems**	The development of energy storage systems can provide an alternative when the main power sources fail and need time to recover. This allows for a more resilient energy grid while enabling decarbonization and peak levelling at a controlled cost. This includes not only electric batteries (like those in cars and buses), but also other forms of energy storage such as thermal tanks (heat), ice banks (cold) or water height (reversed pumping).	4. Natural capital	**2**	**2**	**4**	**4**	**3**
E14	**Collection and storage of forest fuel loads**	Collection and storage of forest fuel loads intend to promote and regulate the collection and storage of wood and combustible material to reduce wildfire hazard. Actions may include: clearing of small trees out of dense areas, reduce the amount of fuel on the ground and increasing the spacing between trees. Materials collected	4. Natural capital	**3**	**3**	**3**	**2**	**3**

		can be used in energy to waste applications such as pellets, biogas or other energy solutions.						
E15	**Sea Water Air Conditioning (SWAC).**	The Seawater Air Conditioning (SWAC) measure is an alternate-energy system design that uses cold water from the deep ocean to provide more efficient, decarbonized and reliable cooling. The sweater is piped to heat exchangers for process cooling or to provide condensation water in air conditioning systems. It replaces air cooling units or fresh water evaporative cooling towers which performances degrades in heat waves. Other subsequent or parallel seawater uses can be combined, like for swimming pools or desalinisation.	5. Physical capital	**1**	**2**	**3**	**1**	**1**
E16	**Demand Side Management (DSM) of Energy**	Demand Side Management (DSM) of energy is an operational strategy that better coordinates producers and consumers of energy. More renewable energy use is possible while ensuring the energy service reliability and controlled costs. DMS balances off-peak and peak demand using peek shaving, which is important, for example, during heat waves.	5. Physical capital	**4**	**3**	**3**	**3**	**3**
E17	**Review building codes of the energy infrastructure**	Review energy infrastructure building codes aims to climate-proof the energy system by reviewing regulatory codes and infrastructures considering the spatial distribution of climate risks. This should include establishment of new procedures, maintenance practices, operational changes, retrofitting and the use of climate and mapping services such as those produced by the Copernicus Emergency Management Service (EMS).	6. Managing long term risk	**4**	**2**	**3**	**3**	**3**

E18	**Upgrade evaporative cooling systems**	Upgrade of evaporative cooling systems that rely on a given range of air temperature and water availability is necessary given that this type of cooling systems are a technology that can be affected by climate change and become compromised due to heat waves and water scarcity.	6. Managing long term risk	**4**	**2**	**3**	**3**	**3**
E19	**Early Warning Systems (EWS)**	Early Warning Systems (EWS) is an information system that assesses climate risks and provides real time information to decision makers, companies, utilities and the general public. Climate data used to control and monitor the energy infrastructure can be relayed to the EWS. Using this data to monitor the evolution of climate related impacts in the energy sector increases the knowledge necessary to make long term climate adaptation decisions.	7. Preparedness	**3**	**4**	**3**	**3**	**3**
E20	**Grid reliability**	Grid reliability improvement aims to find and upgrade critical components and to enhance the energy system resilience to climate risks. This may include redundant circuitry or components that provide alternative dispatch of energy, equipment upgrades (e.g. better cooling to cope with heat waves) or power downrating (e.g. decrease power output of energy transformers so that they do not overheat during heat waves).	7. Preparedness	**3**	**3**	**3**	**4**	**3**
E21	**Study and develop energy grid connections**	Energy grid connections aims to develop interconnections between islands and/or with the mainland allowing for the creation of economies of scale, energy system reliability improvements and more Renewable Energy Sources (RES) penetration.	8. Response	**3**	**3**	**3**	**4**	**3**

E22	**Energy-independent facilities (generators)**	Energy-independent facilities (generators) make it possible for buildings to temporarily create their own energy supply. In case of an energy supply failure (power outage), essential amenities remain functional and can be optimized with Combined Heat and Power (CHP) designs and other decentralised energy generation solutions.	8. Response	**1**	**1**	**3**	**3**	**4**
E23	**Energy recovery microgrids**	Energy recovery microgrids are operational elements of the energy grids that rely on distributed generation to restore systems from power outages and to stabilize the grid. This allows for a flexible and swifter recovery from power outages caused by knock-out events (e.g. tree falls on energy lines), excess demand (e.g. during heat waves) or other causes.	9. Post disaster recovery and rehabilitation	**4**	**2**	**4**	**4**	**3**
E24	**Local recovery energy outage capacity**	Local recovery energy outage capacity consists in increasing and improving the ability of the islands to recover from energy outages caused by or worsen by climate extreme events, like severe sea or windstorms that can lead to island isolation and exacerbate logistical hurdles. To facilitate a swift recovery, it's useful to have more mobile backup power, power line replacements and other grid components, logistics, supplies and personnel.	9. Post disaster recovery and rehabilitation	**2**	**2**	**2**	**3**	**2**
E25	**Hydrogen as energy vector**	The promotion for the installation of electrolysers in areas with the highest renewable potential of unmanageable character. Using the renewable effluents for hydrogen production, the hydrogen could then be used after storage in high-pressure tanks as vehicle fuel, especially for heavy mobility.	Local knowledge	**2**	**4**	**3**	**4**	**2**

E26	**Renewable technology hybridization**	Hybridize more expensive technologies but with greater capacity to manage or provide ancillary services with less expensive but more unstable technologies. Balances the electrical system and guarantees quality supply. For example, if photovoltaic technology means that energy is only available during daylight hours, other technologies such as wind power should be used proportionally to cover what photovoltaic technology cannot.	Local knowledge	**3**	**3**	**3**	**3**	**3**
E27	**Low and high enthalpy geothermal energy**	Support for investment in research to determine whether the site is suitable for geothermal energy. The low enthalpy is very appreciated in air conditioning for its stability, and low cost in favourable circumstances. The high enthalpy gives stability to the electrical network. Once the exploration phase is over, the Canary Islands must enter the research phase with soundings that allow the mapping of the resource, and then move on to the commercial phase.	Local knowledge	**3**	**3**	**4**	**3**	**3**
E28	**Shared self-consumption facilities**	Shared use of facilities to share costs and maximize the efficiency and management capacity of this type of facility. Communicate and help implement shared self-consumption actions through technical assistance and financial incentives.	Local knowledge	**4**	**4**	**3**	**4**	**4**
E29	**Promote cogeneration**	Cogeneration aims to cover the deficit in self-consumption by installing conventional back-up groups in tourist establishments, to satisfy peaks in demand for various forms of energy (electricity + heat), through efficient generators powered by fossil fuels. To assist technically and financially the companies.	Local knowledge	**3**	**2**	**2**	**3**	**3**

E30	**Micro smart grids**	It is an incentive designed with the purpose of providing greater resilience, since in the event of possible power failures in the electrical system, they will always have a guaranteed power supply. They serve to facilitate the penetration of the autogeneration REE in establishments, guaranteeing quality and security in the electrical supply. Technical assistance and financial support.	Local knowledge	**3**	**2**	**3**	**4**	**4**

6.3.4 Aquaculture

Options Characterization				Criteria				
ID	**Name**	**Description**	**Class of adaptation**	**Cost Efficiency**	**Environmental protection**	**Mitigation (GHG emissions) win-wins and trade-offs**	**Technical applicability**	**Social Acceptability**

A1	**Financial schemes, insurance and loans**	Financial schemes, insurance and loans are public or private risk-sharing mechanisms that aim to support farmers to respond to loss of production and infrastructures damages due to extreme weather, such as strong winds, heavy rains, floods or tidal surges. Additionally, it can provide capital to farm relocation, infrastructure and equipment upgrade, repair or replacement required.	1. Financial capital	**4**	**3**	**3**	**4**	**3**
A2	**Tax benefits and subsidies**	Tax benefits and subsidies consists in financial public policy instruments to promote or benefit economic or aquaculture sustainable practices and operator's overall resilience to climate change.	1. Financial capital	**4**	**3**	**3**	**4**	**3**
A3	**Feed production**	An important indirect impact to aquaculture is the change in fisheries production due to climate change. Aquaculture of finfish is highly dependent on fisheries for feed ingredients. This already a current problem with many fisheries overexploited and will only intensify in the future. Therefore, alternative feed ingredients are being developed such as insect meal and algae.	10. Provisioning services	**4**	**4**	**3**	**4**	**3**
A4	**Species selection**	Species selection consists of selecting species that are less sensitive to changes in the environment, less prone to diseases and less dependent on fish meal and oil. For example, choosing non-carnivorous species reduces food dependence and stocking larger hatchery fingerlings reduces the culture cycle and exposure to diseases.	10. Provisioning services	**4**	**3**	**3**	**4**	**3**

A5	**Selective breeding**	Selective breeding consists of genetic selection of species or strains with a focus on developing strains with a higher tolerance to changes in temperature, that grow faster, and which are more resilient to diseases. This is done by selecting and mating only the fish with desirable traits as broodfish. For example, choosing species with a wider temperature tolerance range may reduce the risk of future mortality.	11. Regulating and Maintenance Services	**3**	**3**	**3**	**4**	**2**
A6	**Best Management Practices**	Implementing Best Management Practices at farms which focus on food safety, fish health, environmental impact (including climate change) and social responsibility. These practices improve the farms capacity to participate in value chains with the aim of improving the overall resilience of the farm. For example, increasing hygiene will improve resilience of species to diseases.	11. Regulating and Maintenance Services	**4**	**3**	**3**	**4**	**4**
A7	**Create educational visits**	Students, schools, institutes and organisations can organise visits to the fish farms to learn about aquaculture and the interactions between aquaculture and the environment. These visits can also increase knowledge on different impacts on aquaculture including man-made and climate impacts. Biosecurity should be strictly observed.	12. Cultural services	**4**	**3**	**3**	**4**	**4**
A8	**Promote aquaculture cuisine**	This measure promotes aquaculture via online information and uses local restaurants. Aquaculture itself can be seen as an adaptation measure to climate change as an alternative to wild fisheries, which production and yield will reduce due to climate change. Therefore, promoting aquaculture species in restaurants or setting up specific 'aquaculture' restaurants will provide both a cultural experience and promote farmed products. The online tool highlights the initiative, provides recipes and aggregates information.	12. Cultural services	**4**	**3**	**3**	**4**	**4**

A9	**Awareness campaigns for behavioural change**	Awareness campaigns aim to increase the knowledge of individuals and organisations, it could also be relevant in a region affected by a particular climate threat, groups of stakeholders, and the general public.	2. Human capital	**3**	**3**	**3**	**4**	**4**
A10	**Efficient feed management**	Efficient feed management practices that reduce the Food Conversion Ratio by using technology or practices to feed more efficient helps to reduce the cost of production and increase environmental standards.	2. Human capital	**4**	**4**	**3**	**4**	**3**
A11	**Addressing consumer and environmental concerns at the local level**	This option aims to promote economy and jobs to address the future challenges of climate change. The major challenges need to be underlined and linked to the key concerns and impacts on the aquaculture sector.	3. Social capital					
A12	**Promote cooperation to local consumption**	Cooperation to promote local consumption of aquaculture produced fish specially in tourist sector will reduce the cost of distribution and will improve the creation of add value in local products or by-products in innovative industries.	3. Social capital	**3**	**3**	**3**	**3**	**4**

A13	**Integrated multi-trophic aquaculture (IMTA)**	Integrated multi-trophic aquaculture (IMTA) is an ecosystem-based approach to culture species from different trophic levels (fish, shellfish, seaweeds) in an integrated farm to create balanced systems for environmental sustainability. IMTA can increase resilience due to its tolerance to wider ranges of climatic factors such as temperature and salinity.	4. Natural capital	**2**	**4**	**3**	**2**	**4**
A14	**Short-cycle aquaculture**	Short-cycle aquaculture shortens the farming period and the time in marine cages by stocking larger fingerlings in the nursery stage (land-based) or selecting species with a shorter culture cycle.	4. Natural capital	**4**	**4**	**3**	**4**	**3**
A15	**Recirculation Aquaculture Systems (RAS)**	Recirculation Aquaculture Systems (RAS) are land-based indoor fish farms with closed containment rearing systems where filtration is applied to purify and regulate water parameters and remove toxic metabolic wastes of fish. Since RAS is land-based and indoor it limits the risk of infrastructure destruction due to extreme events in the ocean.	5. Physical capital	**1**	**1**	**2**	**4**	**3**
A16	**Submersible cages**	Submersible cages are oceanic depth-adjustable and can be moved up and down in the sea to escape the worst effects of storms, parasite outbreaks, surface algal blooms and to keep species at an optimal temperature.	5. Physical capital	**4**	**3**	**3**	**3**	**4**

A17	**Climate proof aquaculture activities**	Climate-proof activities refer to investments that consider climate change projections to manage future risks to infrastructures and improve operational safety conditions. E.g. strengthening mooring systems, cage structures and nets.	6. Managing long term risk	**4**	**3**	**3**	**3**	**4**
A18	**Risk-based zoning and site selection**	Risk-based zoning and site selection consists of taking into consideration climate change scenarios when planning and selecting a site for a farm. For example, marine cage operations should not select a site that is (or is expected to be) exposed to high waves or strong currents, and pond farming operations should select sites with low risk of flooding. Zone management can facilitate effective sharing of space and resources with other users, taking into account the carrying capacity of the site.	6. Managing long term risk	**3**	**3**	**3**	**1**	**3**
A19	**Disease prevention methods**	Disease prevention methods are preventive health measures such as vaccines, stronger fingerlings, probiotics, ensuring optimal water quality and implementing stricter hygiene procedures with the aim of reducing the risk of diseases now and in the future.	7. Preparedness	**4**	**4**	**3**	**4**	**3**
A20	**Environmental monitoring and Early Warning Systems (EWS)**	Environmental monitoring and Early Warning Systems (EWS) systematically collects and provides information to fish farmers with the aim of supporting climate risk management decision-making. Monitoring and early warning can facilitate adaptation actions, such as early harvesting or relocation of fish net pens from sites of intense harmful algae blooms. Dynamic vulnerability maps, remote sensing and GIS are typically applied in the development of this type of measures.	7. Preparedness	**4**	**3**	**3**	**4**	**3**

A21	**Mainstreaming Disaster Risk Management (DRM)**	This measure aims to plan and organize DRM considering climate change along five stages including prevention, protection, preparedness, and response, recovery and review in the aquaculture decision making and management frameworks. Examples include interventions to limit farm development in natural hazard areas; review safety engineering standards for farms; study the interactions of climate change in local ecosystems and appropriately develop strategies, arrangements, and procedures to address crises; and post-emergency recovery activities.	8. Response	**3**	**3**	**3**	**1**	**3**
A22	**Contingency for emergency management, early harvest and/or relocation**	These plans consist in moving produce or activities to sites with more suitable characteristics to protect them against climate hazards such as storms, high waves, temperature changes or water quality degradation. Relocation can mean moving activities within the same environment (ocean-ocean; land-land) or between environments (ocean to land). It also includes protocols emergency harvesting to reduce the stock loss.	8. Response	**3**	**3**	**3**	**2**	**3**
A23	**Recovery Post-Disaster plans**	Establish early recovery good practices and objectives. This option will allow to reduce socio-economic and environmental consequences of the disaster. Examples of good practices are: Identify goods and services (support facilities like boats and docks as well as farm infrastructure) that require restoration.	9. Post disaster recovery and rehabilitation	**3**	**3**	**3**	**3**	**3**

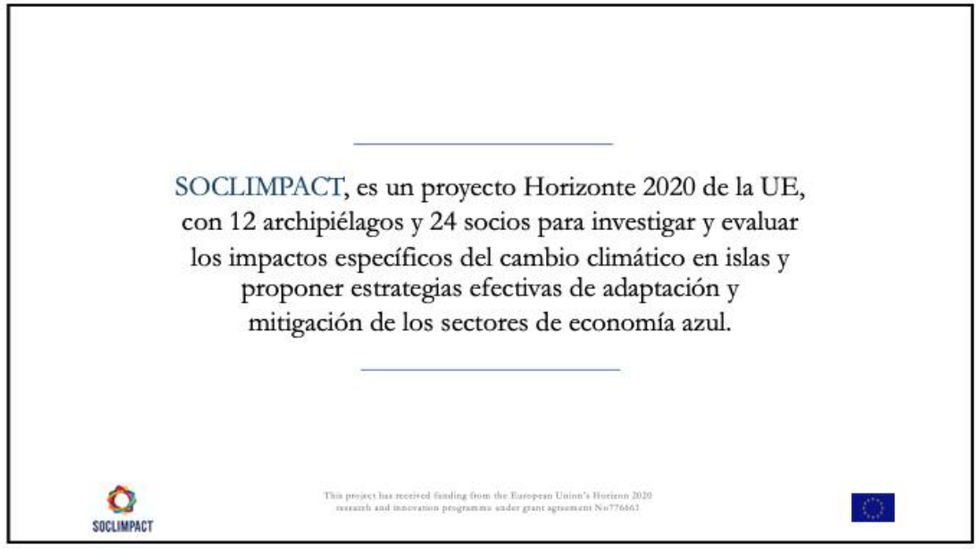
A24	**Recovery Post-Disaster funds**	Create recovery funds and plans for Post-Disaster in Aquaculture with Initiatives to get the economy running quickly, e.g. rebuild damaged critical infrastructures such boats, docks, and farm infrastructure. This option minimizes the economic and social impacts that can occur in a post-disaster context.	9. Post disaster recovery and rehabilitation	**3**	**3**	**3**	**3**	**3**
A25	**Increase POSEI and REF incentives**	Increase incentives that compensate for the distance and insularity in the POSEI and the REF. Also guarantee viable commercial margins, which will be affected by climate change.	Local knowledge	**4**	**2**	**2**	**4**	**3**
A26	**Knowledge transfer and financial support of emerging industries**	Optimize the transfer of knowledge from research groups to the industry, aimed at enabling local production of raw materials and juveniles, and the introduction of new species more resilient to CC and its effects; also, financial support scheme to this industry until it reaches the optimal scale.	Local knowledge	**4**	**3**	**3**	**3**	**3**
A27	**Review and streamline administrative processes**	Improving governance is key to addressing the impact of climate change. Reviewing and streamlining administrative procedures will help minimize the impact on production volumes.	Local knowledge	**4**	**2**	**3**	**2**	**4**

A28	**Promote tourist and non-tourist consumption**	The increase in consumption on the islands helps to reduce emissions, enhances the km 0 concept, contributes to the development of food sovereignty with high quality protein, and strengthens social cohesion.	Local knowledge	**3**	**4**	**4**	**3**	**4**
A29	**Favor the development of off-shore aquaculture**	It means an increase in the area of innovation, technological change. To introduce a cultivation system that does not exist on the islands. It improves the resistance to catastrophic weather episodes as a result of climate change and consequently contributes to reducing the environmental impact, favouring an increase in production.	Local knowledge	**4**	**3**	**2**	**3**	**4**
A30	**Reformulate the POEM (Zoning)**	To address the impact of climate change, the criteria for determining areas to be used in the future need to be improved and expanded: planning. Increasing depth reduces impact, improves habitats, and increases production.	Local knowledge	**3**	**2**	**3**	**4**	**3**

6.4 Interviews script

6.4.1 Tourism

1



2

Bienvenido/a…

- Al proceso de diseño de políticas públicas y de colaboración público privada para adaptar la actividad turística canaria a los riesgos derivados del cambio climático…
- Las opiniones bien informadas son clave para que las políticas estén bien diseñadas y sean eficaces…
- Canarias está construyendo su política para afrontar los retos y oportunidades del cambio climático, y el proyecto Soclimpact quiere contribuir aportando sus resultados y dando voz a las partes interesadas…
- Esta entrevista se estructura en dos partes, la primera para conocer su opinión sobre condicionantes del desarrollo del turismo en el SXXI y evaluar marcos de política posibles; y la segunda para que evalúe medidas alternativas relativas a fortalecer la industria turística frente a los impactos del CC.

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BLOQUE I

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4

Principales tendencias que definirán la evolución del Siglo

Previsiblemente, la evolución de la actividad turística a nivel global, se verá influenciada, entre otros procesos, por:

- El **crecimiento económico** global, del cuál el turismo es un componente fundamental y que al mismo tiempo afecta a la marcha de esta industria, y su distribución por regiones y países.
- La evolución de la **gobernanza global**, incluido el libre comercio y las barreras a los movimientos de mercancías, capitales y personas; la vigencia del multilateralismo vs repliegues nacionalistas; la emergencia de conflictos regionales y locales, incluso armados.
- El **cambio tecnológico**, su velocidad y dirección, especialmente en lo referido a las tecnologías de la información y la comunicación, y del transporte.
- La evolución de la **cohesión social**, de la distribución de la renta y de las políticas de bienestar, en el mundo, y en el entorno europeo.
- La evolución de las emisiones de **GEI** y del **cambio climático**, así como de los acuerdos globales con respecto al cuidado del clima, y de las políticas nacionales.

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5

El entorno del turismo de Canarias en el Siglo 21

Las tendencias que Vd. prevé en cada uno de estos procesos,
¿cómo cree que influirán en el turismo global
y de Canarias a lo largo del Siglo XXI?
(palabras clave)

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6

Preferencias sobre políticas climáticas

En virtud de cómo Vd. evalúe los problemas que puede representar el cambio climático para el turismo, **podría desear que se aplicaran unas u otras políticas** en esta materia.

En el marco de este Proyecto, entenderemos por **política** la *movilización de recursos financieros, y de capacidades técnicas y humanas, para el logro de objetivos concretos en materia de adaptación del turismo a las amenazas del cambio climático y de su contribución a la mitigación del mismo*; incluye todas las formas de **colaboración público-privada.**

A continuación, le pedimos que muestre su grado de acuerdo con 4 posibles **marcos de política** definidos para gestionar los impactos derivados del cambio climático, en general, y de aquellos que se ciernen sobre el turismo, en particular, que se resumen a continuación.

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Ordenar preferencias sobre políticas climáticas

Por favor, ordene las siguientes trayectorias posibles de política de acuerdo con sus preferencias, **numerándolas del 1 al 4**, siendo 1 su preferida.

TPC A

- **No precipitarse**!!! Mejor no hacer nada que hacerlo mal.
- Precipitación → + costes (irrecuperables → - competitividad.
- Hacer lo mínimo al mínimo coste → emergencias, si las hay…
- Esperar a qué otros hagan, aprender de sus errores …
- En este asunto, se va más cómodo en el vagón de cola.

TPC B

- El **crecimiento** es la mejor medicina para todo, incluido el cambio climático.
- Genera capacidades financieras → más inversión → economía a prueba de los impactos del Cambio climático.
- No a la adaptación que frene el crecimiento. No cambios estructurales.
- Descarbonización: aquella que conduzca a la generación de beneficios

TPC C

- La clave está en la **eficiencia** (en el uso de los RN y el MA).
- Eficiencia → incrementa base RN → incrementa opciones de futuro: mejor vía afrontar impacto CC.
- Priorizar el bienestar sostenible de la sociedad (antes que el crecimiento).

TPC D

- *Adaptación transformativa*: adaptación con **transformación estructural**
- Implica "TPC C" y además cambio en: i) preferencias de la sociedad por bienes más eco-amables; ii) cambio tecnológico forzado por incentivos para asegurar que nos ajustamos a los límites de la biosfera; iii) adaptar las organizaciones y el trabajo → mayor resiliencia de toda la sociedad al cambio climático.

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BLOQUE II

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9

Medidas para adaptar la industria al cambio climático en Canarias

A continuación, le mostramos 5 potenciales ámbitos de acciones que podrían implementarse para mejorar la resiliencia del turismo ante la amenaza del cambio climático.

Por favor, ordene de mayor a menor importancia cada ámbito de acciones, según su criterio:

1. Perfeccionar los **incentivos fiscales** para las empresas del sector (carga fiscal, figuras impos.)
2. Apoyo a la **investigación, desarrollo e innovación** que facilite la adaptación*
3. Apoyo a la **gestión** de los entornos del turismo (mercados, operadores, sociedad)
4. Apoyo a la **inversión privada** en adaptación y mitigación del cambio climático
5. Instrumentos de **planificación anticipativa y alerta temprana** frente a los riesgos
6. Otro ámbito, ¿cuál?:

1 = mayor importancia

5 = menor importancia

* En este contexto, incluye la mitigación para adaptarse a las preferencias de los mercados.

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Prioridades de política y horizontes temporales

Vd. puede considerar que unas medidas son más prioritarias que otras, y también que su importancia relativa puede cambiar a lo largo del tiempo. Para facilitar la comparación, le presentaremos pares de medidas, relativas a los 5-6 ámbitos presentados en la diapositiva anterior, para que las compare decidiendo sobre su prioridad e importancia relativa a medio y largo plazo.

Considere también que su preferencia por una medida frente a otra, podría depender del marco (TPC) desde el que estuviera comparándolas. Por favor, proceda a compararlas aportando una breve explicación de su decisión, relacionada con la evolución de las capacidades de adaptación de la sociedad a largo plazo.

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1. Capital financiero

A1	Instrumentos de política económica	Diseñados con el propósito de adaptar las decisiones individuales a los objetivos acordados colectivamente. Diferentes tipos de instrumentos, como: fijación de precios (por ejemplo, tarifas de agua), impuestos y tasas ambientales, subvenciones; comercio (por ejemplo, permiso negociable para la contaminación o la extracción de agua, mecanismos de compensación, pagos por servicios ambientales); y acuerdos voluntarios y planes de gestión de riesgos como los seguros.	VS	A2	Incentivos financieros para retirarse de las zonas de alto riesgo	Los incentivos financieros para retirarse de las zonas de alto riesgo se refieren a la creación de incentivos financieros para retirar o reubicar los asentamientos, la infraestructura y las actividades productivas de la ubicación original debido a su alta exposición a riesgos como las inundaciones, la elevación del nivel del mar y tormentas.

Por favor, señale la opción preferida:

Horizonte cercano (hasta 2030)		Horizonte intermedio (hasta 2050)		Horizonte lejano (hasta 2100)	
A9	A10	A9	A10	A9	A10
☐	☐	☐	☐	☐	☐

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2. Capital humano

A9	Diversificación de actividades y productos	Tiene como objetivo reducir la estacionalidad y la sobrecarga de las infraestructuras y los ecosistemas, valorizando otros infrautilizados. Si se hace tomando en cuenta los riesgos climáticos como olas de calor, erosión costera o la degradación de ecosistemas, podría ayudar a mantener el atractivo del destino.

VS

A10	Programas de sensibilización	Orientados al incremento de la conciencia sobre el cambio climático (valores específicos y necesidades de protección) entre todas las profesiones relacionadas con el turismo (manager generales, administradores de complejos, guías, recepcionistas, etc.) y de la población local en su conjunto.

Por favor, señale la opción preferida:

Horizonte cercano (hasta 2030)		Horizonte intermedio (hasta 2050)		Horizonte lejano (hasta 2100)	
A9	A10	A9	A10	A9	A10
☐	☐	☐	☐	☐	☐

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3. Capital social

A11	Economía circular local	La economía circular local es un sistema económico destinado a eliminar los desechos y el favorecer uso continuo de recursos, que ofrece un marco valioso para reducir las emisiones de carbono (descarbonización) y aumentar la resistencia al cambio climático y sus repercusiones.

VS

A12	Campañas de sensibilización de los turistas	Las campañas de sensibilización turística se centran en el cambio de comportamiento de los visitantes y tienen como objetivo aumentar el conocimiento del cambio climático y sus riesgos, y estimular cambios de comportamiento de los turistas (individuos y organizaciones). Pueden estar dirigidas a grupos específicos de visitantes o al conjunto de ellos.

Por favor, señale la opción preferida:

Horizonte cercano (hasta 2030)		Horizonte intermedio (hasta 2050)		Horizonte lejano (hasta 2100)	
A9	A10	A9	A10	A9	A10
☐	☐	☐	☐	☐	☐

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4. Capital natural

A13	Pesca local sostenible	La pesca local sostenible se refiere a la protección de derechos de pesca de los pescadores artesanales, que mantienen las poblaciones, utilizan métodos sostenibles y proveen material prima de alto valor culinario. Esta opción tiene por objeto añadir valor a los recursos y productos locales, proteger los servicios de los ecosistemas (incluida la fijación de carbono) y disminuir la dependencia externa.

VS

A14	Restricciones de agua, recortes de consumo y reciclaje de aguas residuales	Para hacer frente a las crisis de agua. La restricción (o el racionamiento) de ciertos usos del agua, como el riego del césped, el lavado de automóviles, el llenado de piscinas o la limpieza con mangueras de las zonas pavimentadas, puede ser necesario durante esos períodos. La depuración y reutilización de aguas residuales puede igualmente contribuir a aliviar la escasez en usos que no exigen un nivel de calidad del agua alto.

Por favor, señale la opción preferida:

Horizonte cercano (hasta 2030)		Horizonte intermedio (hasta 2050)		Horizonte lejano (hasta 2100)	
A9	A10	A9	A10	A9	A10
☐	☐	☐	☐	☐	☐

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5. Capital físico

A15	Alimentación de la playas (beach nourishment)	La alimentación de la playa (o reposición) es la colocación artificial de arena para compensar la erosión. La alimentación de las playas también suele tener por objeto mantener la anchura de la playa (con fines turísticos y recreativos). Se pueden utilizar varias técnicas de alimentación de las playas, con preferencia por aquellas que atienden y respetan los procesos de recirculación natural de la arena.

VS

A16	Desalación	La desalación puede contribuir a la adaptación en circunstancias de escasez de agua, actuales o futuros. Entre los ejemplos tecnológicos figuran las tecnologías de accionamiento eléctrico, como la ósmosis inversa, y las tecnologías de accionamiento térmico, basadas principalmente en procesos de destilación de vapor. Pueden ir asociadas a redes eléctricas distribuidas alimentadas por energías renovables.

Por favor, señale la opción preferida:

Horizonte cercano (hasta 2030)		Horizonte intermedio (hasta 2050)		Horizonte lejano (hasta 2100)	
A9	A10	A9	A10	A9	A10
☐	☐	☐	☐	☐	☐

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6. La gestión del riesgo a largo plazo

A17	Estructuras de protección costera	Incluyen espigones, rompeolas, arrecifes artificiales y malecones son diferentes tipos de estructuras artificiales, construidas en la línea de costa (o en los ríos), que están diseñadas para proteger la costa de la subida del nivel del mar o de las tormentas. Esas estructuras pueden utilizarse, por ejemplo, para derivar y retener sedimentos, proteger de la erosión, absorber la energía de las olas o permitir la navegación.

VS

A18	Sequía y planes de conservación del agua	Los planes contra la sequía y de conservación del agua, bien dirigidos al turismo o generals con participación del turismo, persiguen reducir las consecuencias económicas, sociales y ambientales de la escasez de agua, mediante la reducción de las pérdidas y mejoras en la eficiencia.

Por favor, señale la opción preferida:

Horizonte cercano (hasta 2030)		Horizonte intermedio (hasta 2050)		Horizonte lejano (hasta 2100)	
A9	A10	A9	A10	A9	A10
☐	☐	☐	☐	☐	☐

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7. Preparación

A19	Incorporación de la gestión del riesgo de desastres	Se despliega a lo largo de cinco etapas que incluyen la prevención, la protección, la preparación y la respuesta, la recuperación y el análisis. Entre los ejemplos figuran las intervenciones para limitar el desarrollo urbano en las zonas propensas a las inundaciones; la identificación de las zonas propensas a los peligros naturales; la elaboración de estrategias, disposiciones y procedimientos para hacer frente a las crisis; y las actividades de recuperación después de las emergencias.

VS

A20	Utilizar el agua para hacer frente a las olas de calor	El uso del agua para hacer frente a las olas de calor en las ciudades es un conjunto de inversiones en servicios e infraestructuras de abastecimiento de agua que tienen por objeto aumentar la capacidad de recuperación de las ciudades frente a las olas de calor. Incluye intervenciones como crear y/o reparar fuentes de agua potable y de refrigeración, canals principals y ramales de agua en zonas de ocio, fuentes de rociado de agua y mojar las calles, etc.

Por favor, señale la opción preferida:

Horizonte cercano (hasta 2030)		Horizonte intermedio (hasta 2050)		Horizonte lejano (hasta 2100)	
A9	A10	A9	A10	A9	A10
☐	☐	☐	☐	☐	☐

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8. Respuesta

A21	Planes de control de incendios	Acciones de gestión que tienen una amplia gama de aplicaciones, como la detección de alerta temprana, con rutas de escape y asesoramiento a los ciudadanos locales y a los turistas, la eliminación de incendios indeseados y perjudiciales, o el uso de incendios controlados para gestionar el combustible. Además ayudan a aumentar la comprensión de las interacciones del cambio climático con la cubierta vegetal y los regímenes de incendios.	VS	A22	Sistemas de atención de la salud	Los sistemas de prestación de servicios de atención de la salud son medidas preventivas y ajustes que es necesario introducir en los sistemas de atención de la salud, a saber, reforzar los aspectos menos preparados de su funcionamiento y/o logística, a fin de garantizar la eficacia y la eficiencia durante, por ejemplo, las situaciones de altas temperaturas y olas de calor, o brotes infecciosos.

Por favor, señale la opción preferida:

Horizonte cercano (hasta 2030)		Horizonte intermedio (hasta 2050)		Horizonte lejano (hasta 2100)	
A9	A10	A9	A10	A9	A10
☐	☐	☐	☐	☐	☐

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9. Recuperación y rehabilitación después de un desastre

A23	Fondos para la recuperación post-desastre	Fondos para facilitar que el turismo se recupere después de los desastres, mediante iniciativas que pongan en marcha la actividad rápidamente, al tiempo que reconstruyan con mejores cimientos (por ejemplo, reconstruir las infraestructuras críticas dañadas como puertos y carreteras o recuperar el paisaje de los incendios). El objetivo es reducir al mínimo los efectos económicos y sociales (que pueden incluir la pérdida futura del atractivo del destino turístico) posteriores a un desastre.	VS	A24	Planificación de la recuperación temprana previa al desastre	Incluyen el desarrollo de conocimientos, buenas prácticas y objetivos que tienen por objeto la mejora inmediata de las poblaciones afectadas, facilitando al mismo tiempo los ajustes necesarios para reducir el riesgo de futuros desastres. Ejemplos de buenas prácticas son la identificación de los ecosistemas críticos (servicios) que requieren una restauración inmediata o de las comunidades particularmente vulnerables; definición de procedimientos de intervención eficientes; …

Por favor, señale la opción preferida:

Horizonte cercano (hasta 2030)		Horizonte intermedio (hasta 2050)		Horizonte lejano (hasta 2100)	
A9	A10	A9	A10	A9	A10
☐	☐	☐	☐	☐	☐

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10. Servicios de aprovisionamimento

A3	Mejora de la gestión de las aguas subterráneas	Puede concretarse en: 1) conservar los aquíferos, limitando el uso del agua y optimizando su reutilización, y 2) restaurar o aumentar la capacidad de infiltración natural. Contribuyen a la adaptación en circunstancias de reducción de las precipitaciones y de intrusión de agua salada, agravadas por la sobreexplotación de las aguas subterráneas. Suelen incluir la recarga artificial y reducción de pérdidas en distribución.	VS	A4	Sistemas de vigilancia, modelización y previsión climática	Son sistemas de información que proporcionan información climática oportuna y fiable, y datos actualizados sobre ocurrencia y gravedad de los fenómenos extremos, sus posibles impactos y su duración. Se deben ajustar según los peligros climáticos relevantes, como los relacionados con la sequía, la vigilancia de la calidad del agua, la gestión de los recursos hídricos y la predicción y gestión de los riesgos de inundación.

Por favor, señale la opción preferida:

Horizonte cercano (hasta 2030)		Horizonte intermedio (hasta 2050)		Horizonte lejano (hasta 2100)	
A9	A10	A9	A10	A9	A10
☐	☐	☐	☐	☐	☐

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11. Servicios de regulación y mantenimiento

A5	Restauración y rehabilitación de dunas	Se refiere al fortalecimiento de las funciones de seguridad contra inundaciones y de depósito de arena de las dunas. También de su función recreativa. La erosión de las dunas se produce como resultado de la acción del viento, la erosión marina, las actividades humanas y la elevación del nivel del mar (SLR). Entre los posibles ejemplos técnicos se incluyen: la plantación de plantas, coberturas de paja y las vallas.	VS	A6	Rehabilitación y restauración de cuencas pluviales	Son medidas que ponen de relieve las funciones naturales de las cuencas y crean zonas de amortiguación con vegetación a lo largo de los cursos de agua. Mejora las condiciones microclimáticas, reduce la erosión y aumenta la recarga de las aguas subterráneas. En el caso del turismo, esta opción también aumenta las zonas de ocio disponibles, aumenta las zonas de confort térmico y la disponibilidad de agua.

Por favor, señale la opción preferida:

Horizonte cercano (hasta 2030)		Horizonte intermedio (hasta 2050)		Horizonte lejano (hasta 2100)	
A9	A10	A9	A10	A9	A10
☐	☐	☐	☐	☐	☐

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12. Servicios culturales

A7	Gestión adaptativa de los hábitats naturales	Se refiere a la preservación de los servicios de los ecosistemas que son esenciales para el bienestar humano, buena parte de ellos agravados por el cambio climático. Entre las medidas de gestión adaptativa figuran: mejorar la comprensión de la respuesta de las especies; dejar espacio a las dinámicas fluviales y costeras; ayudar al flujo de genes y a la movilidad de las especies; actualización constant de los objetivos y los instrumentos y planes de conservación.

VS

A8	Piscinas naturales	Las piscinas oceánicas son piscinas de agua de mar situadas junto al mar, donde las olas pueden penetrar. El ancho, la longitud y la profundidad de las piscinas oceánicas varía, dependiendo de su ubicación en la línea de costa. Son útiles en el contexto de la subida del nivel del mar, ya que sirven para proteger la costa y constituyen alternativas a las playas.

Por favor, señale la opción preferida:

Horizonte cercano (hasta 2030)		Horizonte intermedio (hasta 2050)		Horizonte lejano (hasta 2100)	
A9	A10	A9	A10	A9	A10
☐	☐	☐	☐	☐	☐

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Ordenar seis medidas concretas y proponer otras

Por favor, ordene de mayor a menor importancia las siguientes medidas concretas, según su criterio:

1	Adaptación pasiva y baja en carbono de los edificios turísticos para periodos de calor extremo más largos	Financiación y asistencia técnica para la adopción de criterios de arquitectura bioclimática en edificios turísticos reformados y de nueva construcción; la reglamentación que la obligue debe ir acompañada de incentivos económicos.	☐
2	Ninguna descarga de aguas residuales al mar	Mejorar el sistema de tratamiento de aguas residuales en todas las islas. Para mitigar el impacto del calentamiento del agua de mar en las praderas de pastos marinos, y contribuir al abastecimiento de agua con una fuente de agua que requiera menos energía que la desalación.	☐
3	Redes eléctricas distribuidas alimentadas por energías renovables	Desarrollar redes eléctricas distribuidas basadas en fuentes renovables (fotovoltaica, eólica) para alimentar plantas desaladoras y consorcios de empresas turísticas, a fin de reducir el costo de la electricidad y las emisiones, y aumentar la estabilidad de la red eléctrica.	☐
4	Prevención de incendios forestales y conservación de ecosistemas endémicos emblemáticos	Incentivar los usos tradicionales de los bosques basados en la ganadería para reducir la inflamabilidad de los bosques y el mantenimiento de las actividades agrícolas en la periferia de las masas forestales, actuando así como cortafuegos.	☐
5	Microáreas marinas protegidas con gestión *bottom-up*	Acuerdos dirigidos por stakeholders para mejorar la gestión de las zonas marinas afectadas por la sobrepesca y la degradación del hábitat para favorecer la rehabilitación del hábitat y crear sinergias entre la pesca sostenible, las actividades turísticas ecológicas y las actividades terrestres.	☐
6	Compostaje de materia orgánica residual para reducir las emisiones de metano, restaurar los paisajes degradados y mejorar la fertilidad del suelo	Los lodos residuales, los residuos orgánicos de la agricultura y la fracción orgánica de los desechos sólidos urbanos se eliminan actualmente en vertederos mal gestionados, liberando metano a la atmósfera. El compostaje contribuiría a vincular el turismo con la descarbonización, las opciones alimentarias locales y la rehabilitación de paisajes.	☐

1 = mayor importancia

6 = menor importancia

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¡Muchas gracias por su participación!

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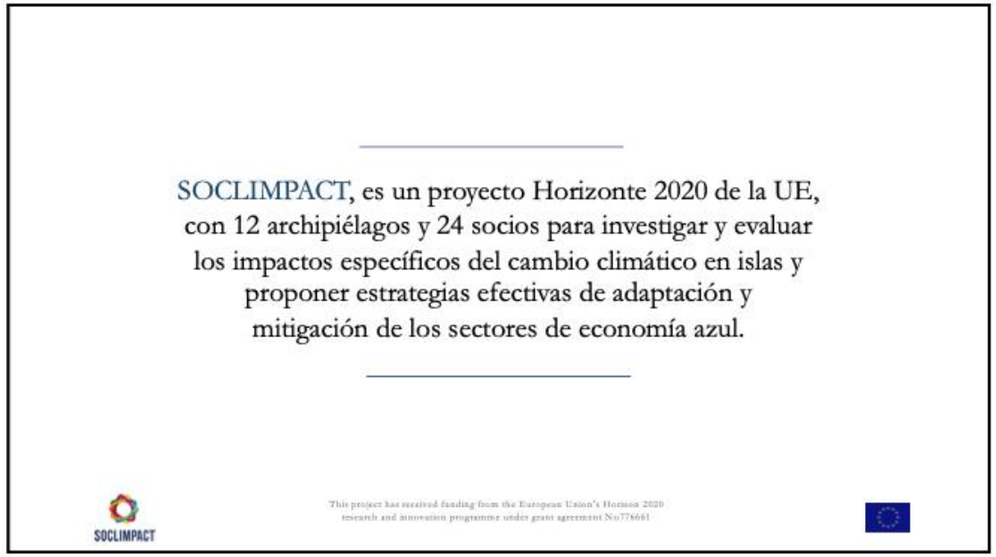
6.4.2 Maritime Transport

1



2

Bienvenido/a…

- Al proceso de diseño de políticas públicas y de colaboración público privada para adaptar el transporte marítimo canario a los riesgos derivados del cambio climático…
- Las opiniones bien informadas son clave para que las políticas estén bien diseñadas y sean eficaces…
- Canarias está construyendo su política para afrontar los retos y oportunidades del cambio climático, y el proyecto Soclimpact quiere contribuir aportando sus resultados y dando voz a las partes interesadas…
- Esta entrevista se estructura en dos partes, la **primera** para conocer cómo ordenaría la importancia de los diferentes **peligros** climáticos, zonas portuarias más **expuestas** y potenciales afecciones al **valor añadido** de la actividad portuaria; y la **segunda** para que exprese su **preferencia** con respecto a **opciones alternativas** de adaptación al cambio climático, en diferentes horizontes temporales.

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BLOQUE I

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4

Hazards

Algunos de los siguientes peligros para la operatividad de su puerto pueden exacerbarse con el cambio climático.

¿Podría por favor ordenar los peligros siguientes de mayor a menor de acuerdo con la información de la que dispone?

a	Fuertes vientos sostenidos y ráfagas de viento	Fuertes vientos capaces de impedir que ciertas operaciones se lleven a cabo con seguridad.	
b	Altura de las olas	Aumento de la altura de las olas, especialmente cuando coincide con la pleamar y en la época del año de mayores mareas.	
c	Subida del nivel del mar	Subida del nivel del mar, haciendo más dañinos los efectos del oleaje y de las marejadas, y pudiendo inundar zonas del recinto portuario.	
d	Lluvias torrenciales y marejadas ciclónicas	Capaces de producir inundaciones de zonas de operaciones portuarias.	
e	Episodios de calor extremo	Olas de calor que puedan afectar a la conservación de las mercancías y a las condiciones de trabajo de los operarios.	
	Otro hazard, ¿cuál?		

1 = mayor importancia

5 = menor importancia

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5

Estructuras y procesos vulnerables

En su puerto, previsiblemente unas estructuras y procesos pueden verse más afectados que otros como con secuencia del cambio climático y de la situación en la que actualmente se encuentran.

¿Podría ordenar las siguientes de mayor a menor vulnerabilidad a los impactos del cambio climático?

a	Estructuras de protección	Diques y escolleras que pueden ser superados por las olas.	
b	Atraque	Líneas de atraque cuya operatividad que pueden verse afectadas por la subida del nivel del mar y el oleaje.	
c	Zona de aproximación buques	La aproximación de buques al recinto portuario puede verse afectada por el oleaje, aun cuando el puerto pudiera permanecer operativo.	
d	Carga y descarga	Las operaciones de carga y descarga pueden verse afectadas por fuertes vientos, por calor extremo o por inundaciones.	
e	Áreas de almacenamiento	Superficies destinadas al almacenamiento de mercancías y servicios administrativos, entre otros, pueden verse afectadas por inundaciones.	
	Otra estructura o proceso, ¿cuál?		

1 = mayor importancia

5 = menor importancia

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6

Efectos económicos

Los diferentes impactos del cambio climático sobre la operativa portuaria pueden afectar al valor añadido de la actividad portuaria, por diferentes motivos.

¿Podría por favor ordenar de mayor a menor los motivos que podrían inducir pérdida de valor agregado de la actividad portuaria?

a	Reestructuración del tráfico marítimo y las operaciones portuarias	Costes de reestructuración de tráfico y de las operaciones portuarias, afectados por fenómenos climáticos extremos.	
b	Pérdida de tráfico marítimo por rutas alternativas	Pérdida de tráfico marítimo por desvío a rutas alternativas climáticamente más seguras.	1 = mayor importancia
c	Pérdida de tráfico marítimo por reducción de la producción de mercancías comercializadas	Pérdida de tráfico marítimo por reducción de la producción de mercancías comercializadas a través de transporte marítimo (indirecto).	↕
d	Pagos a terceros en compensación de pérdidas o gastos en seguros por pérdidas de terceros	Pago a terceros en compensación de pérdidas, o gasto en seguros de cobertura de pérdidas de terceros, debido a factores climáticos.	5 = menor importancia
e	Gastos en reparaciones de estructuras dañadas	Gastos en reparaciones de estructuras portuarias dañadas por diferentes manifestaciones de clima extremo (vientos, oleaje, lluvias torrenciales, marejadas, ciclones, etc.)	
	Otro efecto económico, *¿cuál?*		

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BLOQUE II

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8

Prioridades de política y horizontes temporales

Vd. puede considerar que unas medidas son más prioritarias que otras, y también que su importancia relativa puede cambiar a lo largo del tiempo. Por ello, le presentaremos pares de medidas relativas a los 5 bloques presentados en la diapositiva anterior para que las compare decidiendo sobre su prioridad e importancia relativa a medio y largo plazo.

Considere también que su preferencia por una medida frente a otra, podría depender del marco (TPC) desde el que estuviera comparándolas. Por favor, proceda a compararlas aportando una breve explicación de su decisión relacionada con la evolución de las capacidades de adaptación de la sociedad a largo plazo.

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1. Capital financiero

A1	Mejora de los esquemas de aseguramiento de los puertos	Los seguros para los puertos incluyen planes de distribución de riesgos que tienen por objeto ayudar a los operadores portuarios a responder a los riesgos climáticos que pueden reducir. El seguro subcontrata los riesgos a un tercero a cambio de una compensación financiera regular.

VS

A2	Incentivos financieros para retirarse de las zonas de alto riesgo	Creación de incentivos financieros para retirar o reubicar los asentamientos, la infraestructura y las actividades productivas de la ubicación original debido a su alta exposición a riesgos como las inundaciones, la elevación del nivel del mar y las tormentas.

Por favor, señale la opción preferida:

Horizonte cercano (hasta 2030)		Horizonte intermedio (hasta 2050)		Horizonte lejano (hasta 2100)	
A9	A10	A9	A10	A9	A10
☐	☐	☐	☐	☐	☐

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2. Capital humano

A9	Campañas de sensibilización para promover cambios de comportamiento	Las campañas de sensibilización para el cambio de comportamiento tienen por objeto aumentar los conocimientos de las personas y las organizaciones sobre el cambio climático y el riesgo que afronta el sector del transporte marítimo. Esto facilitaría la aceptación social e institucional de la inversión que los puertos requieren para adaptarse al cambio climático	VS	A10	Formación para la capacitación en el sector portuario	Las medidas de adaptación son ejecutadas en última instancia por el capital humano del Puerto. Por tanto, la formación de los operarios es fundamental para que las medidas planeadas de adaptacion al cambio climatico se lleven a cabo de manera eficaz y eficiente.

Por favor, señale la opción preferida:

Horizonte cercano (hasta 2030)		Horizonte intermedio (hasta 2050)		Horizonte lejano (hasta 2100)	
A9	A10	A9	A10	A9	A10
☐	☐	☐	☐	☐	☐

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3. Capital social

A11	Mejorar las condiciones de los bienes perecederos frente a climas extremos	Preparar los puertos para que los bienes perecederos puedan conservarse en mejores condiciones en contextos de climas extremos. El objetivo es adaptar las condiciones a las características del clima y los cambios que éste pueda soportar.	VS	A12	Economía y empleos resilientes al clima	Hacer la economía y los empleos más resilientes al clima implica que los procesos de comercio dependan menos de las operaciones "Just in Time" (JIT), y que deben aumentarse los stocks estratégicos para hacer frente a posibles interrupciones en los suministros, derivadas de fenomenos climáticos, y reducer los riesgos de desabastecimiento.

Por favor, señale la opción preferida:

Horizonte cercano (hasta 2030)		Horizonte intermedio (hasta 2050)		Horizonte lejano (hasta 2100)	
A9	A10	A9	A10	A9	A10
☐	☐	☐	☐	☐	☐

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4. Capital natural

A13	Sistemas de refrigeración, enfriamiento y ventilación para confort humano	Mejorar la eficiencia de los sistemas de refrigeración, enfriamiento y ventilación para reducir los costes asociados al calor extremo, y mantener las operaciones durante las olas de calor. El confort térmico humano proporcionado por una ventilación y refrigeración eficientes es relevante para garantizar la salud de los pasajeros y la seguridad y productividad de los trabajadores portuarios.

VS

A14	Limitar el desarrollo portuario en las zonas de baja altitud inundables	Limitar el desarrollo portuario y el asentamiento de estructuras en zonas bajas significa reducer las zonas portuarias expuestas a la subida del nivel del mar e inundaciones. Este debe ser un criterio fundamental de la planificación de los desarrollos portuarios.

Por favor, señale la opción preferida:

Horizonte cercano (hasta 2030)		Horizonte intermedio (hasta 2050)		Horizonte lejano (hasta 2100)	
A9	A10	A9	A10	A9	A10
☐	☐	☐	☐	☐	☐

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5. Capital físico

A15	Mejora de la solidez de los buques	Mejorar la resistencia de los buques a las tormentas marinas, disminuyendo el ruido y aumentando la eficiencia. Las cargas inducidas por las olas en las estructuras de los barcos son una preocupación importante en el proceso de diseño del casco. Los armadores deberían preferir diseños que permitan regímenes de olas más exigentes (por ejemplo, que incluyan la capacidad de supervivencia frente a las olas gigantescas).

VS

A16	Aumentar la velocidad operacional y la flexibilidad en los puertos	Tiene por objeto aumentar el atractivo del transporte marítimo a fin de captar más movimiento de carga y de pasajeros. Ello puede promover un cambio modal hacia el transporte marítimo y crear nuevas oportunidades, incluidas las relacionadas con las exportaciones y el turismo. También reduce los efectos de las olas de calor en las mercancías y las personas, y ayuda a la descarbonización de la economía.

Por favor, señale la opción preferida:

Horizonte cercano (hasta 2030)		Horizonte intermedio (hasta 2050)		Horizonte lejano (hasta 2100)	
A9	A10	A9	A10	A9	A10
☐	☐	☐	☐	☐	☐

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6. La gestión del riesgo a largo plazo

A17	Puertos y actividades portuarias a prueba de cambio climático	Las inversiones tienen en cuenta las proyecciones de cambio climático en el entorno para gestionar los riesgos futuros en las infraestructuras portuarias y mejorar las condiciones de seguridad operacional. Pueden incluir la adaptación o reconfiguración de los rompeolas y otras estructuras para evitar sobrecargas e inundaciones debidas a tormentas de mar, fuertes precipitaciones, calor extremo, vientos fuertes y oleaje extremo.

VS

A18	Incorporar la expansión/ reasignación de zonas portuarias en la planificación urbana	Considerar la expansion y reasignación de espacios de la actividad portuaria en planificación urbana tomando en consideración los riesgos derivados del cambio climático, de modo que se faciliten las decisions de las autoridades portuarias a la hora de planificar desarrollos y reasignar áreas para responder a las amenazas del cambio climático.

Por favor, señale la opción preferida:

Horizonte cercano (hasta 2030)		Horizonte intermedio (hasta 2050)		Horizonte lejano (hasta 2100)	
A9	A10	A9	A10	A9	A10
☐	☐	☐	☐	☐	☐

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7. Preparación

A19	Refuerzo de la inspección, reparación y mantenimiento de las infraestructuras	El refuerzo continuo de la inspección, la reparación y el mantenimiento de las infraestructuras tiene por objeto adaptar la vigilancia a un nuevo contexto climático. Los cambios en la frecuencia y/o la intensidad de las tormentas, o la variabilidad de las temperaturas, por ejemplo, pueden tener repercusiones en la infraestructura, aumentando la degradación de los materiales y exigiendo nuevos planes de mantenimiento.

VS

A20	Sistemas de Alerta Temprana y monitoreo del cambio climático	Los sistemas de alerta temprana (EWS) son sistemas de información que evalúan los riesgos climáticos y transmiten esa información a los responsables de la toma de decisiones, a las empresas de servicios públicos y al público en general en tiempo real. Los operadores de transporte deben integrar esta herramienta en los procedimientos para proteger la seguridad de las personas y los bienes en los recintos portuarios.

Por favor, señale la opción preferida:

Horizonte cercano (hasta 2030)		Horizonte intermedio (hasta 2050)		Horizonte lejano (hasta 2100)	
A9	A10	A9	A10	A9	A10
☐	☐	☐	☐	☐	☐

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8. Respuesta

A21	Sistemas de Transporte Inteligente (STI)	Los sistemas de transporte inteligentes (STI) son tecnologías que transmiten a los buques datos automatizados y adaptados, y mensajes relacionados con la seguridad, relativos a los peligros climáticos y otra información pertinente. Los STI utilizan normas de comunicación e información que son uniformes y ampliamente aceptadas por todos los puertos, lo que favorece su adopción.	VS	A22	Prepararse para los retrasos o cancelaciones del servicio	Tiene por objeto promover la creación de nuevos procedimientos, opciones y canales alternativos para la venta de mercancías y el transporte de pasajeros, así como una mejor comunicación para hacer frente a los retrasos o cancelaciones. Contribuye a la mejora de la reputación del puerto y aumenta las preferencias de los clients por el mismo.

Por favor, señale la opción preferida:

Horizonte cercano (hasta 2030)		Horizonte intermedio (hasta 2050)		Horizonte lejano (hasta 2100)	
A9	A10	A9	A10	A9	A10
☐	☐	☐	☐	☐	☐

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9. Recuperación y rehabilitación después de un desastre

A23	Rutas e infraestructuras de reserva en condiciones climáticas extremas	Las rutas e infraestructuras de reserva durante las condiciones meteorológicas extremas tienen por objeto crear una respuesta posterior a los desastres que garantice alternativas disponibles cuando los puertos principales estén dañados o sean inaccesibles debido a fenómenos meteorológicos extremos. Incluyen puertos alternativos de menor tamaño, más sencillos y que se usan para otros fines, pero con una ubicación y orientación diferentes, y vías de acceso alternativas.	VS	A24	Fondos para la recuperación posterior a un desastre	Se trata de fondos de recuperación para que el sector del transporte marítimo se recupere después de los desastres, mediante iniciativas que pongan en marcha rápidamente la economía y viabilicen la reconstrucción de las infraestructuras críticas dañadas, como puertos y carreteras. El objetivo es reducir al mínimo los efectos económicos y sociales que pueden producirse en un contexto post-desastre.

Por favor, señale la opción preferida:

Horizonte cercano (hasta 2030)		Horizonte intermedio (hasta 2050)		Horizonte lejano (hasta 2100)	
A9	A10	A9	A10	A9	A10
☐	☐	☐	☐	☐	☐

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10. Servicios de aprovisionamimento

A3	Estructuras de protección costera respetuosas con la vida marina	Las estructuras de protección costera amigables con la vida marina son estructuras de protección costera construidas con materiales que maximizan la fijación de los organismos marinos. Esta opción reduce los impactos del cambio climático en los ecosistemas locales, proporciona depuración de los desechos de agua (hechos por organismos marinos) y bioindicadores de la calidad del agua dentro de los puertos.

VS

A4	Infraestructuras combinadas para la protección y el aprovechamiento de la energía de las olas	Las infraestructuras de protección combinada y de energía de las olas es una medida energética que combina las estructuras de protección del mar con la producción de energía de las olas. Esto puede crear economías de escala, aumentar la protección costera y disminuir aún más la propagación de las olas dentro del puerto durante las operaciones normales.

Por favor, señale la opción preferida:

Horizonte cercano (hasta 2030)		Horizonte intermedio (hasta 2050)		Horizonte lejano (hasta 2100)	
A9	A10	A9	A10	A9	A10
☐	☐	☐	☐	☐	☐

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11. Servicios de regulación y mantenimiento

A5	Incentivar la propulsión híbrida o eléctrica de los buques	La propulsión híbrida y totalmente eléctrica de los buques es respetuosa con el medio ambiente marino, disminuye las emisiones y puede aumentar la maniobrabilidad de los buques, útil en puertos pequeños y condiciones meteorológicas difíciles (p.e. propulsores acimutales eléctricos). Las maniobras a baja velocidad con motores convencionales crean contaminación del aire y del agua, ruido y consumo de combustible.

VS

A6	Estructuras de protección costera	Los espigones, rompeolas, arrecifes artificiales y malecones son diferentes tipos de estructuras artificiales, construidas en la línea de costa, diseñadas para protegerla de la subida del nivel del mar y de las tormentas. Esas estructuras pueden utilizarse, por ejemplo, para derivar y atrapar sedimentos, proteger de la erosión, absorber la energía de las olas o permitir la navegación.

Por favor, señale la opción preferida:

Horizonte cercano (hasta 2030)		Horizonte intermedio (hasta 2050)		Horizonte lejano (hasta 2100)	
A9	A10	A9	A10	A9	A10
☐	☐	☐	☐	☐	☐

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Seis nuevas medidas concretas

Por favor, ordene de mayor a menor importancia de las siguientes acciones para mantener la operatividad de los puertos de Canarias frente a fenómenos climáticos extremos, según su criterio:

1			
2			
3			
4			
5			
6			

1 = mayor importancia

6 = menor importancia

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¡Muchas gracias por su participación!

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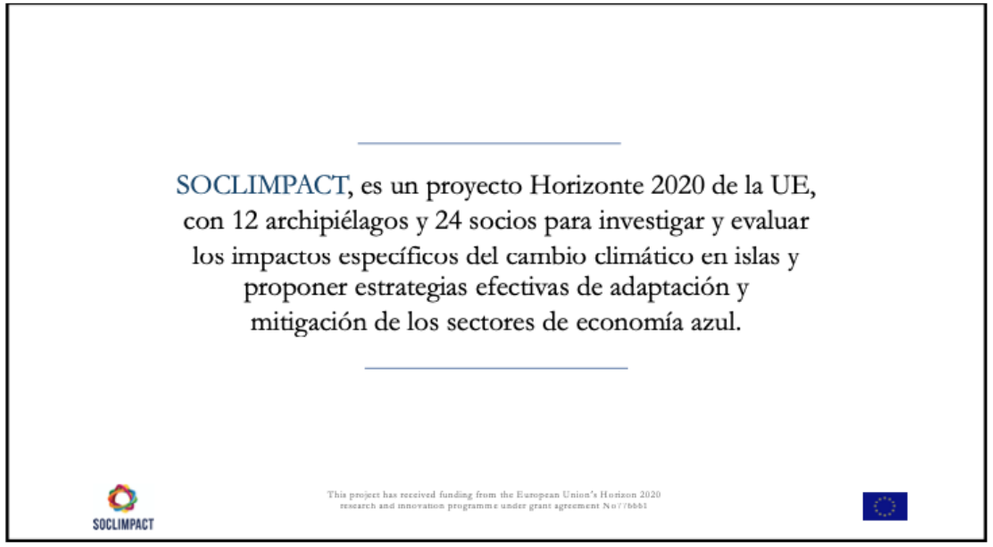
6.4.3 Energy

1



2

Bienvenido/a…

- Al proceso de diseño de políticas públicas y de colaboración público privada para adaptar el sector energético canario a los riesgos derivados del cambio climático…
- Las opiniones bien informadas son clave para que las políticas estén bien diseñadas y sean eficaces…
- Canarias está construyendo su política para afrontar los retos y oportunidades del cambio climático, y el proyecto Soclimpact quiere contribuir aportando sus resultados y dando voz a las partes interesadas…
- Esta entrevista se estructura en dos partes, la primera para conocer su opinión sobre condicionantes del desarrollo del sector energético en el SXXI y marcos de política preferidos; y la segunda para que evalúe medidas alternativas relativas a fortalecer el sector energético frente a los impactos del CC.

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BLOQUE I

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Principales tendencias que definirán la evolución del Siglo

Previsiblemente, la evolución del sector de la energía a nivel global, se verá influenciada, entre otros procesos, por:

- El **crecimiento económico** global, del cuál la energía es un vector fundamental, y su distribución por regiones y países.
- La evolución de la **gobernanza global**, incluido el libre comercio y las barreras a los movimientos de mercancías, capitales y personas; la acción de las instituciones multilaterales; la emergencia y desarrollo de conflictos regionales o locales, especialmente en zonas ricas en materias primas energéticas.
- El **cambio tecnológico**, su velocidad y dirección, especialmente en lo referido a las tecnologías de producción y acumulación de energía y de gestión de las redes eléctricas.
- La evolución de la **cohesión social**, de la distribución de la renta y de las políticas de bienestar, en el mundo, que incluyen las condiciones de acceso a la producción y consumo de la energía..
- La evolución de las emisiones de **GEI** y del **cambio climático**, así como de los acuerdos globales con respecto al cuidado del clima.

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5

El entorno del sector energético canario en el Siglo 21

Las tendencias que Vd. prevé en cada uno de estos procesos, ¿cómo cree que influirán en el sector energético global y en el sector energético canario del Siglo XXI?

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6

Preferencias sobre políticas climáticas

En virtud de cómo Vd. evalúe los problemas que puede representar el cambio climático para el sector energético, **podría desear que se aplicaran unas u otras políticas** en esta materia.

En el marco de este Proyecto, entenderemos por **política** la *movilización de recursos financieros, y de capacidades técnicas y humanas, para el logro de objetivos concretos en materia de adaptación del sector energético a las amenazas del cambio climático y su contribución a la mitigación del mismo*; incluye todas las formas de **colaboración público-privada.**

A continuación, le pedimos que muestre su grado de acuerdo con 4 posibles **marcos de política** definidos para gestionar los impactos derivados del cambio climático, en general, y de aquellos que se ciernen sobre el sector energético, en particular, que se resumen a continuación.

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Ordenar preferencias sobre políticas climáticas

Por favor, ordene las siguientes trayectorias posibles de política de acuerdo con sus preferencias, **numerándolas del 1 al 4**, siendo 1 su preferida.

TPC A

- **No precipitarse**!!! Mejor no hacer nada que hacerlo mal.
- Precipitación → + costes (irrecuperables → - competitividad.
- Hacer lo mínimo al mínimo coste → emergencias, si las hay
- Esperar a qué otros hagan, aprender de sus errores …
- En este asunto, se va más cómodo en el vagón de cola.

TPC B

- El **crecimiento** es la mejor medicina para todo, incluido el cambio climático.
- Genera capacidades financieras → más inversión → economía a prueba de los impactos del Cambio climático.
- No a la adaptación que frene el crecimiento. No cambios estructurales.
- Descarbonización: aquella que conduzca a la generación de beneficios

TPC C

- La clave está en la **eficiencia** (en el uso de los RN y el MA).
- Eficiencia → incrementa base RN → incrementa opciones de futuro: mejor vía afrontar impacto CC.
- Priorizar el bienestar sostenible de la sociedad (antes que el crecimiento).

TPC D

- *Adaptación transformativa*: adaptación con **transformación estructural**
- Implica "TPC C" y además cambio en: i) preferencias de la sociedad por bienes más eco-amables; ii) cambio tecnológico forzado por incentivos para asegurar que nos ajustamos a los límites de la biosfera; iii) adaptar las organizaciones y el trabajo → mayor resiliencia de toda la sociedad al cambio climático.

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BLOQUE II

SOCLIMPACT

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9

Medidas para adaptar la industria al cambio climático

A continuación, le mostramos 5 potenciales ámbitos de acciones que podrían implementarse para mejorar la resiliencia del sector energético al cambio climático.

Por favor, ordene de mayor a menor importancia cada ámbito de acciones, según su criterio:

1. Más potentes **incentivos financieros y fiscales** para las empresas del sector
2. Apoyo a la **investigación, desarrollo e innovación** que facilite la adaptación
3. Apoyo a la mejora de la **gestión** de los procesos productivos y de los entornos
4. Apoyo a la **inversión privada** para fortalecer la industria frente al cambio climático
5. Instrumentos de **planificación anticipativa y alerta temprana** frente a los riesgos

1 = mayor importancia

5 = menor importancia

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Prioridades de política y horizontes temporales

Vd. puede considerar que unas medidas son más prioritarias que otras, y también que su importancia relativa puede cambiar a lo largo del tiempo. Por ello, le presentaremos pares de medidas, relativas a los 5 bloques presentados en la diapositiva anterior, para que las compare decidiendo sobre su prioridad e importancia relativa a medio y largo plazo.

Considere también que su preferencia por una medida frente a otra, podría depender del marco (TPC) desde el que estuviera comparándolas. Por favor, proceda a compararlas aportando una breve explicación de su decisión, relacionada con la evolución de las capacidades de adaptación de la sociedad a largo plazo.

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1. Capital financiero

A1	**Apoyo financiero para edificios con baja demanda energética**	Planes financieros en forma de préstamos, subvenciones o desgravaciones fiscales son formas de apoyar la reducción de las necesidades energéticas de los edificios nuevos o existentes, logrando que aborden el cambio climático de una manera más eficiente. Reduce la demanda energética para confort térmico (aire acondicionado, calefacción).

VS

A2	**Apoyo financiero para el control inteligente de la energía en casas y edificios**	Uso eficiente y automatizado de la energía que permite el ahorro y crea sinergias con los servicios públicos. Por ejemplo, coordinar la apertura automatizada de los conductos de ventilación con el funcionamiento del aire acondicionado, evitando el consumo de energía cuando sea posible. Reduce los costes de la climatización

Por favor, señale la opción preferida:

Horizonte cercano (hasta 2030)		Horizonte intermedio (hasta 2050)		Horizonte lejano (hasta 2100)	
A9	A10	A9	A10	A9	A10
☐	☐	☐	☐	☐	☐

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2. Capital humano

A9	Empleos y negocios verdes	La promoción de empleos y negocios verdes consiste en capacitar a las personas y apoyar a las empresas verdes para que apliquen soluciones energéticas en toda la economía, tanto en la mitigación como en la adaptación. Un ejemplo de ello puede ser el apoyo a proyectos de investigación para ayudar a las empresas a ocuparse de las nuevas tecnologías pertinentes para la acción climática.	VS	A10	Servicio de información pública sobre la acción climática	Proporcionar al público en general información sobre las opciones de adaptación y mitigación disponibles para sus actividades y negocios. Incluye la difusión de información y el asesoramiento sobre las soluciones y ayudas disponibles. Este tipo de información es pertinente, por ejemplo, para apoyar a las viviendas, los hoteles o el comercio a adaptarse al cambio climático.

Por favor, señale la opción preferida:

Horizonte cercano (hasta 2030)		Horizonte intermedio (hasta 2050)		Horizonte lejano (hasta 2100)	
A9	A10	A9	A10	A9	A10
☐	☐	☐	☐	☐	☐

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3. Capital social

A11	Producción y consumo en pequeña escala (prosumidores)	Promover la cooperación para la creación de economías de escala tanto en la producción como en el consumo de energía. Esto permite un mayor uso de los recursos renovables locales y la recuperación de energía residual, importante en eventos como las olas de calor.	VS	A12	Plataforma de información de riesgos	Promover la comunicación entre el público en general y los órganos de la administración en relación sobre riesgos relacionados con el cambio climático. El público en general informa directamente de los riesgos a medida que toma conciencia de ellos (inestabilidad de acantilados, árboles que caen sobre las líneas de energía, los arbustos secos que pueden arder por las líneas de energía, etc.

Por favor, señale la opción preferida:

Horizonte cercano (hasta 2030)		Horizonte intermedio (hasta 2050)		Horizonte lejano (hasta 2100)	
A9	A10	A9	A10	A9	A10
☐	☐	☐	☐	☐	☐

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4. Capital natural

A13	Sistemas de almacenamiento de energía	El desarrollo de sistemas de almacenamiento de energía puede proporcionar una alternativa cuando las principales fuentes de energía fallan y necesitan tiempo para recuperarse. Esto permite una red de energía más resistente, a la vez que permite la descarbonización y la nivelación de los picos a un costo controlado (incluye baterías eléctricas, depósitos térmicos (calor), los bancos de hielo (frío) o la altura del agua (bombeo invertido).	VS	A14	Recogida y almacenamiento de cargas de combustible forestal	La recolección y el almacenamiento de cargas de combustible forestal tienen por objeto promover y regular la recolección y el almacenamiento de madera y material combustible para reducir el peligro de incendios forestales. Los materiales recolectados pueden utilizarse en aplicaciones de energía como pellets, biogás u otras soluciones energéticas.

Por favor, señale la opción preferida:

Horizonte cercano (hasta 2030)		Horizonte intermedio (hasta 2050)		Horizonte lejano (hasta 2100)	
A9	A10	A9	A10	A9	A10
☐	☐	☐	☐	☐	☐

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5. Capital físico

A15	SeaWater Air Conditioning (SWAC)	La medida del aire acondicionado de agua de mar es un diseño de sistema de energía alternativa que utiliza agua fría de las profundidades del océano para proporcionar un enfriamiento más eficiente, descarbonizado y fiable. Este sistema está conectado a intercambiadores de calor para el proceso de enfriamiento o para proporcionar agua de condensación en los sistemas de aire acondicionado. Sustituye a otras unidades cuyo rendimiento se degrada en las olas de calor.	VS	A16	Gestión de la Demanda (DSM) de la Energía	Es una estrategia operacional que coordina mejor a los productores y consumidores de energía. Es posible utilizar más energía renovable, al tiempo que se garantiza la fiabilidad del servicio de energía y el control de los costos. La DMS equilibra la demanda en horas punta y en horas de menor demanda, lo cual es importante, por ejemplo, durante las olas de calor.

Por favor, señale la opción preferida:

Horizonte cercano (hasta 2030)		Horizonte intermedio (hasta 2050)		Horizonte lejano (hasta 2100)	
A9	A10	A9	A10	A9	A10
☐	☐	☐	☐	☐	☐

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6. La gestión del riesgo a largo plazo

A17	Revisar los códigos de construcción de la infraestructura energética	Tiene por objeto proteger el sistema energético contra el clima mediante la revisión de los códigos e infraestructuras reglamentarias teniendo en cuenta la distribución espacial de los riesgos climáticos. Incluye el establecimiento de nuevos procedimientos, prácticas de mantenimiento, cambios operacionales, adaptación y el uso de servicios climáticos y cartográficos como los producidos por el Servicio de Gestión de Emergencias de Copérnico (EMS).

VS

A18	Mejorar los sistemas de refrigeración por evaporación	Mejorar los sistemas de refrigeración por evaporación que dependen de un determinado rango de temperatura del aire y de la disponibilidad de agua es necesario dado que este tipo de sistemas de refrigeración es una tecnología que puede verse afectada por el cambio climático y se ve comprometida debido a las olas de calor y a la escasez de agua.

Por favor, señale la opción preferida:

Horizonte cercano (hasta 2030)		Horizonte intermedio (hasta 2050)		Horizonte lejano (hasta 2100)	
A9	A10	A9	A10	A9	A10
☐	☐	☐	☐	☐	☐

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No776661

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17

7. Preparación

A19	Sistemas de alerta temprana (EWS)	Los Sistemas de Alerta Temprana son un sistema de información que evalúa los riesgos climáticos y proporciona información en tiempo real a los responsables de la toma de decisiones, las empresas, los servicios públicos y el público en general. Los datos climáticos que se utilizan para controlar y supervisar la infraestructura energética pueden ser transmitidos al EWS. Vigilar la evolución de los impactos relacionados con el clima en el sector de la energía aumenta los conocimientos necesarios para tomar decisiones de adaptación al clima a largo plazo.

VS

A20	Fiabilidad de la red	La mejora de la fiabilidad de la red tiene por objeto encontrar y mejorar los componentes críticos y aumentar la resistencia del sistema energético a los riesgos climáticos. Esto puede incluir circuitos o componentes redundantes que proporcionen un despacho alternativo de energía, mejoras en los equipos (por ejemplo, mejor refrigeración para hacer frente a las olas de calor) o reducción de la potencia (por ejemplo, disminución de la potencia de los transformadores de energía para que no se sobrecalienten durante las olas de calor).

Por favor, señale la opción preferida:

Horizonte cercano (hasta 2030)		Horizonte intermedio (hasta 2050)		Horizonte lejano (hasta 2100)	
A9	A10	A9	A10	A9	A10
☐	☐	☐	☐	☐	☐

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8. Respuesta

A21	Estudiar y desarrollar interconexio-nes de las redes de energía	Las conexiones de la red de energía tienen por objeto desarrollar las interconexiones entre las islas y/o con el continente permitiendo la creación de economías de escala, mejoras en la fiabilidad del sistema energético y una mayor penetración de las fuentes de energía renovables (FER).	VS	A22	Instalaciones independientes de la energía (generadores)	Las instalaciones independientes de energía (generadores) permiten que los edificios creen temporalmente su propio suministro de energía. En caso de que se produzca un fallo en el suministro de energía (corte de corriente), las instalaciones esenciales continúan funcionando y pueden optimizarse con diseños de cogeneración (Combined Heat and Power) y otras soluciones de generación de energía descentralizada.

Por favor, señale la opción preferida:

Horizonte cercano (hasta 2030)		Horizonte intermedio (hasta 2050)		Horizonte lejano (hasta 2100)	
A9	A10	A9	A10	A9	A10
☐	☐	☐	☐	☐	☐

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9. Recuperación y rehabilitación después de un desastre

A23	Microrredes de recuperación de energía	Las microrredes de recuperación de energía son elementos operativos de las redes de energía que dependen de la generación distribuida para restaurar los sistemas de los cortes de energía y para estabilizar la red. Esto permite una recuperación flexible y más rápida de los cortes de energía causados por eventos de apagón (por ejemplo, la caída de árboles en las líneas de energía), el exceso de demanda (por ejemplo, durante las olas de calor) u otras causas.	VS	A24	Capacidad local de recuperación de cortes de energía	Consiste en aumentar y mejorar la capacidad de las islas para recuperarse de cortes de energía causados o empeorados por eventos climáticos extremos, como tormentas de viento severo, que pueden llevar al aislamiento de las islas y exacerbar los obstáculos logísticos. Para facilitar una rápida recuperación, es útil contar con más energía de reserva móvil, reemplazos de líneas eléctricas y otros componentes de la red, logística, suministros y personal.

Por favor, señale la opción preferida:

Horizonte cercano (hasta 2030)		Horizonte intermedio (hasta 2050)		Horizonte lejano (hasta 2100)	
A9	A10	A9	A10	A9	A10
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10. Servicios de aprovisionamimento

A3	Eficiencia energética en la gestión del agua en zonas urbanas	Consiste en la adaptación del diseño y la construcción urbana para la conservación del agua que evita el uso de la energía en situaciones de escasez. Por ejemplo, el Diseño Urbano Sensible al Agua (WSUD) tiene como objetivo planificar la conservación del agua y el almacenamiento de las aguas pluviales con la integración de elementos de diseño urbano. Esto tanto para minimizar los impactos hidrológicos en el medio ambiente como el uso energético asociado al suministro de agua.

VS

A4	Tubos y tuberías subterráneas en la planificación urbana	Los tubos y tuberías subterráneas se utilizan para calentar o enfriar el ambiente en todo el mundo y son más resistentes al cambio climático. Estos sistemas pueden ser del tipo de Intercambiador de Calor del Aire de la Tierra (EAHE) y de Bomba de Calor de Fuente Terrestre (GSHP). Ambos sistemas utilizan tubos o tuberías que normalmente necesitan ser enterrados a una distancia del edificio o la casa. La medida considera esta necesidad, y permite y fomenta el uso de dicho espacio en la planificación urbana.

Por favor, señale la opción preferida:

Horizonte cercano (hasta 2030)		Horizonte intermedio (hasta 2050)		Horizonte lejano (hasta 2100)	
A9	A10	A9	A10	A9	A10
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11. Servicios de regulación y mantenimiento

A5	Energía de la biomasa de los residuos domésticos	Las plantas de energía de biomasa queman los residuos domésticos, los residuos de los parques y jardines públicos y los lodos generados por las plantas de tratamiento de aguas residuales. Los pueblos y ciudades también pueden realizar la producción urbana y los bosques recreativos, que pueden utilizarse para producir biomasa para plantas de cogeneración (Combinación de calor y energía) así como de tri-generación (Combinación de calor y energía en frío).

VS

A6	Corredores verdes urbanos	Las zonas verdes urbanas disminuyen la temperatura del aire en una ciudad y, por lo tanto, reducen las necesidades de energía. El aire caliente tiende a transportar la contaminación y las partículas a capas más altas de la atmósfera, causando una nube de contaminación. La creación de corredores verdes también promueve la biodiversidad, aumenta el valor turístico y disminuye la cantidad de agua que se evacua durante las tormentas.

Por favor, señale la opción preferida:

Horizonte cercano (hasta 2030)		Horizonte intermedio (hasta 2050)		Horizonte lejano (hasta 2100)	
A9	A10	A9	A10	A9	A10
☐	☐	☐	☐	☐	☐

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12. Servicios culturales

A7	Huertos urbanos	Las parcelas de jardín educativo son sitios donde la gente, especialmente los niños, pueden cultivar con voluntarios una tarde a la semana después de la escuela. La cosecha puede llevarse a casa. Esto crea bienestar mientras que tener productos frescos locales reduce el consumo de energía y la contaminación. También se usan para educar a la gente sobre otras medidas de acción climática, directa e indirectamente relacionadas con la energía, tales como los residuos, el compostaje, la retención de agua y los corredores verdes.

VS

A8	Piscinas climatizadas con calor residual de las centrales eléctricas	Las centrales eléctricas necesitan refrigeración y su calor residual puede ser utilizado en piscinas para uso público y turismo. Este tipo de diseño de recuperación de calor se llama Combinación de Calor y Energía (CHP). Las piscinas proporcionan un disipador de calor para las centrales eléctricas que aumenta la eficiencia. Muy útil durante las olas de calor.

Por favor, señale la opción preferida:

Horizonte cercano (hasta 2030)		Horizonte intermedio (hasta 2050)		Horizonte lejano (hasta 2100)	
A9	A10	A9	A10	A9	A10
☐	☐	☐	☐	☐	☐

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Seis nuevas medidas concretas

Por favor, ordene de mayor a menor importancia las siguientes medidas concretas, según su criterio:

1	Hidrógeno como vector energético	Especialmente para la movilidad pesada, la medida incluiría producción y acumulación en zonas de mayor potencial renovable de carácter no gestionable; establecer red de hidrogeneras.	
2	Hibridación de renovables	Hibridar tecnologías más costosas pero con mayor capacidad de gestión o de aporte de servicios auxiliares con tecnologías menos costosas pero más inestables. Equilibra sistema eléctrico y garantiza suministro con calidad.	
3	Geotermia de baja y alta entalpía	La baja es muy apreciada en climatización por su estabilidad, y bajo coste en circunstancias propicias. La alta da estabilidad a la red eléctrica. Una vez superada la fase de exploración, Canarias debe adentrase en la de investigación con sondeos que permitan mapear el recurso, para luego pasar a la fase comercial.	
4	Promover la cogeneración	Especialmente en establecimientos turísticos, para satisfacer picos de demanda de formas diversas de energía (electricidad + calor), mediante generadores eficientes alimentados con combustibles fósiles. Asistir técnica y financieramente a las empresas.	
5	Microrredes inteligentes	Sirven para facilitar la penetración de las EERR de autogeneración en establecimientos, garantizando calidad y seguridad en el suministro eléctrico. Asistencia técnica y apoyo financiero.	
6	Autoconsumo compartido	Uso compartido de instalaciones para compartir gastos y maximizar la eficiencia y la capacidad de gestión de este tipo de instalaciones. Asistencia técnica e incentivos financieros.	

1 = mayor importancia

6 = menor importancia

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¡Muchas gracias por su participación!

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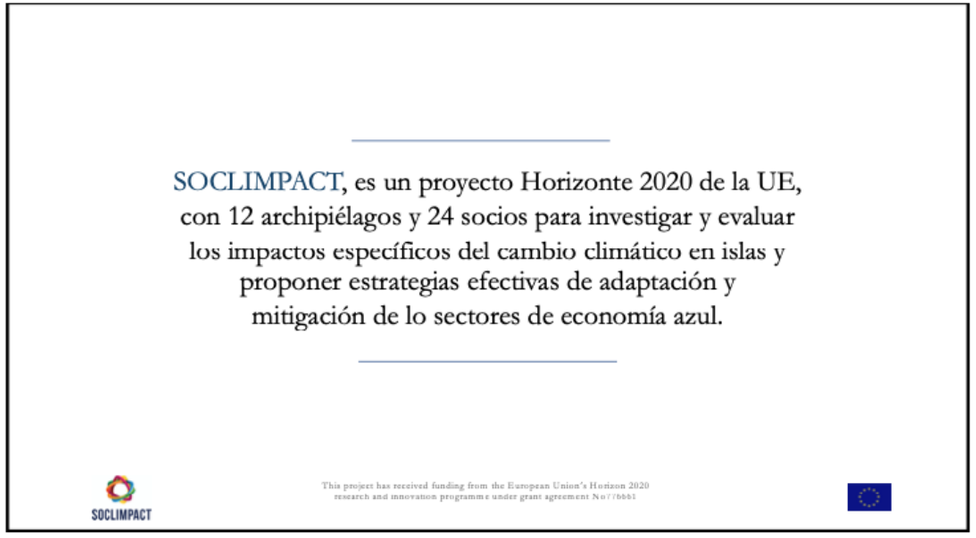
6.4.4 Aquaculture

1



2

Bienvenido/a…

- Al proceso de diseño de políticas públicas y de colaboración público privada para adaptar la acuicultura canaria a los riesgos derivados del cambio climático…
- Las opiniones bien informadas son clave para que las políticas estén bien diseñadas y sean eficaces…
- Canarias está construyendo su política para afrontar los retos y oportunidades del cambio climático, y el proyecto Soclimpact quiere contribuir aportando sus resultados y dando voz a las partes interesadas…
- Esta entrevista se estructura en dos partes, la primera para conocer su opinión sobre condicionantes del desarrollo de la acuicultura en el SXXI y marcos de política preferidos; y la segunda para que evalúe medidas alternativas relativas a fortalecer la acuicultura frente a los impactos del CC.

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BLOQUE I

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4

Principales tendencias que definirán la evolución del Siglo

Previsiblemente, la evolución de la acuicultura a nivel global, se verá influenciada, entre otros factores, por:

- El **crecimiento económico** global, y su distribución por regiones y países.
- La evolución de la **gobernanza global**, incluido el libre comercio y las barreras a los movimientos de mercancías, capitales y personas; la acción de las instituciones multilaterales; la emergencia y desarrollo de conflictos regionales o locales.
- El **cambio tecnológico**, su velocidad y dirección, que influirá en la producción primaria y la industria agroalimentaria.
- La evolución de la **cohesión social**, de la distribución de la renta y de las políticas de bienestar.
- El estado de los hábitats naturales, marinos y terrestres, la evolución de las emisiones de **GEI** y del **cambio climático**, y de los acuerdos globales con respecto al cuidado de los mares y del clima.

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5

El entorno de la acuicultura canaria en el Siglo 21

Las tendencias que Vd. prevé en cada una de estas dimensiones,

¿cómo cree que influirán en la acuicultura global, y en la acuicultura canaria, del Siglo XXI?

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6

Preferencias sobre políticas climáticas

En virtud de cómo Vd. evalúe los problemas que puede representar el cambio climático para la acuicultura, **podría desear que se aplicaran unas u otras políticas** en esta materia.

En el marco de este Proyecto, entenderemos por política a la *movilización de recursos financieros, y de capacidades técnicas y humanas, para el logro de objetivos concretos en materia de adaptación de la acuicultura a las amenazas del cambio climático*; incluye todas las formas de colaboración público-privada.

A continuación, le pedimos que muestre su grado de acuerdo con 4 posibles **marcos de política** definidos para gestionar los impactos derivados del cambio climático, en general, y de aquellos que se ciernen sobre la acuicultura, en particular, que se resumen a continuación.

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Ordenar preferencias sobre políticas climáticas

Por favor, ordene las siguientes trayectorias posibles de política de acuerdo con sus preferencias, numerándolas del 1 al 4, siendo 1 su preferida.

TPC A

- **No precipitarse**!!! Mejor no hacer nada que hacerlo mal.
- Precipitación → + costes (irrecuperables → - competitividad.
- Hacer lo mínimo al mínimo coste → emergencias, si las hay
- Esperar a qué otros hagan, aprender de sus errores …
- En este asunto, se va más cómodo en el vagón de cola.

TPC B

- El **crecimiento** es la mejor medicina para todo, incluido el cambio climático.
- Genera capacidades financieras → más inversión → economía a prueba de los impactos del Cambio climático.
- No a la adaptación que frene el crecimiento. No cambios estructurales.
- Descarbonización: aquella que conduzca a la generación de beneficios

TPC C

- La clave está en la **eficiencia** (en el uso de los RN y el MA).
- Eficiencia → incrementa base RN → incrementa opciones de futuro: mejor vía afrontar impacto CC.
- Priorizar el bienestar sostenible de la sociedad (antes que el crecimiento).

TPC D

- *Adaptación transformativa*: adaptación con **transformación estructural**
- Implica "TPC C" y además cambio en: i) preferencias de la sociedad por bienes más eco-amables; ii) cambio tecnológico forzado por incentivos para asegurar que nos ajustamos a los límites de la biosfera; iii) adaptar las organizaciones y el trabajo → mayor resiliencia de toda la sociedad al cambio climático.

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BLOQUE II

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9

Medidas para adaptar la industria al cambio climático

A continuación, le mostramos 5 potenciales ámbitos de acciones que podrían implementarse para mejorar la resiliencia de la acuicultura ante el cambio climático.

Por favor, ordene de mayor a menor importancia cada ámbito de acciones, según su criterio:

1. Más potentes **incentivos financieros y fiscales** para las empresas del sector
2. Apoyo a la **investigación, desarrollo e innovación** que facilite la adaptación
3. Apoyo a la mejora de la **gestión** de los procesos productivos y los entornos
4. Apoyo a la **inversión privada** para fortalecer la industria frente al cambio climático
5. Instrumentos de **planificación anticipativa y alerta temprana** frente a los riesgos

1 = mayor importancia

5 = menor importancia

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Prioridades de política y horizontes temporales

Vd. puede considerar que unas medidas son más prioritarias que otras, y también que su importancia relativa puede cambiar a lo largo del tiempo. Por ello, le presentaremos pares de medidas, relativas a los 5 bloques presentados en la diapositiva anterior, para que las compare decidiendo sobre su prioridad e importancia relativa a medio y largo plazo.

Considere también que su preferencia por una medida frente a otra, podría depender del marco (TPC) desde el que estuviera comparándolas. Por favor, proceda a compararlas aportando una breve explicación de su decisión, relacionada con la evolución de las capacidades de adaptación de la sociedad a largo plazo.

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1. Capital financiero

A1	Ayudas financieras, seguros y préstamos	Son instrumentos públicos o privados orientados a reducir el riesgo de los inversores en acuicultura, ayudándoles a responder a las pérdidas de producción y a los daños en infraestructuras generados por fenómenos climáticos extremos. También pueden apoyar la reubicación, la mejora de estructuras y equipos y la reparación o reposición de elementos dañados.

VS

A2	Beneficios fiscales y subsidios	Son instrumentos financieros públicos que pueden emplearse para sostener beneficios y promover practices sostenibles que redunden en mayor resiliencia frente a los impactos del cambio climático

Por favor, señale la opción preferida:

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A9	A10	A9	A10	A9	A10
☐	☐	☐	☐	☐	☐

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2. Capital humano

A9	Campañas de concienciación	Tienen como objetivo aumentar el conocimiento de las personas y las organizaciones, seleccionando adecuadamente contenidos, canales y grupos objetivo.	VS	A10	Gestión eficiente de alimentos	La mejora de la eficiencia de las prácticas de alimentación mediante el uso de conocimientos y tecnología desarrollada a tal fin. Ayuda a reducir costes y a mejorar el medio ambiente del entorno.

Por favor, señale la opción preferida:

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A9	A10	A9	A10	A9	A10
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3. Capital social

A11	Abordar las preocupaciones de los consumidores y del medio ambiente a nivel local	Esta opción tiene por objeto promover la economía y el empleo para hacer frente a los futuros desafíos del cambio climático. Es necesario subrayar los principales desafíos y vincularlos con las principales preocupaciones y repercusiones en el sector de la acuicultura.	VS	A12	Promoción del consumo local	El consumo local, especialmente en el sector turístico, reducirá el costo de distribución y mejorará la creación de valor añadido en procesos productivos locales de industrias innovadoras.

Por favor, señale la opción preferida:

Horizonte cercano (hasta 2030)		Horizonte intermedio (hasta 2050)		Horizonte lejano (hasta 2100)	
A9	A10	A9	A10	A9	A10
☐	☐	☐	☐	☐	☐

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4. Capital natural

A13	Acuicultura multitrófica integrada	Enfoque basado en el ecosistema para el cultivo de especies de diferentes niveles tróficos (peces, mariscos, algas marinas) en una granja integrada, que además contribuye a la sostenibilidad ambiental. Aumentar la resiliencia debido a su tolerancia a rangos más amplios de factores climáticos como la temperatura y la salinidad.	VS	A14	Introducir acuicultura de ciclo corto	Acorta el período de cultivo y el tiempo en jaulas marinas al sembrar alevines más grandes en la etapa de cría (en tierra) o al seleccionar especies con un ciclo de cultivo más corto.

Por favor, señale la opción preferida:

Horizonte cercano (hasta 2030)		Horizonte intermedio (hasta 2050)		Horizonte lejano (hasta 2100)	
A9	A10	A9	A10	A9	A10
☐	☐	☐	☐	☐	☐

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5. Capital físico

A15	Granjas en tierra con sistemas de recirculación	Son piscifactorías en tierra con sistemas de cría de ciclo cerrado donde se aplica filtración para purificar y regular los parámetros del agua y eliminar los desechos metabólicos tóxicos de los peces. Dado que está basado en tierra, limita el riesgo de destrucción de la infraestructura debido a eventos extremos en el océano.	VS	A16	Jaulas sumergibles	Son jaulas de profundidad oceánica ajustable para escapar de los peores efectos de tormentas, brotes de parásitos y floraciones de algas en la superficie, y para mantener las especies a una temperatura óptima.

Por favor, señale la opción preferida:

Horizonte cercano (hasta 2030)		Horizonte intermedio (hasta 2050)		Horizonte lejano (hasta 2100)	
A9	A10	A9	A10	A9	A10
☐	☐	☐	☐	☐	☐

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6. La gestión del riesgo a largo plazo

A17	Inversiones a prueba de clima extremo	Inversiones que consideran las proyecciones de cambio climático para gestionar los riesgos futuros de las infraestructuras y mejorar las condiciones de seguridad operativa (fortalecer los sistemas de amarre, estructuras de jaulas y redes, etc.).

VS

A18	Zonificación basada en el riesgo y selección de localización	La zonificación basada en el riesgo y la selección de sitios consiste en tener en cuenta los escenarios de cambio climático al planificar y seleccionar un sitio para una granja. Por ejemplo, las operaciones de jaulas marinas no deben seleccionar un sitio que esté (o se prevea que esté) expuesto a olas altas o corrientes fuertes, y las operaciones de cría en estanques deben seleccionar sitios con bajo riesgo de inundación.

Por favor, señale la opción preferida:

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A9	A10	A9	A10	A9	A10
☐	☐	☐	☐	☐	☐

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7. Preparación

A19	Adoptar más y mejores métodos de preveción de la enfermedad	Medidas de salud preventiva como vacunas, alevines más fuertes, probióticos, asegurando una calidad óptima del agua e implementando procedimientos de higiene más estrictos con el objetivo de reducir el riesgo de enfermedades ahora y en el futuro.

VS

A20	Sistemas de vigilancia ambiental y de alerta temprana	Los sistemas de vigilancia del medio ambiente y de alerta temprana reúnen sistemáticamente y proporcionan información a los piscicultores con el fin de apoyar la adopción de decisiones sobre la gestión de los riesgos climáticos. La vigilancia y la alerta temprana pueden facilitar las medidas de adaptación, como la cosecha temprana o la reubicación de los corrales de redes de peces desde los lugares donde hay intensas floraciones de algas nocivas.

Por favor, señale la opción preferida:

Horizonte cercano (hasta 2030)		Horizonte intermedio (hasta 2050)		Horizonte lejano (hasta 2100)	
A9	A10	A9	A10	A9	A10
☐	☐	☐	☐	☐	☐

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8. Respuesta

A21	Incorporación de la gestión del riesgo de desastres	Esta medida tiene por objeto planificar y organizar la gestión de los recursos hídricos teniendo en cuenta el cambio climático a lo largo de cinco etapas que incluyen la prevención, la protección, la preparación y la respuesta, la recuperación y el examen en los marcos de adopción de decisiones y de gestión de la acuicultura. Entre los ejemplos: las intervenciones para limitar el desarrollo de las explotaciones en zonas de peligro; revisar las normas de ingeniería de seguridad para las explotaciones; estudiar las interacciones del cambio climático en los ecosistemas locales y elaborar estrategias.	VS	A22	Planes de contingencia para la gestión de emergencias, cosecha temprana y/o reubicación	Estos planes consisten en trasladar los productos o actividades a lugares con características más adecuadas para protegerlos contra los peligros climáticos como las tormentas, las olas altas, los cambios de temperatura o la degradación de la calidad del agua. La reubicación puede significar el traslado de actividades dentro del mismo entorno (océano-océano; tierra-tierra) o entre entornos (océano a tierra). También incluye protocolos de recolección de emergencia para reducir la pérdida de existencias.

Por favor, señale la opción preferida:

Horizonte cercano (hasta 2030)		Horizonte intermedio (hasta 2050)		Horizonte lejano (hasta 2100)	
A9	A10	A9	A10	A9	A10
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9. Recuperación y rehabilitación después de un desastre

A23	Planes de recuperación post-desastre	Establecer buenas prácticas y objetivos de recuperación temprana. Esta opción permitirá reducir las consecuencias socioeconómicas y ambientales del desastre. Algunos ejemplos de buenas prácticas son Identificar los bienes y servicios (instalaciones de apoyo como barcos y muelles, así como la infraestructura agrícola) que requieren restauración.	VS	A24	Fondos para la recuperación post-desastre	Crear fondos de recuperación y planes para el Post-Desastre en la Acuicultura con Iniciativas para hacer funcionar la economía rápidamente, por ejemplo, reconstruir las infraestructuras críticas dañadas como barcos, muelles e infraestructura acuícola. Esta opción reduce al mínimo las repercusiones económicas y sociales que pueden producirse en un contexto posterior a un desastre.

Por favor, señale la opción preferida:

Horizonte cercano (hasta 2030)		Horizonte intermedio (hasta 2050)		Horizonte lejano (hasta 2100)	
A9	A10	A9	A10	A9	A10
☐	☐	☐	☐	☐	☐

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10. Servicios de aprovisionamimento

A3	Producción de alimentos alternativos	El cambio climático afecta a la disponibilidad de alimento convencional procedente de pesquerías, muchas de ellas ya sobreexplotadas, empeorará en el futuro. La investigación en alimentos complementarios, como los basados en insectos o algas, puede contribuir a aliviar la escasez/carestía de las fuentes convencionales.	VS	A4	Selección de especies	Consiste en mejorar criterios de selección de especies a añadir a los de Mercado y costes convencionales, para considerar también la sensibilidad a cambios en el medio ambiente, predisposición a enfermedades asociadas y cuya alimentación dependa menos del pescado (por ejemplo especies no-carnívoras).

Por favor, señale la opción preferida:

Horizonte cercano (hasta 2030)		Horizonte intermedio (hasta 2050)		Horizonte lejano (hasta 2100)	
A9	A10	A9	A10	A9	A10
☐	☐	☐	☐	☐	☐

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11. Servicios de regulación y mantenimiento

A5	Selección genética	Investigación y desarrollo para desarrollar cepas con mayor tolerancia a los cambios en la temperatura del agua, que crezcan más rápidamente y más resilientes a las enfermedades, mediante la selección y cruce de los peces con características deseables como reproductores.	VS	A6	Adoptar los más avanzados códigos de mejores prácticas	Se enfocan en la seguridad alimentaria, la salud de los peces, el impacto ambiental (incluido el cambio climático) y la responsabilidad social. Estas prácticas mejoran la capacidad de las granjas para participar en cadenas de valor con el objetivo de mejorar la resiliencia general de la explotación.

Por favor, señale la opción preferida:

Horizonte cercano (hasta 2030)		Horizonte intermedio (hasta 2050)		Horizonte lejano (hasta 2100)	
A9	A10	A9	A10	A9	A10
☐	☐	☐	☐	☐	☐

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12. Servicios culturales

A7	Programas de visitas educativas	Visitas a las piscifactorías para aprender sobre la acuicultura y las interacciones entre la acuicultura y el medio ambiente. Estas visitas también pueden aumentar el conocimiento sobre los diferentes impactos en la acuicultura, incluidos los impactos climáticos y los provocados por el hombre.

VS

A8	Promoción de la cocina con especies cultivadas	Incluye la promoción de las especies de la acuicultura en los restaurantes o la creación de restaurantes específicos de "acuicultura" proporcionará una experiencia cultural y promoverá los productos de cultivo. Difundirla como una adaptación eficiente al cambio climático y la reducción de pesquerías. Se debe apoyar en TICs.

Por favor, señale la opción preferida:

Horizonte cercano (hasta 2030)		Horizonte intermedio (hasta 2050)		Horizonte lejano (hasta 2100)	
A9	A10	A9	A10	A9	A10
☐	☐	☐	☐	☐	☐

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Seis nuevas medidas concretas

Por favor, ordene de mayor a menor importancia las siguientes medidas concretas, según su criterio:

1	Aumentar incentivos POSEI y REF	Incrementar los **incentivos que compensan la distancia** e insularidad en el **POSEI** y en el **REF** y garantizan márgenes comerciales viables, para que compensen también los impactos del cambio climático en la producción y comercialización.	
2	Transferencia de conocimientos y ayuda financiera a la innovación	Optimizar la **transferencia de conocimientos** de los grupos de investigación a la industria, sobre todo en **viabilizar la producción local de insumos y de alevines**, y a la introducción de **nuevas especies** más resilientes al CC y sus efectos; además con apoyo financiero hasta que alcancen la escala óptima.	
3	Revisar y agilizar los procedimientos administrativos	Revisar y agilizar los procedimientos administrativos, que hoy representan **costes e incertidumbre**, y retrasan o inviabilizan inversiones acuícolas en las Islas en consonancia con su potencial.	
4	Promocionar consumo local turístico y no turístico	Con **menos coste de comercialización**, el incremento del consumo en las islas además contribuye a disminuir emisiones (km 0), potencia la soberanía alimentaria con proteína de alta calidad, y fortalece la cohesión social.	
5	Favorecer el desarrollo de la acuicultura off-shore	Incluye zonificación y asistencia técnica y financiera para adoptar esta **innovación offshore**; que mejora la resistencia a los episodios meteorológicos extremos y aumentar la escala de producción, reduciendo los costes medios y aumentando la competitividad.	
6	Reformular el POEM Zonificación	Para enfrentarse al impacto del cambio climático hay que mejorar y ampliar los criterios para determinar las zonas de usos futuros. Incrementar la profundidad reduce el impacto, mejora los hábitats e incrementa la producción.	

1 = mayor importancia

6 = menor importancia

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¡Muchas gracias por su participación!

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Downscaling climate impacts and decarbonisation pathways in EU islands, and enhancing socioeconomic and non-market evaluation of Climate Change for Europe, for 2050 and beyond

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Work Package 7:

This is a result of Tasks 7.3. This deliverable will include the agendas, the list of participants, and the workshops outputs including the decisions taken.

Deliverable 7.3.

Workshop Report - Corsica

Island Focal Point coordinated by Ramboll France

Ghislain Dubois, Yoelma Rodriguez Dartois, Adeline Cauchy

First version – 07/12/2020

Revised Version – 22/12/2020

Final version – 22/12/2020

1 Introduction

This document presents the results of the stakeholders' consultation process to design the **SOCLIMPACT Adaptation Pathways Workshops in Corsica region**. This process is included in SOCLIMPACT Task 7.3 - Engage islands' stakeholders in the design of alternative pathways. According to the project Description of Action, it is expected that these online workshops use the background material prepared in Task 7.2/D7.2 and include the main results from previous WPs.

In the consultation process, the following objectives are expected to be covered:

10. **Identify and present the characterized packages of adaptation and risk management options** available for each archipelago/island.
11. **Develop detailed archipelago/island integrated adaptation pathways**, in three timeframes: Short term (up to 2030), Mid-century (up to 2050) and End-century (up to 2100).
12. **Evaluate** and rank pathways for Blue Economy sectors.

In Corsica, the consultation process was split into two online webinars. The original plan was to hold physical workshops (WS) in each archipelago. However, health and travel limitations due to Covid-19 forced changes to the original plan and partners decided to develop two shorter online sessions mixed with an online survey.

2 Methodology

The process implemented in Corsica followed the general process for Local Working Groups proposed by WP7 (Figure 1).

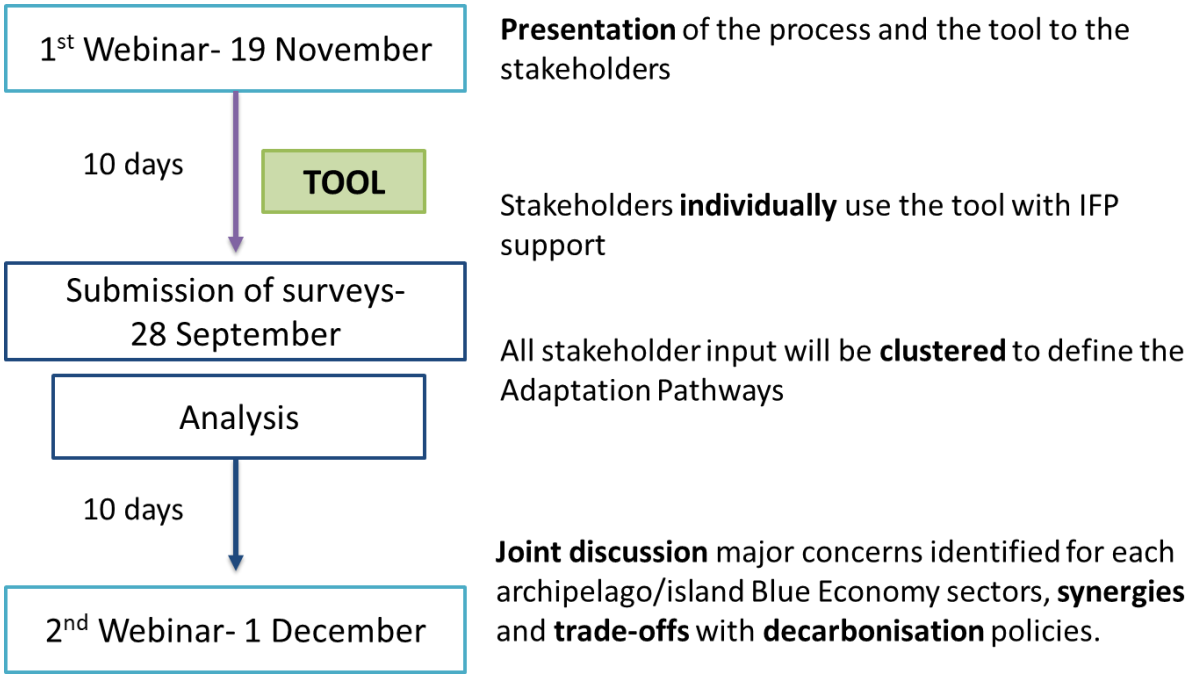

Figure 1: General survey process

The Corsica Local Working Group (LWG) webinars were performed on the 19th of November 2020 and on the 1st of December 2020. In the first stage the webinar included Tourism and Aquaculture only. Five

questionnaires were returned for Tourism, and therefore could be processed to evaluate the pathways during the second workshop. Two questionnaires only were received for aquaculture prior to the second workshop, and one after the workshop. Therefore, we present the results for aquaculture, but without the feedback from stakeholders. The 24 options/measures available per sector were characterized by the IFP using the five criteria defined. In addition, up to six additional adaptation options per island and per sector could be added by the LWG (class of adaptation "Local Knowledge"). In Corsica, no "Local Knowledge was added for the survey.

The **Adaptation Pathways methodology applied in SOCPLIMPACT was based in the framework developed by Suckall et al. (2018) and considered the three main strategic vectors for climate resilience: (1) vulnerability reduction -** Five capitals of Sustainable Livelihoods Approach (SLA)**; (2) Disaster Risk Reduction –** developed throughout Hyogo and Sendai Frameworks; **(3) Social-Ecological Resilience** – that emerge from the Millennium Ecosystem Assessment (MEA) and Common International Classification of Ecosystem Services (CICES).

The **Adaptation Pathways** aim to capture the policy preferences in time and the relevancy of the context traduced in investment and commitment (Suckall et al., 2018). These Adaptation Pathways Trajectories (APT) were delineated as a set of adaptation classes (Figure 2) each one with two options/measures to choose from. Each individual stakeholder choices contribute to create a policy pathway together with the other choices made by different stakeholders. If the majority of stakeholders chose one option, then that measure was incorporated in the island adaptation pathway for that specific class in each APT, per sector. The result of the series of choices in the three timeframes defines the pathway. If there is a tie between two options, then they will both be included and become part of the adaptation pathway in each time frame (i.e., options were included in the pathway when they were selected 50% or more in each time frame in each APT).

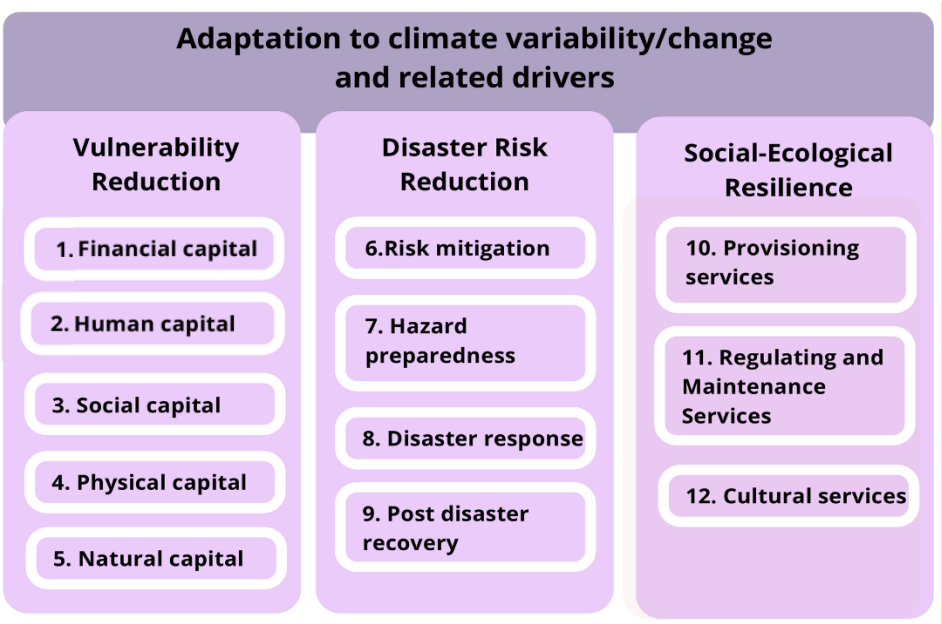

Figure 2 - The 12 classes of adaptation in the figure are structured in three broader objectives (Vulnerability reduction, Disaster Risk reduction and Ecosystem and social resilience).

The results of the Adaptation Pathways are presented in this report in two different outputs per sector: **(1) Selected Adaptation Pathways; and (2) Sustainability Performance.**

The (**1) Selected Adaptation Pathways** outputs aim to capture the acceptance of each adaptation option by calculating the options (number of times) selected within the maximum number of times they can be selected (Ratio – Selected/Maximum). This considers the number of times the option was selected by all stakeholders in all four APTs and three timeframes.

The **(2) Sustainability performance** outputs aim to characterize each pathway through the evaluation of the options chosen in each APT. The options selected in each APTs are evaluated considering a set of criteria: Cost Efficiency; Environmental protection; Mitigation (GHG emissions) win-wins and trade-offs; Technical applicability; Social acceptability (Table 3).

Table 9 – Description of the criteria used to evaluate the adaptation pathways performance.

Criteria	Description	
Cost Efficiency	Ability to efficiently address current or future climate hazards/risks in the most economical way	Higher score = higher cost efficiency
- *Environmental protection*	Ability to protect the environment, now and in the future	Higher score = higher environmental protection
- *Mitigation (GHG emissions) win-wins and trade-offs*	Current ability to meet (win-win) or not (trade-off) the island/archipelago's mitigation objectives	Higher score = higher mitigation win-wins and lower trade-offs
- *Technical applicability*	Current ability to technically implement the option/measure in the island/archipelago	Higher score = higher technical applicability
- *Social acceptability*	Current social acceptability of the option/measure in the island/archipelago	Higher score = higher social acceptability

The results are presented in a spider diagram and is the average of all options chosen for the participants in each APT pathway.

The attendees would like to note that, from their point of view, the protocol presents a limitation: The possibility of not answering in the questionnaire should have been allowed.

3 Summary of Background Material

To support the decisions within the Online Survey Tool and to define the Adaptation Pathways, relevant information related with climate, socio-economy and adaptation were presented to stakeholders. The deliverable 7.2 (Background Materials, with an Appendix per island) were the preferential source information but additional and tailored information was developed (figure 4).

In particular, some visual representation of results was developed and integrated in the Online Survey Tool (a detailed Excel sheets with clickable links leading to PDF visualisations) (Figure 3).

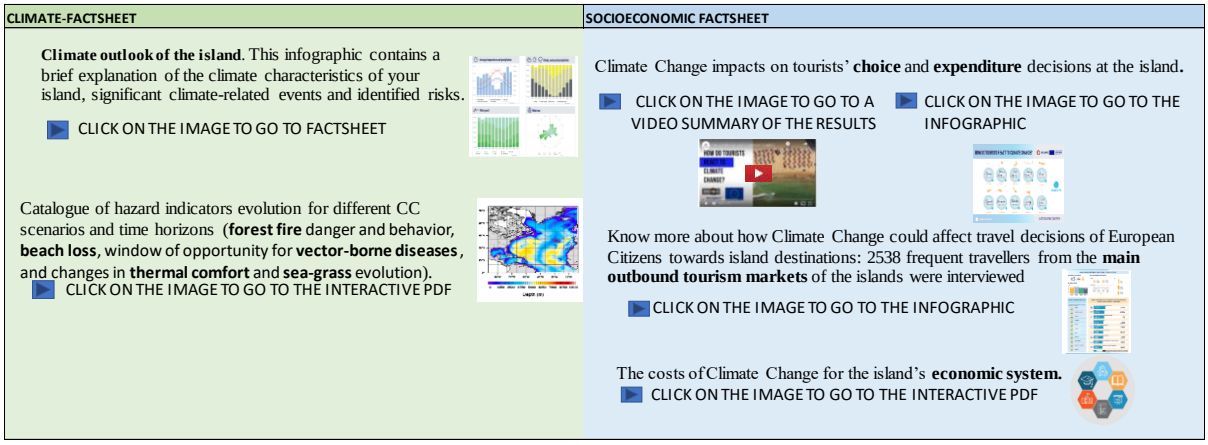

Figure 3 - Visual representation of how the background material was presented and delivered in the Online Tool Survey for Azores

Figure 4: Example of visual background information provided to stakeholders for Aquaculture and Tourism

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4 Sector Adaptation Pathways

4.1 Tourism

Tourism pathways are based on choices made by 5 expert island stakeholders.

4.1.1 Selected Adaptation Pathways

ID	Name	Class number	Ratio	APT A			APT B			APT C			APT D		
				S	M	L	S	M	L	S	M	L	S	M	L
T1	Instruments économiques (EPIs)	1	70%												
T2	Incitations financières à se retirer des zones de risques	1	30%												
T10	Programmes de sensibilisation du public	2	50%												
T9	Diversification des produits et de l'activité touristique	2	50%												
T11	Economie circulaire locale	3	80%												
T12	Campagne de sensibilisation des touristes	3	20%												
T14	Restriction d'usages de l'eau et recyclage	4	87%												
T13	Pêche locale durable	4	13%												
T15	Rechargement des plages	5	60%												
T16	Désalinisation	5	0%												
T17	Ouvrage de protection des côtes	6	65%												
T18	Plan de gestion des sécheresse	6	35%												
T19	Gestion des risques naturels	7	60%												
T20	Uilisation de l'eau pour le rafraîchissement urban	7	40%												
T22	Amélioration des systèmes de santé	8	73%												
T21	Plan de gestion des feux de forêt	8	27%												
T24	Plan d'anticipation des crises	9	63%												
T23	Fonds de récupération post crise	9	37%												
T4	Systèmes de suivi, modélisation et prévision	10	70%												
T3	Adaptation de la gestion des eaux souterraines	10	30%												
T5	Restauration et réhabilitation des dunes	11	60%												
T6	Restauration et réhabilitation des rivières	11	40%												
T7	Gestion adaptative des habitats naturels	12	67%												
T8	Piscines d'eau de mer	12	33%												

Figure 5: Adaptation pathways for tourism in Corsica. Options are identified with an ID number, full name, and class of adaptation number. Adaptation objectives are identified in each option by colour: ***vulnerability reduction (red),*** *Disaster* ***Risk Reduction (blue); Social-Ecological Resilience (green);*** *Local Knowledge adaptation options (grey). Each ATP (APT A; APT B; APT C; APT D) is represented in three timeframes: S - Short term (up to 2030), M- Medium term (up to 2050), L - Long term (until 2100). Bold letters in each ATP indicate the option was available to be selected. Highlighted options indicate the measure was selected in each ATP and timeframe: ATP A (light blue); ATP B (light green); ATP C (Light orange) and ATP D (light purple). Space with colour: option was selected for the timeframe: Short term, Medium term, or Long term. A white cell means that the option was available in that APT but was not chosen and a grey cell means that it was not available in that APT.*

We can see in the results that:

- Few solutions linked to water (T6 River restoration, T16 : Desalination, T18 Drought management) are chosen, since water scarcity is not a real problem in Corsica
- On the short terme, actions like awareness raising campaign (T12 or T10) are chosen, while on the longer term, actions that require more investment (T9) are chosen.

In APTA, actions that are less resource intensive (T10) are prefered to actions more intensive in investment (T12). Respondents explained during the WS n°2, that raising awareness of tourists that removing seagrass banks on the beaches can be detrimental to beach erosion, is a cost intensive and high impact measure.

In APTB, economic instruments (T1) are preferred over incentives to relocate activities, which is in line with the economic orientation of the scenario.

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In APTC, circular economy (T11), is by far prefered to tourist awarenss raising (T12). Circular economy is an important challenge with large political interest in Corsica.

From APTA to D, and especially in APTD, the diversification of tourism (T9) is chosen earlier and more often than awareness raising (T10). This illustrates the good understanding of APTs by respondents.

When compared to the results compiled to 8 other SOCLIMPACT islands (Figure 6). It appears that Corsica makes the same hierarchisation of choices, except for water. Indeed, since Corsica is a low-risk area for water scarcity, the adaptation solutions linked to this risk are less chosen.

ID	Name	Class number	Ratio	APT A			APT B			APT C			APT D		
				S	M	L	S	M	L	S	M	L	S	M	L
T2	Financial incentives to retreat from high-risk areas	1	44%												
T1	Economic Policy Instruments (EPIs)	1	56%												
T10	Public awareness programmes	2	38%												
T9	Activity and product diversification	2	62%												
T12	Tourist awareness campaigns	3	34%												
T11	Local circular economy	3	66%												
T13	Local sustainable fishing	4	41%												
T14	Water restrictions, consumption cuts and grey-water	4	59%												
T16	Desalination	5	46%												
T15	Beach nourishment	5	54%												
T18	Drought and water conservation plans	6	50%												
T17	Coastal protection structures	6	50%												
T20	Using water to cope with heat waves	7	31%												
T19	Mainstreaming Disaster Risk Management (DRM)	7	69%												
T21	Fire management plans	8	49%												
T22	Health care delivery systems	8	51%												
T23	Post-Disaster recovery funds	9	38%												
T24	Pre-disaster early recovery planning	9	62%												
T3	Adaptation of groundwater management	10	44%												
T4	Monitoring, modelling and forecasting systems	10	56%												
T5	Dune restoration and rehabilitation	11	48%												
T6	River rehabilitation and restoration	11	52%												
T8	Ocean pools	12	32%												
T7	Adaptive management of natural habitats	12	68%												

Figure 6 - Averaged adaptation options and pathways for the tourism ***sector in 8 other islands (Azores, Crete, Cyprus, Fehmarn, Madeira, Malta, Sicily and Sardinia****). Options are identified with an ID number, full name, and class of adaptation number. Adaptation objectives are identified in each option by colour:* ***vulnerability reduction (red),*** *Disaster* ***Risk Reduction (blue); Social-Ecological Resilience (green);*** *Local Knowledge adaptation options (grey). Each ATP (APT A; APT B; APT C; APT D) is represented in three timeframes: S - Short term (up to 2030), M- Medium term (up to 2050), L - Long term (until 2100). Highlighted options indicate the measure was selected in each ATP and timeframe: ATP A (light blue); ATP B (light green); ATP C (Light orange) and ATP D (light purple).*

4.1.2 Sustainability Performance

Figure 7 - Pathways evaluation for tourism sector considering: Cost Efficiency; Environmental protection; Mitigation (GHG emissions) win-wins and trade-offs; Technical applicability; Social acceptability. The policy pathways scenarios: APT A - Minimum Intervention; APT B - Economic Capacity Expansion (ECE); APT C- Efficiency Enhancement (EE); APT D - System Restructuring (SR), for different timeframes: short, medium, and long term

The performance of the four ATP scenarios for tourism sector are considerably similar during the three timeframes considered. In general, scenarios show a high level of social acceptability and technical applicability and a medium cost efficiency and environmental protection with a low performance in mitigation win-wins and trade-offs.

Some differences across pathways exist:

- APTA (minimal intervention) tends to have a higher acceptability (since little action is taken) than others
- APTD (system restructuring) contributes more to environmental protection, which is also understandable, since this is a very voluntarist scenario.
- APT C (system efficiency) has a better score for mitigation

4.2 Aquaculture

Aquaculture pathways are based on choices made by 3 expert island stakeholders. Given that the minimum threshold for data processing was 3 interviews, and that the 3rd interview was only received after the 2nd workshop, we decided to process the result, but we couldn't collect the feedback of stakeholders.

4.2.1 Selected Adaptation Pathways

We can see in the results that there is a clear hierarchy of stakeholders preference (Figure 8), the Multitrophic integrated aquaculture is often chosen, as well as local consumption, species selection, disease prevention; while short cycle aquaculture or fish food production are more rarely chosen.

ID	Name	Class number	Ratio	APT A			APT B			APT C			APT D		
				S	M	L	S	M	L	S	M	L	S	M	L
A13	Aquaculture intégrée multi-trophique (IMTA)	4	78%												
A12	Promition de la consommation locale des produits de l'aquac	3	78%												
A4	Sélection d'espèces	10	75%												
A19	Méthode de prévention des maladies	7	67%												
A16	Cages submersibles	5	67%												
A9	Sensibilisation et changement de comportements	2	58%												
A8	Promotion de recettes à base de poissons d'élevage	12	56%												
A5	Elevage de souches résistantes	11	56%												
A24	Fonds pour la récupération post crise	9	56%												
A21	Gestion des risques naturels	8	56%												
A17	Infrastructures d'aquaculture résistante au climat	6	53%												
A1	Dispositifs financiers, assurances et prêts	1	50%												
A2	Taxes et subventions	1	50%												
A18	Zonage et sélection de sites	6	47%												
A7	Organisation de visites éducatives	12	44%												
A6	Amélioration de la gestion globale	11	44%												
A22	Plan de déplacement des fermes aquacoles	8	44%												
A23	Plan de récupération post crise	8	44%												
A10	Amélioration du nourrissage / alimentation	2	42%												
A20	Suivi environnementale et système d'alerte précoce	7	33%												
A15	Aquaculture indoor avec recirculation de l'eau	5	33%												
A3	Actions sur la production d'aliments pour poissons	10	25%												
A11	Répondre aux attentes environnementales au niveau locale	3	22%												
A14	Aquaculture à cycle de production court	4	22%												

Figure 8: Adaptation pathways for aquaculture in Corsica. Options are identified with an ID number, full name, and class of adaptation number. Adaptation objectives are identified in each option by colour: ***vulnerability reduction (red),*** *Disaster* ***Risk Reduction (blue); Social-Ecological Resilience (green);*** *Local Knowledge adaptation options (grey). Each ATP (APT A; APT B; APT C; APT D) is represented in three timeframes: S - Short term (up to 2030), M- Medium term (up to 2050), L - Long term (until 2100). Highlighted options indicate the measure was selected in each ATP and timeframe: ATP A (light blue); ATP B (light green); ATP C (Light orange) and ATP D (light purple). A white cell means that the option was available in that APT but was not chosen and a grey cell means that it was not available in that APT.*

When choices and APT are considered (Figure 9), we see that:

- Local consumption of aquaculture products (A12) is preferred to Local environmental concerns (A11);
- Integrated multitrophic aquaculture (A13) is preferred by far too short cycle aquaculture (A14)
- Submersible cages (A16) are preferred to indoor aquaculture (A15)
- Species selection (A4) are preferred to fish food improvement (A3)

In APTA, short term soft measures are preferred more often and also at long term, while in APT B, C, and even more on D, actions including some restructuring of relocation are chose, which seems consistent with the pathway's rationale.

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ID	Name	Class number	Ratio	APT A			APT B			APT C			APT D		
				S	M	L	S	M	L	S	M	L	S	M	L
A1	Dispositifs financiers, assurances et prêts	1	50%												
A2	Taxes et subventions	1	50%												
A9	Sensibilisation et changement de comportements	2	58%												
A10	Amélioration du nourrissage / alimentation	2	42%												
A12	Promition de la consommation locale des produits de	3	78%												
A11	Répondre aux attentes environnementales au niveau locale	3	22%												
A13	Aquaculture intégrée multi-trophique (IMTA)	4	78%												
A14	Aquaculture à cycle de production court	4	22%												
A16	Cages submersibles	5	67%												
A15	Aquaculture indoor avec recirculation de l'eau	5	33%												
A17	Infrastructures d'aquaculture résistante au climat	6	53%												
A18	Zonage et sélection de sites	6	47%												
A19	Méthode de prévention des maladies	7	67%												
A20	Suivi environnementale et système d'alerte précoce	7	33%												
A21	Gestion des risques naturels	8	56%												
A22	Plan de déplacement des fermes aquacoles	8	44%												
A23	Plan de récupération post crise	8	44%												
A24	Fonds pour la récupération post crise	9	56%												
A4	Sélection d'espèces	10	75%												
A3	Actions sur la production d'aliments pour poissons	10	25%												
A5	Elevage de souches résistantes	11	56%												
A6	Amélioration de la gestion globale	11	44%												
A8	Promotion de recettes à base de poissons d'élevage	12	56%												
A7	Organisation de visites éducatives	12	44%												

Figure 9 - Averaged adaptation options and pathways for the aquaculture ***sector in Corsica****. Options are identified with an ID number, full name, and class of adaptation number. Adaptation objectives are identified in each option by colour:* ***vulnerability reduction (red),*** *Disaster* ***Risk Reduction (blue); Social-Ecological Resilience (green);*** *Local Knowledge adaptation options (grey). Each ATP (APT A; APT B; APT C; APT D) is represented in three timeframes: S - Short term (up to 2030), M- Medium term (up to 2050), L - Long term (until 2100). Bold letters in each ATP indicate the option was available to be selected. Highlighted options indicate the measure was selected in each ATP and timeframe: ATP A (light blue); ATP B (light green); ATP C (Light orange) and ATP D (light purple). A white cell means that the option was available in that APT but was not chosen and a grey cell means that it was not available in that APT.*

4.2.2 Sustainability Performance

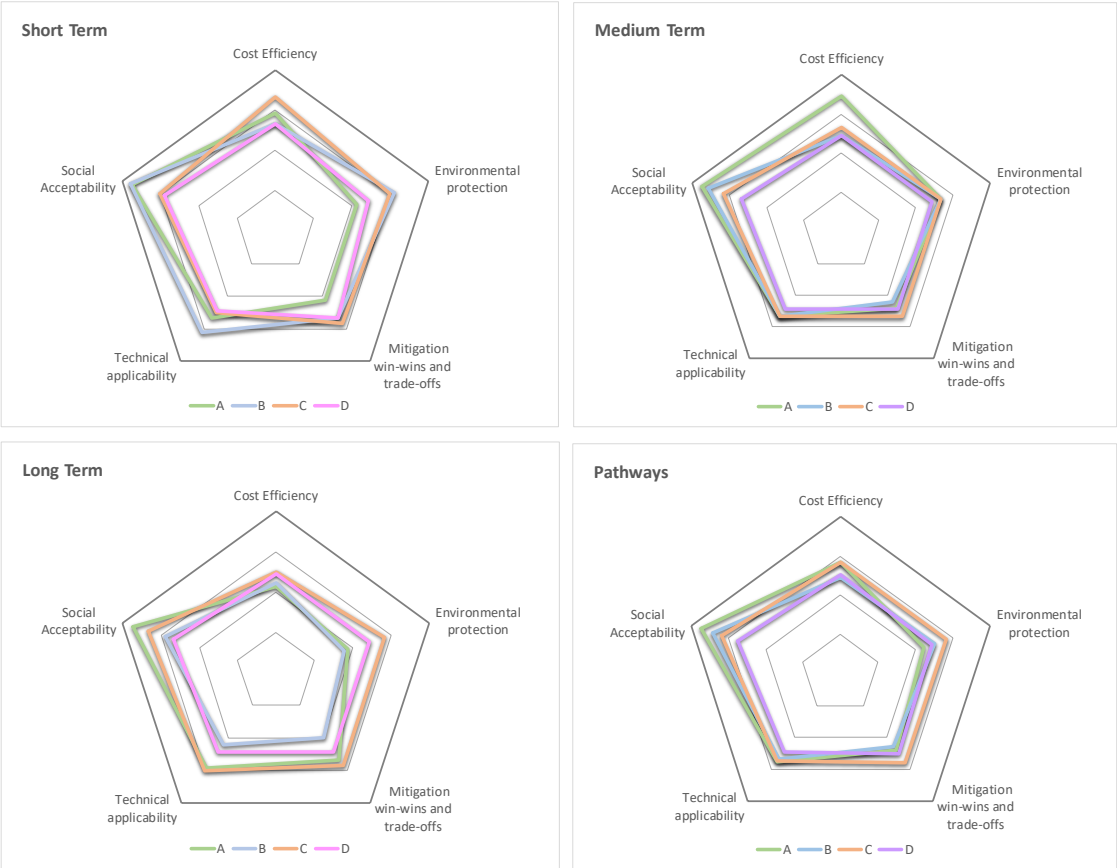

Figure 10 - Pathways evaluation for aquaculture sector considering: Cost Efficiency; Environmental protection; Mitigation (GHG emissions) win-wins and trade-offs; Technical applicability; Social acceptability. The policy pathways scenarios: APT A - Minimum Intervention; APT B - Economic Capacity Expansion (ECE); APT C- Efficiency Enhancement (EE); APT D - System Restructuring (SR), for different timeframes: short, medium, and long term

Some differences across pathways exist:

- APTA (minimal intervention) tends to have a higher social acceptability (since little action is taken) and cost efficiency, at short and medium term
- APTD (system restructuring) never performs the best, for none of the criteria
- APT B (Economic Capacity Expansion) seems very efficient on the medium term, and APT C Efficiency enhancement) on the long term

5 Discussion and Conclusions

Despite its complexity and the necessity to run a virtual meeting, this survey on adaptation pathways was well received and understood by our stakeholders. Respondents generally confirmed the climate risk assessments delivered by SOCLIMPACT and added some more specific comments.

The analysis of the tourism sector clearly led to clear conclusion for the tourism sector:

- There is a clear hierarchisation of climate risks:
    - Beach loss are clearly a risk, but due to the high beach linear and surface, beaches will not disappear in Corsica
    - Heat stress and discomfort is an issue, but tourists appear to bear very well higher temperatures: Corsica is a sea and sand destination, but can also offer fresh areas in the mountains
    - Vector-borne diseases transmitted by *Aedes Albopictus* should not increase
    - Seagrass should not be subject to increased heat stress, compared to other islands
- Exposure and vulnerability will increase in the future (more tourists, more competition between tourism and agriculture for water, for instance in the Cap Corse)
- In this perspective, if the tourism sector clearly needs a climate change adaptation policy, it is also obvious that there is no need to restructure completely the tourism system to do so. Contrary for instance to snow tourism in the Alps, where the snow resources will disappear at some altitudes and therefore call for a radical change in the tourism product, in Corsica we are talking more of moderate adaptation to climate change. Therefore, APT A in the short term, then APT B or C in the mid and long term, should be sufficient to preserve the tourism activity

6 References

Suckall, N., Tompkins, E. L., Nicholls, R. J., Kebede, A. S., Lázár, A. N., Hutton, C., Vincent, K., Allan, A., Chapman, A., Rahman, R., Ghosh, T., & Mensah, A. (2018). A framework for identifying and selecting long term adaptation policy directions for deltas. *Science of the Total Environment*, *633*, 946–957. https://doi.org/10.1016/j.scitotenv.2018.03.234

7 Webinars

7.1 1st Webinar

7.1.1 Objectives

1. The context of the Project: Sectors, Models and Outputs

2. Background material to support your decisions.

3. Present the Online Survey Tool – Design of adaptation pathways for Azores.

- Adaptation options up to 2030, 2050 and until the end of the century

- How to fill in and submit the Online Survey Tool

7.1.2 Agenda

13h30 – 13h45 Welcome and Round table

13h45 – 14h00 Brief presentation of the SOCLIMPACT project

14h00 – 14h30 The main results for aquaculture and tourism

14h30 – 14h30 Q&A

14h30 – 15h00 Introduction to the survey process and the associated timeline (Adaptation Pathways by sector - survey tool)

15h00 – 15h30 Selection of local adaptation options by sector

15h10 – 15h20 Next steps

7.1.3 Minutes

- Welcome and Round table

15 actors of the tourist activity and the aquaculture sector in Corsica participated in the workshops the list of those attendees is presented in table 3.

Table 10 – Round table Webinar 1: Attendees.

Name	Last Name	Organisme
Virginie	Bollini	ADEME de Corse
Michel	Marengo	STARESO
Patrick	Rebillout	Météo France
Laetitia	Hugot	Conservatoire botanique national de Corse
Marie-Cécile	Andrei-Ruiz	OEC
Claude	Albertini	DRAAF / SRISE
Serge	Chiarovano	Délégué au DIRMed
Jérémy	Visconti	CAPA
Camille	Ceccaldi	Office d'équipement hydraulique de Corse
Qualitair	Jean-Luc Savelli	Qualitair Corse
Audrey	SCOFFONI	CAB
Georges	WINTERSTEIN	DREAL Corse
Anna		Parcu di Corsica
Jean-François	Santelli	CAPA
Sylvia	Agostini	Université de Corse

- Brief presentation of the SOCLIMPACT project

Ramboll proceeded to the presentation of the SOCLIMPACT project and the context of the project. The presentation can be found in the shared directory of the project.

- The main results for aquaculture and tourism

The key elements of the project for aquaculture and tourism were reviewed by Ramboll. Thus, the different effects of climate change and the results of the modelling of the SOCLIMPACT project were explained during the session. The results were confronted to the local results detained by experts in Corsica. For instance, the diminution of suitable periods for *aedes albopictus* (mosquito), as modelled by SOCLIMPACT was confirmed by experts. Same occurred, for the relatively lower vulnerability to fires of Corsica than other islands.

Ramboll provided several precisions on the way some key risks were modelled.

- Introduction to the survey process and associated timeline 'Adaptation trajectories by sector (survey tool)

Participants asked questions on the low representativity of our sample (a few questionnaires processed to represent a Pathway)

7.2 2nd Webinar

7.2.1 Objectives

- Present the final *Pathways Adaptation* CORSICA

- Discuss the *Pathways Adaptation* results

7.2.2 Agenda

13h30 – 13h45 Welcome and Round table

13h45 – 14h00 Ramboll: quick overview

14h00 – 14h20 Open discussion on adaptation policies in Corsica

14h20 – 14h30 Q&A

14h30 – 15h00 Presentation of the results of the survey on adaptation pathways in Corsica

15h00 – 15h10 Q&A

15h10 – 15h20 Next steps

7.2.3 Minutes

- Welcome and Round table

Ghislain Dubois, Ramboll, welcomes the attendees. He reminds that the meeting aims to present to the attendees the results of the surveys and to get feedback from participants on climate change adaptation pathways.

- Round table:

5 actors of the tourist activity and the aquaculture sector in Corsica participated in the workshop. The list of those attendees is presented in table 4. Please note that these persons attended the 1st workshop on November.

Table 11 – Round table Webinar 2: Attendees.

Name	Last Name	Company
Marie-Cécile	Andrei-Ruiz	OEC
Jean-Luc	Savelli	Qualitair Corse
Georges	WINTERSTEIN	DREAL Corse
Anna		Parcu di Corsica
Sylvia	Agostini	Université de Corse

- Open discussion on adaptation policies in Corsica

Three questions were asked by Ramboll to the attendees.

  - What are the main reference documents on adaptation to climate change in Corsica, at the regional (CTC) level?

Jean-Luc S: Urban Planning Agency CTC, SRCAE Corsica (regional plan on air, climate and energy, elaborated in 2012)

Sylvia Agostini mentioned some works on the temperature and the relationship with rising water levels

- What is the status of the adaptation component of the PCAET (Local climate air and energy plan)?

Jean-Luc: Ajaccio PCET exists, must be reviewed in PCAET. Other PCAET Bastia, Porto-Vecchio in progress.

- Studies and reference works?

Jean-Luc: Works by the University of Toulouse and Corsica observatoire de l'atmosphère de l'océan, several actions within the framework of this project, design of electricity sensors in thunderstorms to monitor the evolution of intense events during the year. https://corsica.obs-mip.fr/

Jean-Luc Savelli : SRCAE, refer to l'agence de l'urbanisme et l'énergie

Sylvia Agostini: Work in progress by the Stareso on the follow up of the dynamics of species

Georges Winterstein: for the water sector, some works have been done. Please consult: https://www.eaurmc.fr/jcms/pro_94071/fr/plan-de-bassin-d-adaptation-au-changement-climatique-bassin-de-corse

- Presentation of the results of the survey on adaptation pathways in Corsica

Ramboll received 5 responses for tourism and 2 responses for aquaculture. Only tourism can be exploited with the number of results received (we required 3 at minimum per sector)To compare, for the other islands the results were a little bit more consistent. Madeira has collected more surveys, a in depth interview work was done. Some results are listed below

1. **The order of the choices**

T11 Local Circular Economy was frequently chosen. Stakeholders confirm it is an important topic in Corsica.

T16 The desalination was less retained, interpretation is that the water resource is less weak in Corsica (less population, mountains) the participants felt less need to go in this direction

For instance, Malta are more concerned by the water desalinisation than the T14.

2. Pathway A

Raising public awareness, not diversifying the tourism offer, was the most selected pathway, which is consistent the concept of "minimal intervention" contained in APT A.

3. Pathway D

Anticipation of crises is preferred to post crisis intervention, which seems also logical.

- Comparison of results between Corsica and the other islands

Samples are not representative, but vision of the problems is not different from the other islands.

Local/sustainable fishing is more chosen in the other islands than in Corsica.

Restoration of the dunes in Corsica is a big issue

- Questions & Answers

Ramboll: Does the approach seem clear to you?

Jean Luc-Savelli: yes, with the limit of the sample size

Ramboll: What difficulties did you have in answering the questionnaire?

Attendees: No

Ramboll: One of the 4 pathways seem more recommendable than another?

Sylvia: Raising tourist awareness, maintenance of Posidonia banks

Jean -Luc S: sustainable actions, recharging the beaches is useless

Intermediate scenarios are more relevant, the maximum scenario is too complicated to implement

Ghislain: the relevance of an action or other is conditioned by the choices made.

It had been noted that thermal comfort was likely to be reduced with climate change.

Sylvia: Pollution scares tourists more than the temperature.

Ghislain do you think that the risk of forest fires affects the image of the island in relation to tourism.

Sylvia no

Jean-Luc, no, the tourists will come to Corsica, unless the area is damaged in the same year, but two or three years later the tourists return.

Adeline: we see a trend of degradation in the tourism sector and if the recurrence and frequency of forest fires is too strong.

Sylvia and Jean-Luc say that tourists forget about the fires quickly enough and come back.

Ramboll: It is necessary to diversify / reorganise the touristic proposition in Corsica? Or some minor adaptation could be enough?

Attendees: No, not necessarily

Ghislain: If we look at the results, pathway D is not the one that is trendier, but overall, we are on development rather than upheaval.

Jean-Luc confirms, the beaches will be there, and the fact of having mountains allows to keep the touristic attraction.

The same feeling and opinion is shared by the whole participants.

Ramboll: Regarding the climate change effects, according to you, which actions are a priority to preserve the touristic economy of the Island?

Sylvia: Sensibilisation of the population. I.e.: the Posidonia benches maintain the beaches

Jean-Luc: preserve biodiversity and the Roseaux's backshore, protection work is the most relevant and effective

Marie-Cécile: Improve awareness of tourists/local inhabitants/local actors about Posidonia and the importance to preserve the wild side of the island

Ramboll: What action is most recommended?

Jean-Luc a combination of several actions/solutions. Very Important Freshwater Management. Pumping on groundwater and watercourses brings new problems

Sylvia: climate change is long-term. Stress in water resources in Rogliano in summer is a real situation.

Ramboll: What about Agricultural evolution vs tourism evolution?

Jean-Luc: If we want to promote circular economy, we will have to work on water management.

Marie-Cécile: we will have to look at the conflicts, management of species and biodiversity, management of tourist flows, etc. The adaptation of tourism will have to be done in conciliation with the other sectors.

We can imagine conflicts between the different sectors in the future.

Marie-Cécile: to encourage the spreading of tourist flows.

Ghislain

The simulation approach of the University of Lisbon helps to see strategies and adaptation in more detail, interesting to build an action and an operational approach.

- Next steps

SOCLIMPACT will be finished in March 2021. A more global and complete presentation is planned with the European Commission.

A quick presentation of the SOCLIMPACT platform and the information exchange system. https://soclimpact.net/

Be aware that the REIS platform will be populated with all the information of the project. A tool for adaptation (for every Island of the project) will be put in the website: https://reissoclimpact.net/adaptation-support-tool/

- Remarks / Questions

Jean-Luc, he is interested in the maritime transport part, he will contact the researchers when the information will be updated in the website.

Marie-Cécile: She is interested in aspects related to the spread of diseases (links transferred to her colleagues)

Georges, He has some comments on the Appendix 4. He will send his comments to Ghislain

Thank you to the participants.

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8 Annexes - Corsica

8.1 Adaptation Options Evaluation

8.1.1 Tourism

Table 12 – Adaptation option characterization for Tourism sector

Options Characterization				Criteria					Sources
ID	Name	Description	Class of adaptation	Cost Efficiency	Environmental protection	Mitigation (GHG emissions) win-wins and trade-offs	Technical applicability	Social Acceptability	
T1	Instruments économiques (EPIs)	Les instruments de politique économique (IPE) sont des incitations conçues et mises en œuvre dans le but d'adapter les décisions individuelles aux objectifs convenus collectivement. Différents types d'instruments peuvent être appliqués, tels que : la tarification (par exemple, les tarifs de l'eau), les taxes et redevances environnementales, les subventions ; les échanges (par exemple, les permis négociables pour la pollution ou le prélèvement d'eau, les mécanismes de compensation, les paiements pour les services environnementaux) ; les accords volontaires et les systèmes de gestion des risques tels que les assurances.	1. Capital financier	3	3	4	2	3	Climate-Adapt/behavioural change
T2	Incitations financières à se retirer des zones de risques élevé	Les incitations financières à se retirer des zones à haut risque désignent la création d'incitations financières pour retirer ou relocaliser des établissements, des infrastructures et des activités productives de leur emplacement d'origine en raison de leur forte exposition à des risques tels que les inondations, l'élévation du niveau de la mer et les ondes de tempête.	1. Capital financier	2	2	1	1	1	Climate-Adapt/retreat
T3	Adaptation de la gestion des eaux souterraines	L'adaptation de la gestion des eaux souterraines peut être utilisée pour (1) conserver les réservoirs d'eaux souterraines, en limitant l'utilisation de l'eau et en optimisant la réutilisation de l'eau, et (2) restaurer ou augmenter la capacité d'infiltration naturelle. Dans ces deux cas, ils deux contribuent à l'adaptation dans des circonstances de réduction des précipitations et d'intrusion d'eau salée de mer aggravée par la surexploitation des eaux souterraines. Différents ensembles	10. Services écosystémiques	3	3	3	3	3	Climate-Adapt/groundwater
T4	Systèmes de suivi, modélisation et prévision	Les systèmes de surveillance, de modélisation et de prévision sont des systèmes d'information qui fournissent en temps utile des informations climatiques fiables, ainsi que des données actualisées sur l'occurrence et la gravité des événements extrêmes, leurs impacts possibles et leur durée. Différents systèmes peuvent être mis en œuvre pour répondre à différents risques climatiques, tels que ceux liés à la sécheresse, la surveillance de la qualité de l'eau, la gestion des ressources en	10. Services écosystémiques	4	3	3	3	4	Climate-Adapt/monitoring
T5	Restauration et réhabilitation des dunes	La restauration et la réhabilitation des dunes font référence au renforcement de la sécurité contre les inondations et des fonctions de réservoir de sable des dunes. L'érosion des dunes est le résultat de l'action du vent, de l'érosion marine, des activités humaines et de l'élévation du niveau de la mer (ENM). Parmi les techniques possibles, on peut citer la plantation d'herbe, le chaume et les clôtures.	11. Services de régulation et de maintenance	2	3	3	3	4	Climate-Adapt/dunes

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T6	**Restauration et réhabilitation des rivières**	La réhabilitation et la restauration des rivières sont des mesures qui mettent l'accent sur les fonctions naturelles des rivières et créent des zones tampons végétalisées le long des cours d'eau. Cela contribue à l'amélioration des conditions microclimatiques, réduit le ruissellement et l'érosion, et augmente la recharge des nappes phréatiques. Pour le tourisme, cette option permet l'élargissement des zones de loisirs disponibles, accroît les zones de confort	11. Services de régulation et de maintenance	**4**	**4**	**4**	**3**	**4**	Climate-Adapt/rivers	
T7	**Gestion adaptative des habitats naturels**	La gestion adaptative des habitats naturels fait référence à la préservation des services écosystémiques qui sont essentiels au bien-être de l'homme. Les activités humaines induisent des pressions et des impacts sur la biodiversité et les écosystèmes qui ont tendance à être aggravés par le changement climatique. Les mesures de gestion adaptative comprennent : la compréhension de la réaction des espèces, l'aménagement des rivières et des côtes, l'aide au flux génétique, la	12. Services culturels	**4**	**4**	**4**	**3**	**4**	Climate-Adapt	
T8	**Piscines d'eau de mer**	Les piscines océaniques sont des bassins d'eau de mer situés au bord de la mer où les vagues peuvent s'y engouffrer. La largeur, la longueur et la profondeur des piscines océaniques varient et dépendent souvent de leur emplacement sur le littoral. Ces structures de loisirs sont utiles dans le contexte de l'élévation du niveau de la mer, car elles constituent une protection supplémentaire de la côte et créent des alternatives aux zones de loisirs sur la plage.	12. Services culturels	**3**	**3**	**2**	**4**	**4**	CNN	By Water Research Laboratory (WRL) to the city of Marion (Australia)
T9	**Diversification des produits et de l'activité touristique**	La diversification des activités et des produits comprend des actions visant à élargir les activités et les produits touristiques, à réduire la saisonnalité et la surcharge des infrastructures et des écosystèmes. Le passage de la dépendance des produits "soleil, mer et sable" à des activités de loisirs alternatives peut réduire les impacts des vagues de chaleur, de l'érosion côtière ou de la dégradation des écosystèmes, et contribuer ainsi à maintenir l'attractivité des	2. Capital humain	**3**	**2**	**2**	**2**	**3**	**Small States' Resilience to Natural Disasters and Climate Change** - Role for the IMF, IMF Policy paper, 2016	Kaján E., Saarinen J., 2013, Tourism, climate change and adaptation: a review
T10	**Programmes de sensibilisation du public**	Les programmes de sensibilisation du public établissent des programmes ciblés qui sensibilisent les guides, les gestionnaires de sites et les communautés locales au changement climatique (valeurs spécifiques et besoins de protection).	2. Capital humain	**2**	**3**	**3**	**4**	**4**	Belle, N. and Bramwell, B., 2005	
T11	**Economie circulaire locale**	L'économie circulaire locale est un système économique visant à éliminer les déchets et l'utilisation continue des ressources qui offre un cadre précieux pour réduire les émissions de carbone des matériaux (décarbonisation) et accroître la résilience au changement climatique et à ses impacts.	3. Capital social	**4**	**4**	**4**	**2**	**1**	https://gca.org/solutions/why-is-the-path-to-a-resilient-economy-circular	Global Center on Adaptation
T12	**Campagne de sensibilisation des touristes**	Les campagnes de sensibilisation des touristes visent à modifier le comportement des visiteurs et à accroître les connaissances des touristes (individus et organisations) sur le changement climatique et les risques auxquels sont confrontées les destinations touristiques. Ces campagnes peuvent être ciblées sur les régions touchées par une menace climatique particulière, sur des groupes spécifiques de visiteurs ou sur le secteur du tourisme en général.	3. Capital social	**2**	**3**	**3**	**3**	**3**	https://climate-adapt.eea.europa.eu/metadata/adaptation-options/awareness-campaigns-for-behavioural-change	Climate-Adapt/awareness
T13	**Pêche locale durable**	La pêche durable locale désigne la promotion des zones/droits de pêche pour les petits pêcheurs locaux qui maintiennent les stocks et utilisent des méthodes durables. Cette option vise à ajouter de la valeur aux ressources et produits locaux, à protéger les services des écosystèmes et à réduire la dépendance vis-à-vis de l'extérieur.	4. Capital naturel	**2**	**3**	**3**	**3**	**2**	https://climate-adapt.eea.europa.eu/metadata/projects/mediterranean-network-of-sustainable-small-scale-fishing-communities	Based on Climate Adapt/fishing
T14	**Restriction d'usages de l'eau et recyclage**	Des restrictions peuvent être appliquées pour permettre aux services de l'administration des eaux de faire face aux crises. La restriction (ou le rationnement) de certains usages de l'eau, tels que l'irrigation des pelouses, le lavage des voitures, le remplissage des piscines ou le nettoyage au jet d'eau des trottoirs, peut être nécessaire pendant ces périodes. Le recyclage (ou la	4. Capital naturel	**4**	**4**	**4**	**3**	**1**	https://climate-adapt.eea.europa.eu/metadata/adaptation-options/water-restrictions-and-consumption-cuts	Climate-Adapt/water

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T15	**Rechargement des plages**	Le rechargement des plages (ou réapprovisionnement) est le placement artificiel de sable pour compenser l'érosion. Le rechargement des plages vise aussi souvent à maintenir la largeur des plages (à des fins touristiques et récréatives). Plusieurs techniques de rechargement des plages peuvent être utilisées, notamment le rechargement de la plage, de l'arrière-plage et du rivage, ainsi que le rechargement du littoral à grande échelle (par exemple à l'aide de moteurs à	5. Capital physique	**2**	**1**	**2**	**4**	**4**	https://climate-adapt.eea.europa.eu/metadata/adaptation-options/beach-and-shoreface-nourishment	Climate-Adapt/beach
T16	**Désalinisation**	La désalination est le processus qui consiste à retirer le sel de l'eau de mer ou saumâtre pour la rendre utilisable à diverses fins, y compris la consommation, et peut contribuer à l'adaptation aux circonstances des problèmes actuels ou futurs de pénurie d'eau. Les exemples technologiques comprennent les technologies électriques, comme l'osmose inverse, et les technologies thermiques, basées principalement sur des procédés de distillation à la vapeur.	5. Capital physique	**2**	**4**	**1**	**4**	**4**	https://climate-adapt.eea.europa.eu/metadata/adaptation-options/desalinisation	Climate-Adapt/desalinisation
T17	**Ouvrage de protection des côtes**	Les structures de protection du littoral telles que les épis, les brise-lames, les récifs artificiels et les digues sont différents types de structures artificielles, construites sur le littoral (ou les rivières), qui sont conçues pour protéger la côte contre l'élévation du niveau de la mer ou les tempêtes. Ces structures peuvent être utilisées, par exemple, pour faire dériver et piéger les sédiments, protéger de l'érosion, absorber l'énergie des vagues ou permettre la navigation.	6. Gérer les risques à long terme	**3**	**3**	**3**	**4**	**4**	https://climate-adapt.eea.europa.eu/metadata/adaptation-options/groynes-breakwaters-and-artificial-reefs	Climate-Adapt/groynes and artificial reefs
T18	**Plan de gestion des sécheresse**	Les plans de lutte contre la sécheresse et de conservation de l'eau font référence à l'adaptation et/ou à la participation du tourisme aux plans de gestion de la sécheresse dans le but de réduire les conséquences économiques, sociales et environnementales de la sécheresse, de la pénurie d'eau, de réduire les pertes d'eau et d'améliorer l'efficacité du secteur.	6. Gérer les risques à long terme	**3**	**3**	**4**	**3**	**3**	https://climate-adapt.eea.europa.eu/metadata/adaptation-options/adaptation-of-drought-and-water-conservation-plans	Climate-Adapt
T19	**Gestion des risques naturels**	L'intégration de la gestion des risques de catastrophes (GRN) vise à planifier et à organiser la GRN selon cinq étapes, à savoir la prévention, la protection, la préparation, la réponse, la récupération et la révision. Les exemples comprennent les interventions visant à limiter le développement urbain dans les zones inondables, à identifier les zones exposées aux risques naturels, à élaborer des stratégies, des dispositions et des procédures pour faire face aux crises, et des	7. Préparation / anticipation	**3**	**3**	**3**	**3**	**4**	https://climate-adapt.eea.europa.eu/metadata/adaptation-options/crises-and-disaster-management-systems-and-plans	Climate-Adapt/crises and disaster
T20	**Uilisation de l'eau pour le rafraîchissement urban**	L'utilisation de l'eau pour faire face aux vagues de chaleur dans les villes est un ensemble d'investissements dans les services et les infrastructures d'approvisionnement en eau qui visent à accroître la résilience des villes face aux vagues de chaleur. Différents ensembles d'interventions grises sont généralement appliqués, comme par exemple : la création et/ou la réparation de fontaines pour l'eau potable et le refroidissement ; les fontaines à jet d'eau ; et le mouillage des	7. Préparation / anticipation	**4**	**3**	**2**	**3**	**4**	https://climate-adapt.eea.europa.eu/metadata/adaptation-options/water-uses-to-cope-with-heat-waves-in-cities	Climate-Adapt / heat waves
T21	**Plan de gestion des feux de forêt**	Les plans de gestion des incendies sont des mesures de gestion qui ont un large champ d'application, comme la détection précoce, avec des voies d'évacuation et des conseils aux citoyens locaux et aux touristes, la mobilisation et la suppression des incendies indésirables et dommageables, ou l'utilisation du feu pour gérer le combustible. En outre, ces plans aident à mieux comprendre les interactions du changement climatique avec la couverture végétal et les régimes d'incendie.	8. Réponse	**4**	**4**	**3**	**3**	**4**	https://climate-adapt.eea.europa.eu/metadata/adaptation-options/adaptation-of-fire-management-plans	Climate-Adapt /fire
T22	**Amélioration des systèmes de santé**	Les systèmes de prestation de soins de santé sont des actions préventives et des ajustements qui doivent être appliqués aux systèmes de soins de santé, notamment le renforcement des aspects moins préparés de son fonctionnement et/ou de sa logistique, afin de garantir l'efficacité et l'efficience, par exemple dans des situations de température élevée et de canicule.	8. Réponse	**2**	**2**	**3**	**3**	**4**	a) https://climate-adapt.eea.europa.eu/help/share-your-info/adaptation-options/heat-health-action-plans b) https://climate-adapt.eea.europa.eu/metadata/guidances/heat-health-action-plans-	Climate-Adapt /health actions
T23	**Fonds de récupération post crise**	Les fonds de relance post-catastrophe sont des fonds destinés au secteur du tourisme pour lui permettre de se remettre sur pied après une catastrophe, grâce à des initiatives qui permettent de relancer rapidement l'économie tout en reconstruisant mieux (par exemple, reconstruire les infrastructures essentielles endommagées telles que les ports et les routes ou recréer le paysage après un incendie). L'objectif est de minimiser les impacts économiques et sociaux (qui	9.Récupération et réhabilitation post crise	**2**	**1**	**2**	**3**	**4**	a) https://www.preventionweb.net/publications/view/32306 b) https://www.imf.org/external/np/pp/eng/2016/110416.pdf	a) PreventionWeb (UNDRR) b) International Monetary Fund (IMF)
T24	**Plan d'anticipation des crises**	Les plans d'anticipation, avant la catastrophe comprennent le développement de connaissances, de bonnes pratiques et d'objectifs visant à améliorer les conditions de vie des communautés touchées, tout en facilitant les ajustements nécessaires pour réduire le risque de catastrophes futures. Parmi les exemples de bonnes pratiques, on peut citer l'identification des écosystèmes critiques (biens et services) qui nécessitent une restauration immédiate après une catastrophe ou	9.Récupération et réhabilitation post crise	**4**	**3**	**3**	**3**	**4**	a) https://www.preventionweb.net/publications/view/32306 b) https://www.imf.org/external/np/pp/eng/2016/110416.pdf	a) PreventionWeb (UNDRR) b) International Monetary Fund (IMF)

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8.1.2 Aquaculture

Options Characterization				Criteria					Sources
ID	Name	Description	Class of adaptation	Cost Efficiency	Environmental protection	Mitigation (GHG emissions) win-wins and trade-offs	Technical applicability	Social Acceptability	
A1	**Dispositifs financiers, assurances et prêts**	Financial schemes, insurance and loans are public or private risk-sharing mechanisms that aim to support farmers to respond to loss of production and infrastructures damages due to extreme weather, such as strong winds, heavy rains, floods or tidal surges. Additionally, it can provide capital to farm relocation, infrastructure and equipment upgrade, repair or replacement required.	1. Capital financier	3	3	4	2	3	Barange, M. et al (2018). **Impacts of climate change on fisheries and aquaculture: synthesis of current knowledge, adaptation and mitigation options**. FAO Fisheries and Aquaculture Technical Paper No. 627. Rome, FAO. 628 pp
A2	**Taxes et subventions**	Tax benefits and subsidies consists in financial public policy instruments to promote or benefit economic or aquaculture sustainable practices and operator's overall resilience to climate change.	1. Capital financier	2	2	1	1	1	Barange, M. et al (2018). **Impacts of climate change on fisheries and aquaculture: synthesis of current knowledge, adaptation and mitigation options**. FAO Fisheries and Aquaculture Technical Paper No. 627. Rome, FAO. 628 pp
A3	**Actions sur la production d'aliments pour poissons**	An important indirect impact to aquaculture is the change in fisheries production due to climate change. Aquaculture of finfish is highly dependent on fisheries for feed ingredients. This already a current problem with many fisheries overexploited and will only intensify in the future. Therefore, alternative feed ingredients are being developed such as insect meal and algae.	10. Services écosystémiques	3	3	3	3	3	Rosa, R., Marques, A., & Nunes, M. L. (2012). **Impact of climate change in Mediterranean aquaculture**. Reviews in Aquaculture, 4(3), 163-177.
A4	**Sélection d'espèces**	Species selection consists of selecting species that are less sensitive to changes in the environment, less prone to diseases and less dependent on fish meal and oil. For example, choosing non-carnivorous species reduces food dependence and stocking larger hatchery fingerlings reduces the culture cycle and expusure to diseases.	10. Services écosystémiques	4	3	3	3	4	Ahmed, N., Thompson, S. & Glaser, M. G**lobal Aquaculture Productivity, Environmental Sustainability, and Climate Change Adaptability**. Environmental Management 63, 159–172 (2019).
A5	**Elevage de souches résistantes**	Selective breeding consists of genetic selection of species or strains with a focus on developing strains with a higher tolerance to changes in temperature, that grow faster, and which are more resilient to diseases. This is done by selecting and mating only the fish with desirable traits as broodfish. For example, choosing species with a wider temperature tolerance range may reduce the risk of future mortality.	11. Services de régulation et de maintenance	2	3	3	3	4	Pedro B. Bueno, 2017 - **ADAPTATION STRATEGIES OF THE AQUACULTURE SECTOR** TO THE IMPACTS OF CLIMATE CHANGE
A6	**Amélioration de la gestion globale**	Implementing Best Management Practices at farms which focus on food safety, fish health, environmental impact (including climate change) and social responsibility. These practices improve the farms capacity to participate in value chains with the aim of improving the overall resilience of the farm. For example, increasing hygiene will improve resilience of species to diseases.	11. Services de régulation et de maintenance	4	4	4	3	4	Harvey, B. et al. 2017. **Planning for aquaculture diversification**: the importance of climate change and other drivers. FAO. Technical Workshop, 23–25 June 2016, FAO Rome. FAO Fisheries and Aquaculture Proceedings No. 47. Rome. Barange, M. et al (2018). **Impacts of climate change on fisheries and aquaculture**: synthesis of current knowledge, adaptation and mitigation options. FAO Technical Paper No. 627. Rome, FAO. 628 pp

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A6	**Amélioration de la gestion globale**	Implementing Best Management Practices at farms which focus on food safety, fish health, environmental impact (including climate change) and social responsibility. These practices improve the farms capacity to participate in value chains with the aim of improving the overall resilience of the farm. For example, increasing hygiene will improve resilience of species to diseases.	11. Services de régulation et de maintenance	**4**	**4**	**4**	**3**	**4**	Harvey, B. et al. 2017. **Planning for aquaculture diversification**: the importance of climate change and other drivers. FAO. Technical Workshop, 23–25 June 2016, FAO Rome. FAO Fisheries and Aquaculture Proceedings No. 47. Rome.	Barange, M. et al (2018). **Impacts of climate change on fisheries and aquaculture**: synthesis of current knowledge, adaptation and mitigation options. FAO Technical Paper No. 627. Rome, FAO. 628 pp
A7	**Organisation de visites éducatives**	Students, schools, institutes and organisations can organise visits to the fish farms to learn about aquaculture and the interactions between aquaculture and the environment. These visits can also increase knowledge on different impacts on aquaculture including man-made and climate impacts. Biosecurity should be strictly observed.	12. Services culturels	**4**	**4**	**4**	**3**	**4**		
A8	**Promotion de recettes à base de poissons d'élevage**	This measure promotes aquaculture via online information and uses local restaurants. Aquaculture itself can be seen as an adaptation measure to climate change as an alternative to wild fisheries, which production and yield will reduce due to climate change. Therefore, promoting aquaculture species in restaurants or setting up specific 'aquaculture' restaurants will provide both a cultural experience and promote farmed products. The online tool highlights the initiative,	12. Services culturels	**3**	**3**	**2**	**4**	**4**		
A9	**Sensibilisation et changement de comportements**	Awareness campaigns aim to increase the knowledge of individuals and organisations, it could also be relevant in a region affected by a particular climate threat, groups of stakeholders, and the general public.	2. Capital humain	**3**	**2**	**2**	**2**	**3**	**Climate-Adapt** - metadata adaptation options	
A10	**Amélioration du nourrissage / alimentation**	Efficient feed management practices that reduce the Food Conversion Ratio by using technology or practices to feed more efficient helps to reduce the cost of production and increase environmental standards.	2. Capital humain	**2**	**3**	**3**	**4**	**4**	Pedro B. Bueno, 2017 - **ADAPTATION STRATEGIES OF THE AQUACULTURE SECTOR TO THE IMPACTS OF CLIMATE CHANGE.** FAO	
A11	**Répondre aux attentes environnementales au niveau locale**	This option aims to promote economy and jobs to address the future challenges of climate change. The major challenges need to be underlined and linked to the key concerns and impacts on the aquaculture sector.	3. Capital social	**4**	**4**	**4**	**2**	**1**	Integrating aquaculture within local communities	
A12	**Promition de la consommation locale des produits de l'aquaculture**	Cooperation to promote local consumption of aquaculture produced fish specially in tourist sector will reduce the cost of distribution and will improve the creation of add value in local products or by-products in innovative industries.	3. Capital social	**2**	**3**	**3**	**3**	**3**	BASE on Integrating aquaculture within local communities	
A13	**Aquaculture intégrée multi-trophique (IMTA)**	Integrated multi-trophic aquaculture (IMTA) is an ecosystem-based approach to culture species from different trophic levels (fish, shellfish, seaweeds) in an integrated farm to create balanced systems for environmental sustainability. IMTA can increase resilience due to its tolerance to wider ranges of climatic factors such as temperature and salinity.	4. Capital naturel	**2**	**3**	**3**	**3**	**2**	Ahmed, N., et al(2019). **Global Aquaculture Productivity, Environmental Sustainability, and Climate Change Adaptability**. Environmental Management 63, 159–172.	
A14	**Aquaculture à cycle de production court**	Short-cycle aquaculture shortens the farming period and the time in marine cages by stocking larger fingerlings in the nursery stage (land-based) or selecting species with a shorter culture cycle.	4. Capital naturel	**4**	**4**	**4**	**3**	**1**	Pedro B. Bueno, 2017 - **ADAPTATION STRATEGIES OF THE AQUACULTURE SECTOR TO THE IMPACTS OF CLIMATE CHANGE.** FAO	

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A15	**Aquaculture indoor avec recirculation de l'eau**	Recirculation Aquaculture Systems (RAS) are land-based indoor fish farms with closed containment rearing systems where filtration is applied to purify and regulate water parameters and remove toxic metabolic wastes of fish. Since RAS is land-based and indoor it limits the risk of infrastructure destruction due to extreme events in the ocean.	5. Capital physique	**2**	**1**	**2**	**4**	**4**	Pedro B. Bueno, 2017 - ADAPTATION STRATEGIES OF THE AQUACULTURE SECTOR TO THE IMPACTS OF CLIMATE CHANGE	Barange, M. et al (2018). **Impacts of climate change on fisheries and aquaculture**: synthesis of current knowledge, adaptation and mitigation options. FAO Technical Paper No. 627. Rome, FAO. 628 pp
A16	**Cages submersibles**	Submersible cages are oceanic depth-adjustable and can be moved up and down in the sea to escape the worst effects of storms, parasite outbreaks, surface algal blooms and to keep species at an optimal temperature.	5. Capital physique	**2**	**4**	**1**	**4**	**4**	Ahmed, N., et al(2019). **Global Aquaculture Productivity**, Environmental Sustainability, and Climate Change Adaptability. Environmental Management 63, 159–172.	Barange, M. et al (2018). **Impacts of climate change on fisheries and aquaculture**: synthesis of current knowledge, adaptation and mitigation options. FAO Technical Paper No. 627. Rome, FAO. 628 pp
A17	**Infrastructures d'aquaculture résistante au climat**	Climate-proof activities refer to investments that consider climate change projections to manage future risks to infrastructures and improve operational safety conditions. E.g. strengthening mooring systems, cage structures and nets.	6. Gérer les risques à long terme	**3**	**3**	**3**	**4**	**4**	Decision-making and economics of adaptation to climate change in the fisheries and aquaculture sector	
A18	**Zonage et sélection de sites**	Risk-based zoning and site selection consists of taking into consideration climate change scenarios when planning and selecting a site for a farm. For example, marine cage operations should not select a site that is (or is expected to be) exposed to high waves or strong currents, and pond farming operations should select sites with low risk of flooding. Zone management can facilitate effective sharing of space and resources with other users, taking into account the carrying	6. Gérer les risques à long terme	**3**	**3**	**4**	**3**	**3**	Pedro B. Bueno, 2017 - **ADAPTATION STRATEGIES OF THE AQUACULTURE SECTOR TO THE IMPACTS OF CLIMATE CHANGE.** FAO	
A19	**Méthode de prévention des maladies**	Disease prevention methods are preventive health measures such as vaccines, stronger fingerlings, probiotics, ensuring optimal water quality and implementing stricter hygiene procedures with the aim of reducing the risk of diseases now and in the future.	7. Préparation / anticipation	**3**	**3**	**3**	**3**	**4**	Pedro B. Bueno, 2017 - **ADAPTATION STRATEGIES OF THE AQUACULTURE SECTOR TO THE IMPACTS OF CLIMATE CHANGE.** FAO	
A20	**Suivi environnementale et système d'alerte précoce**	Environmental monitoring and Early Warning Systems (EWS) systematically collects and provides information to fish farmers with the aim of supporting climate risk management decision-making. Monitoring and early warning can facilitate adaptation actions, such as early harvesting or relocation of fish net pens from sites of intense harmful algae blooms. Dynamic vulnerability maps, remote sensing and GIS are typically applied in the development of this type of	7. Préparation / anticipation	**4**	**3**	**2**	**3**	**4**	Barange, M. et al (2018). **Impacts of climate change on fisheries and aquaculture: synthesis of current knowledge, adaptation and mitigation options**. FAO Fisheries and Aquaculture Technical Paper No. 627. Rome, FAO. 628 pp	
A21	**Gestion des risques naturels**	This measure aims to plan and organize DRM considering climate change along five stages including prevention, protection, preparedness, and response, recovery and review in the aquaculture decision making and management frameworks. Examples include interventions to limit farm development in natural hazard areas; review safety engineering standards for farms; study the interactions of climate change in local ecosystems and appropriately develop strategies, arrangements, and procedures to address crises; and post-emergency recovery activities	8. Réponse	**4**	**4**	**3**	**3**	**4**	EU-funded project: EnviGuard	
A22	**Plan de déplacement des fermes aquacoles**	These plans consist in moving produce or activities to sites with more suitable characteristics to protect them against climate hazards such as storms, high waves, temperature changes or water quality degradation. Relocation can mean moving activities within the same environment (ocean-ocean; land-land) or between environments (ocean to land). It also includes protocols emergency harvesting to reduce the stock loss.	8. Réponse	**2**	**2**	**3**	**3**	**4**	Pedro B. Bueno, 2017 - **ADAPTATION STRATEGIES OF THE AQUACULTURE SECTOR TO THE IMPACTS OF CLIMATE CHANGE.** FAO	
A23	**Plan de récupération post crise**	Establish early recovery good practices and objectives. This option will allow to reduce socio-economic and environmental consequences of the disaster. Examples of good practices are: Identify goods and services (support facilities like boats and docks as well as farm infrastructure) that require restoration.	8. Réponse	**2**	**1**	**2**	**3**	**4**	Adapted from: **METHODOLOGICAL GUIDE FOR POST-DISASTER RECOVERY PLANNING PROCESSES**	
A24	**Fonds pour la récupération post crise**	Create recovery funds and plans for Post-Disaster in Aquaculture with Initiatives to get the economy running quickly, e.g. rebuild damaged critical infrastructures such boats, docks, and farm infrastructure. This option minimizes the economic and social impacts that can occur in a post-disaster context.	9.Récupération et réhabilitation post crise	**4**	**3**	**3**	**3**	**4**	International Monetary Fund (IMF)	PreventionWeb (UNDRR)

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SOCLIMPACT

Downscaling climate impacts and decarbonisation pathways in EU islands, and enhancing socioeconomic and non-market evaluation of Climate Change for Europe, for 2050 and beyond

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Work Package 7:

This is a result of Tasks 7.3. This deliverable will include the agendas, the list of participants, and the workshops outputs including the decisions taken.

Deliverable 7.3.

Workshop reports - Crete

Island Focal Point:

Crete	KRITI	Arisitides Stratakis; Lina Anezaki; Maria Kalaitzaki;

1 Introduction

This document presents the results of the stakeholders' consultation process to design the **SOCLIMPACT Adaptation Pathways Workshops in Region of Crete**. This process is included in SOCLIMPACT Task 7.3 - Engage islands' stakeholders in the design of alternative pathways. According to the project Description of Action is expected that these online workshops use the background material prepared in Task 7.2/D7.2 and include the main results from previous WPs. The original plan was to hold physical workshops in each archipelago. However, health and travel limitations due to Covid-19 forced changes to the original plan and partners decided to develop two shorter online sessions mixed with an online survey. The rationale was to make it as easier as possible for both **IFP** and **LWG** (stakeholders) to carry out the proposed work, without seriously compromising the **scientific quality** of the projects' outcomes.

Two workshops were organised by Region of Crete, the Island Focal Point (IFP).

The workshops were held with the following objectives:

- Identify packages of adaptation and risk management options for Crete, up to 2030, 2050 and until the end of the century.
- Develop detailed archipelago/island integrated adaptation pathways, in three-timeframes: Short term (up to 2030), Mid-century (up to 2050) and End-century (up to 2100).
- Evaluate and rank pathways for Blue Economy sectors.

The Region of Crete's LWG webinars were performed on the 15th of October 2020 and on the 23rd of November 2020.

In the first stages was scheduled that the webinar included 3 of the sectors involved in SOCLIMPACT project. The aquaculture sector was excluded because of the low interest. Finally, two Blue Economy sectors of SOCLIMPACT (Tourism and Marine Transport) were included in the workshops.

Originally, the workshops were planned to be held as physical meetings; however, the decision to have the workshops online was taken due to the COVID-19 pandemic and the subsequent health limitations, using ZOOM. The two regional workshops in Crete were conducted online in Greek using ZOOM.

The following schedule was followed although there were delays:

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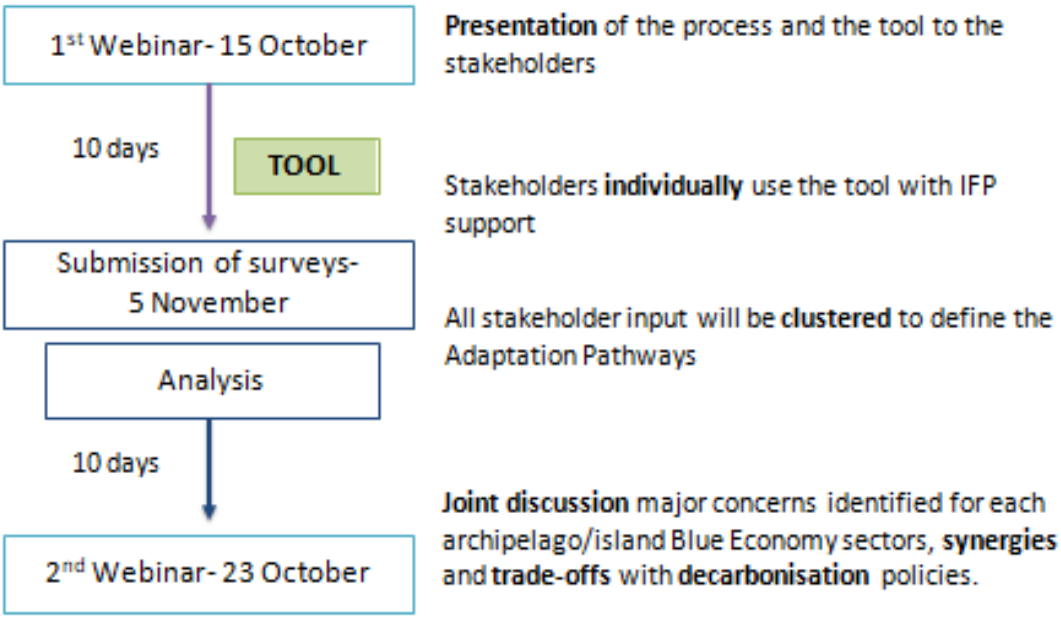


Figure 1.1: Time plan

2 General methodology

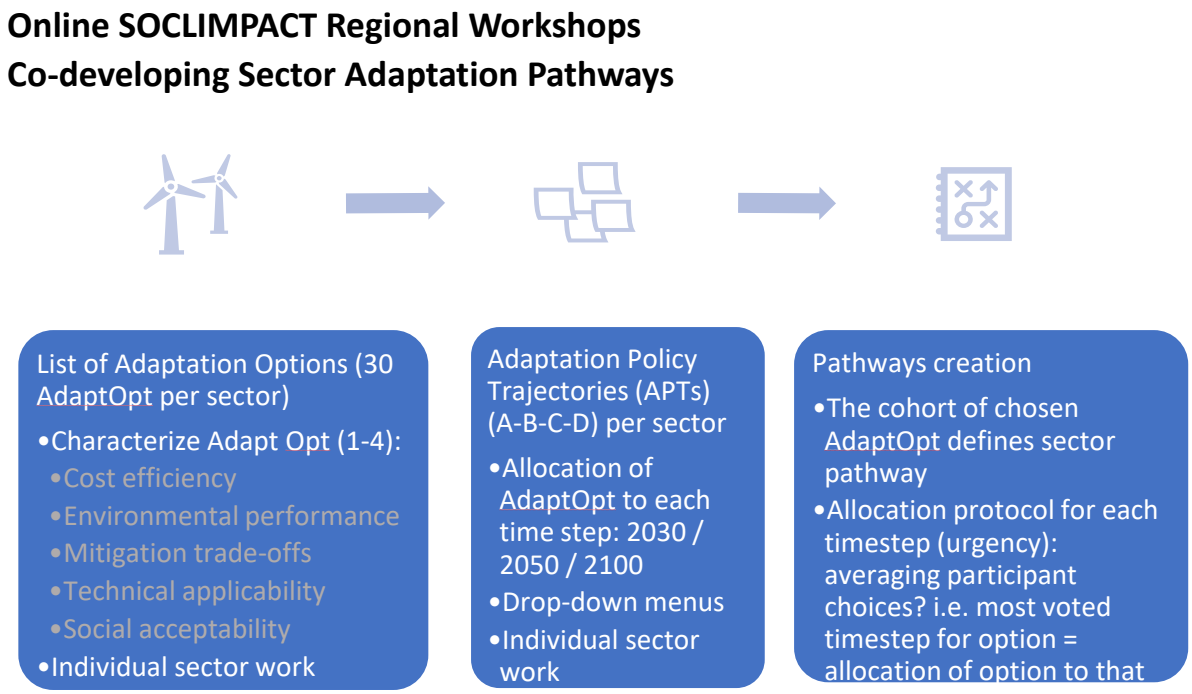


Figure 2.1: Conceptual diagram for the 'Sector Adaptation Pathways - online survey tool'

- The **Adaptation Pathways methodology applied in SOCPLIMPACT was based in the framework developed by Suckall et al.2018 and considered the three main strategic vectors for climate resilience: (1) vulnerability reduction** - Five capitals of Sustainable Livelihoods Approach (SLA)**;** **(2) Disaster Risk Reduction** –developed throughout Hyogo and Sendai Frameworks; **(3) Social-Ecological Resilience** –that emerge from the Millennium Ecosystem Assessment (MEA) and Common International Classification of Ecosystem Services (CICES).

- The **Adaptation Pathways** aim to capture the policy preferences in time and the relevancy of the context traduced in investment and commitment(Suckall et al., 2018). These Adaptation Pathways Trajectories (APT) were delineated as a set of adaptation classes each one with two options/measures to choose from. Each individual stakeholder choices contribute to create a policy pathway together with the other choices made by different stakeholders. If most of the stakeholders chose one option, then that measure was incorporated in the island adaptation pathway for that specific class in each APT, per sector. The result of the series of choices in the three timeframes defines the pathway. If there is a tie between two options, then they will both be included and become part of the adaptation pathway in each time frame. The options were included in the pathway when they were selected 50% or more in each time frame of each APT.

- Pathway options are grouped around three objectives: (1) actions to reduce socio-economic vulnerability; (2) actions that address disaster risk reduction; and (3) actions that affect social-ecological resilience. Adaptation policy under **vulnerability reduction**, **disaster risk reduction**, and **social-**

ecological resilience were developed considering classes of adaptation under which the participants decide which are the most relevant options for the Crete region.

- For **vulnerability reduction** five classes were considered: (1) Financial capital; (2) Human capital; (3) Social capital; (4) Natural capital; and (5) Physical capital. For **Disaster Risk Reduction** four classes were considered: (6) managing long term risk; (7) preparedness; (8) response; (9) post disaster recovery and rehabilitation. For **Social-Ecological Resilience** three classes were considered: (10) Post disaster recovery and rehabilitation; (11) Provisioning services; and (12) Regulating and Maintenance Services

3 Background Material

The background material that was presented at the first webinar, was based on results of the SOCLIMPACT project for Crete to help stakeholders to make decisions regarding adaptation options. Catalogue of hazard indicators evolution for different CC scenarios and time horizons (**forest fire** danger and behavior, **beach loss**, window of opportunity for **vector-borne diseases**, and changes in **thermal comfort** and **seagrass).**

The most relevant and interesting results were presented to the stakeholders, hazard indicators evolution for different CC scenarios and time horizons (**forest fire** danger and behavior, **beach loss** and changes in **thermal comfort** and **sea-grass)** to support their decisions for selecting adaptation options, and, subsequently, the formation of the adaptation pathways for Crete.

Socio-economic impact assessment of climate change scenarios using the GEM-E3-ISL model was presented by Mr. Charalambidis of E3Modelling.

Anna Karali from N.O.A presented Climate information as a component in risk assessment in its Blue Economy of Crete.

3.1 Climate and climate related risks in Crete (GREECE)

The climate of Crete is generally described as mild Mediterranean. The atmosphere can be quite humid, depending on the proximity to the sea, while winter is mild. The precipitation in Crete is characterized by spatial and temporal variation increasing towards the western and north parts of the island. Western Crete (Chania Province) receives more rain compared to the Eastern part of Crete. The island is mountainous with mean elevation of 482 m ranging from sea level to 2450m (Psiloritis, Lefka Ori). Snowfall is common on the mountains between November and May, but rare in the low-lying areas. During the Cretan summer, average temperatures reach the high 20s-low 30s Celsius with maxima touching the upper 30s-mid 40s. More sunny days and higher temperatures prevail across the south coast, including the Messara valley and Asterousia mountains, driven mainly by the prevailing North African climatic zone. In general, a basic characteristic of the local climate are large deviations from place to place.

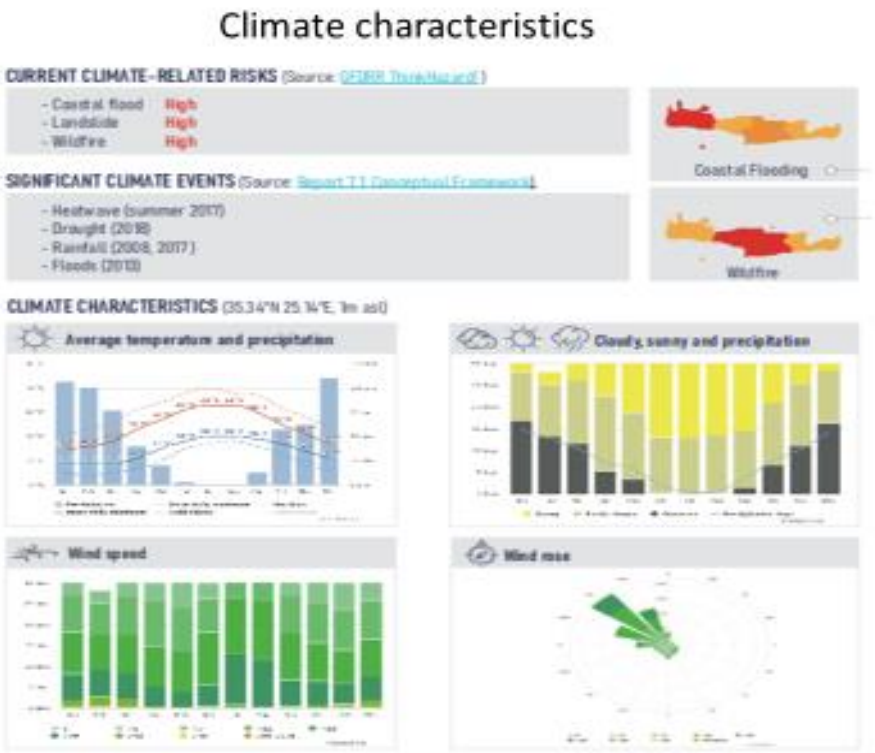


Figure 3.1: Climate characteristics, significant climate-related events and identified risks

3.1.1 Maritime transport

Sea level rise

From biophysical impacts, the mean sea level rise could trigger floods on ports, damage to storage capacity, damage in ports' infrastructures and equipment (navigation), and increase in the number of operational steps. This hazard also leads to users' risk perception leading to lower rates of moorings and turnover and increased costs of maintenance in nautical installations and equipment. For Crete the SLR ranges from 23cm (RCP2.6) to 63cm (RCP8.5) at the end of the century.

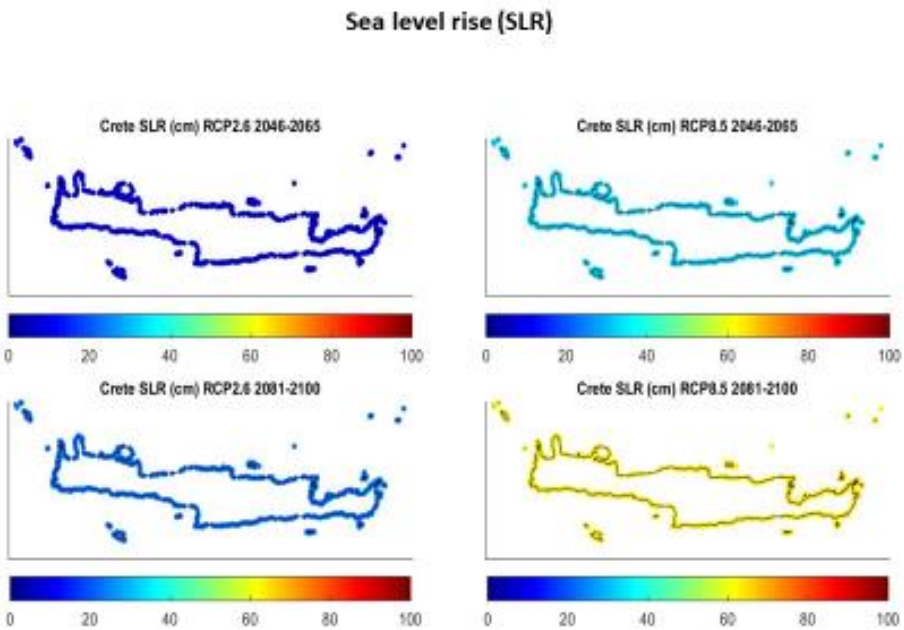


Figure 3.2: Sea level rise in different scenarios and time frames

Mean sea level rise (in cm) with respect to the present (1986-2005)
Ensemble of CMIP5 simulations and scaling approximation for RCP 2.6

Island	Ambitious Mitigation Policies (RCP 2.6)	Ambitious Mitigation Policies (RCP 2.6)	Bussiness as Usual (RCP8.5)	Bussiness as Usual (RCP8.5)
	Mid-Century (2046-2065)	End of Century (2081-2100)	Mid-Century (2046-2065)	End of Century (2081-2100)
	Mean SLR	Mean SLR	Mean SLR	Mean SLR
	cm	cm	cm	cm
Balearic	12	25	33	66
Canary	14	27	37	74
Crete	12	23	32	63
Madeira	14	27	37	75
Sardinia	11	22	30	60
West	13	27	35	70
Azores	12	24	34	69
Baltic	10	20	28	57
Corsica	11	21	29	58
Cyprus	10	20	29	58
Malta	12	24	32	65
Sicily	11	23	31	63

Figure 3.3: Table of mean sea level rise (in cm)

Climate Change impacts on ports' operability costs for different CC scenarios and time horizons

The costs have been estimated with reference to 1meter. This is the investment needed to increase the infrastructures' height by 1 meter. There is not necessarily a strict correspondence between the SLR and the required elevation of port infrastructures, which also depend on the coastal hydrodynamic and the shape of dikes of each port. By experts' recommendation, we have assumed at 1 m increase in port height is required to cope with the SLR under RCP 8.5 scenario of emissions. Extrapolation for other RCP scenarios is then conducted based on proportionality.

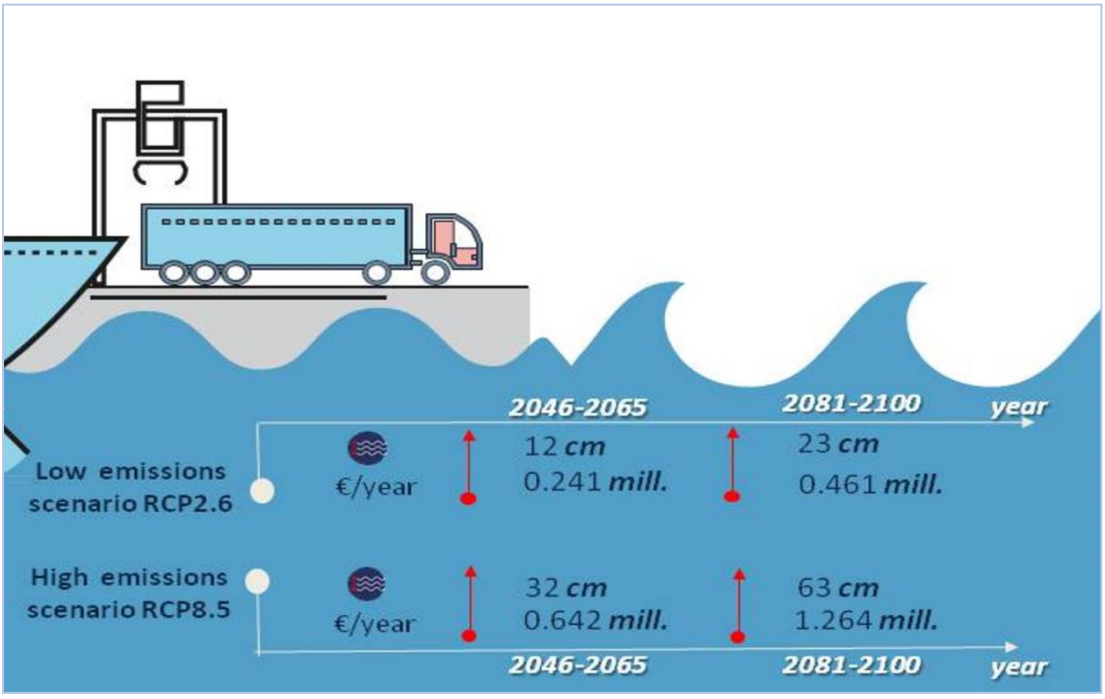
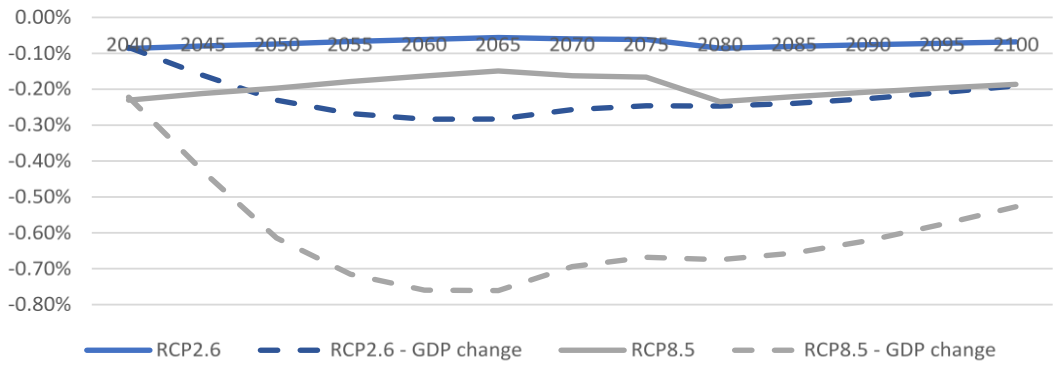


Figure 3.4: Climate Change impacts on ports' operability costs for different CC scenarios and time horizons



Source: GEM-E3-ISL, D5.6

Figure 3.5: GDP change

In this scenario we consider the case where the rise in sea level causes damage to the port infrastructure of the island.

The result is a decrease in GDP of 0.2% on average for the period 2040-2100 in the RCP2.6 scenario and 0.6% for the RCP8.5 scenario.

3.1.2 Tourism

Beach flooding

One of the consequences of an increase in the mean sea level will be the flooding of coastal areas. This includes sand beaches, which are the main asset for tourism activities in most of the European islands. Therefore, estimating the potential risk of beach loss due to climate change is of paramount importance for the economy of the islands. In order to get an accurate estimation of beach flooding, not only the sea level rise (SLR) is required, but also the wind wave characteristics. Wind waves induce a water run up when reaching the beaches that can increase significantly the extension of the flooded area, especially under storm conditions. The projected beach loss is of paramount importance for stakeholders of all EU islands highly depending of 3S (sea, sun and sand) tourism product. For Crete, it is estimated that, under mean conditions, the total beach surface loss ranges from ~53% to ~68% at the end of the century.

Ensemble of models developed by Lionello et al, 2016 using MedCORDEX simulations (Mediterranean Islands) and Global simulations produced by Hemer et al. (2013) (Atlantic Islands)

Island	Ambitious Mitigation Policies (RCP 2.6)	Ambitious Mitigation Policies (RCP 2.6)	Business As Usual (RCP8.5)	Business As Usual (RCP8.5)
	Mid-Century (2046-2065)	End of Century (2081-2100)	Mid-Century (2046-2065)	End of Century (2081-2100)
	Absolute change	Absolute change	Absolute change	Absolute change
	cm	cm	cm	cm
Balearic	43,61	56,27	85,68	119,94
Canary	48,60	59,92	104,13	137,80
Crete	**34,79**	**47,00**	**88,26**	**116,54**
Madeira	61,34	71,41	130,32	162,91
Sardinia	32,31	43,23	70,07	98,90
West indies	45,11	57,35	87,61	131,37
Azores	67,55	77,62	142,92	169,88
Corsica	30,09	40,61	63,41	92,48
Cyprus	27,63	37,5	64,54	92,47
Malta	36,25	49,96	97,5	120,18
Sicily	30,93	42,64	78,62	105,36

Figure 3.6: Beach flooding in European islands

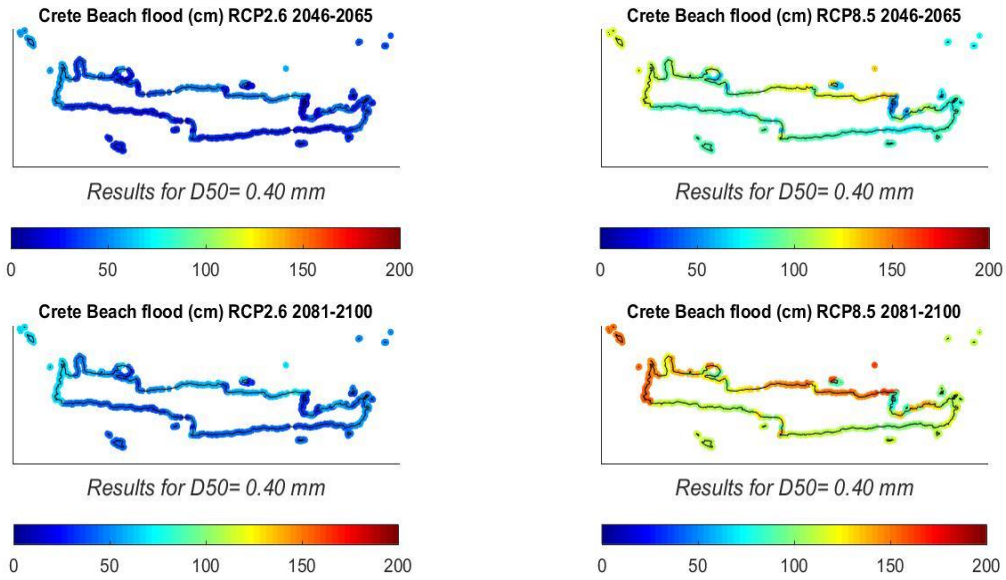


Figure 3.7: Beach flooding in different scenarios and time frames for Crete

Thermal discomfort

From one month in the current climate and 1.5 months in the middle of the century for both scenarios, Crete is expected to have 3.5 months with conditions of intense discomfort by the end of the century according to RCP8.5.

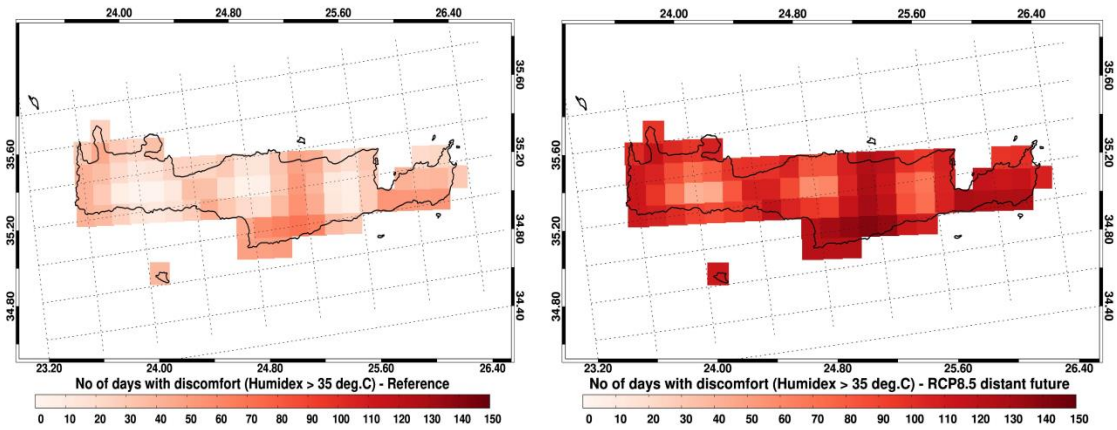


Figure 3.8 : HUMIDITY INDEX 35° Number of Days with discomfort level Humidex greater than 35°C

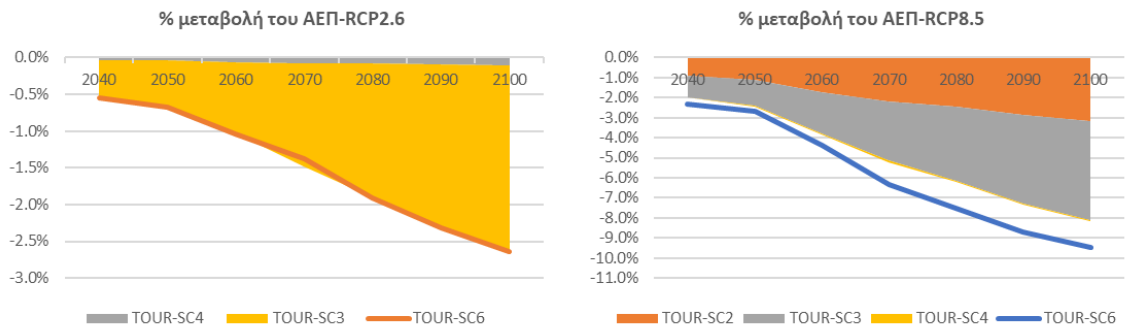
Socio-economic impact assessment of climate change scenarios using the GEM-E3-ISL model was presented by Mr. Charalambidis of E3Modelling.

In these scenarios we examine the impact of the reduction of tourist revenues in the economy of Crete as a result of adverse changes of climate change: i) in the area of beaches, ii) in the risk of fires and iii) in the increase of temperature. The biggest impact on tourism revenue, according to estimates, seems to have the

reduction of the area of beaches, emphasizing the importance of this type of tourism (beach and coastal tourism) for the economy of Crete.

According to the data provided by the island's tourism satellite account, tourism was responsible for about 18% of GDP in Crete. This percentage is projected to increase in the reference scenario in the future and reach around 23% in 2100.

The estimated cumulative decrease in tourism revenues, for the period 2040-2100, in the scenarios RCP2.6 and RCP8.5 is of the order of 13.6% and 42.5% respectively in relation to the levels of the reference scenario. The decrease in GDP compared to the values of the reference scenario for the period 2040-2100 is equal to 1.7% in the scenario RCP2.6 and by 6.1% in the scenario RCP8.5.



Πηγη: GEM-E3-ISL

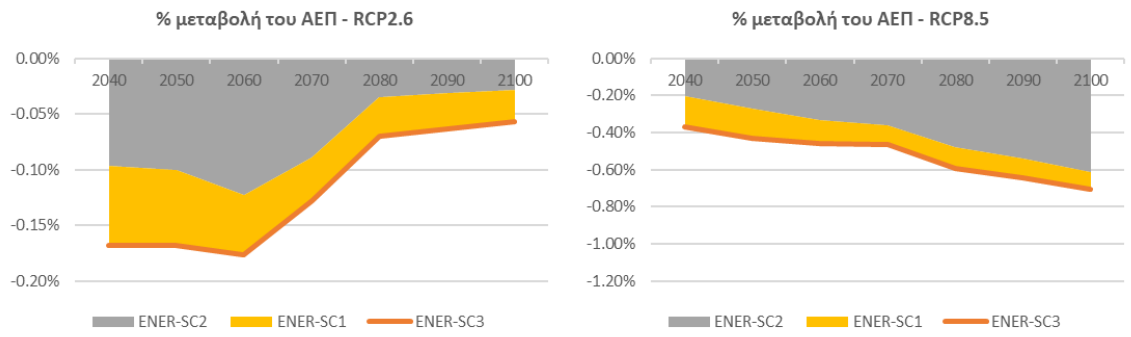
Figure 3.9: % change of GDP (impact of the reduction of tourist revenues) in different scenarios through time

This decrease is mainly due to the decline in consumer spending as household incomes shrink (e.g. by 12% in RCP2.6)

One factor holding back the decline in GDP is: a) the reduction of imports, on the one hand due to the reduction of consumer spending and on the other hand due to the substitution of imported products with locally produced ones and b) the increase of exports. The level of exports depends on the cost of production which appears reduced due to the fall in wages (in response to the rising level of unemployment caused by the decline in tourism activity) and the reduction in the cost of capital.

Since the tourism industry is shrinking most of the available capital of the island will be directed to support other productive sectors whose demand does not depend directly on tourism and especially those with the greatest export prospects.

3.1.3 Energy



Πηγη: GEM-E3-ISL

Figure 3.10: % change of GDP (impact of increased electricity demand) in different scenarios through time

In these scenarios we examine the impact of increased electricity demand due to increased cooling needs due to rising temperatures as well as due to increasing coverage of the island's water supply needs by desalination plants due to reduced rainfall days.

In total, the island's electricity needs appear increased by 10.3% for the period 2040-2065 and by 15.4% for the period 2080-2100 for the RCP8.5 scenario while in the RCP2.6 scenario the estimated increase is of the order of 3.8% during the period 2040-2065 while in the long run it is of the order of 0.7%.

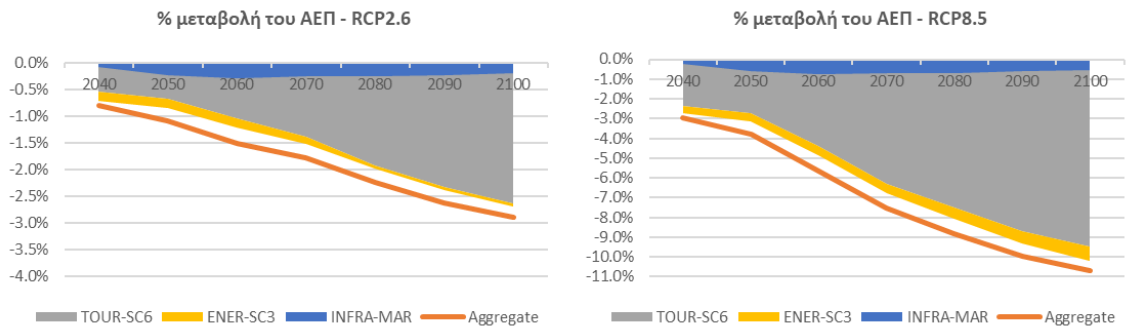
The electricity generation system, both in the reference scenario and in the other scenarios, is considered "closed", in the sense that the future connection of Crete with mainland Greece is not taken into account as at the time of the study the project has not yet been completed. In addition, no changes in the mix of power generation technologies are considered.

Consequence of the studied changes, based on the above assumptions, is the increase of electricity prices and therefore the cost of production, as well as the increase of investments for the expansion of electricity generation units. GDP is down slightly compared to the reference scenario of 0.1% in the RCP2.6 scenario and 0.6% in the RCP8.5 scenario during the period 2040-2100.

Rising production costs, combined with increased household spending on electricity, lead to reduced activity due to reduced competitiveness of local businesses.

3.1.4 Results - Cumulative effects

The cumulative impact scenario is a synthesis of the aforementioned changes. In this scenario we look at the impact on the economy of the simultaneous change in tourism spending, electricity demand and damage to port infrastructure.

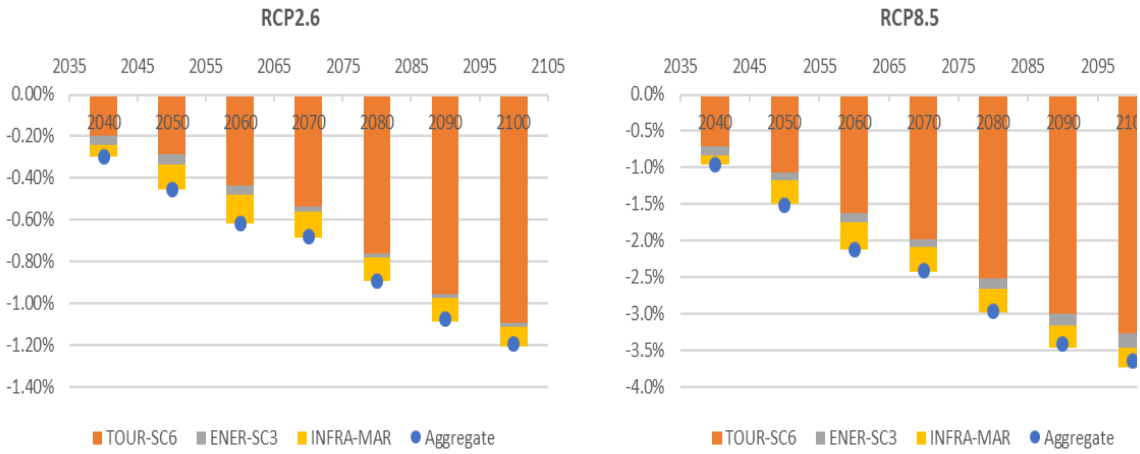


Πηγη: GEM-E3-ISL

Figure 3.11: % change of GDP (simultaneous change in tourism spending, electricity demand and damage to port infrastructure)in different scenarios through time

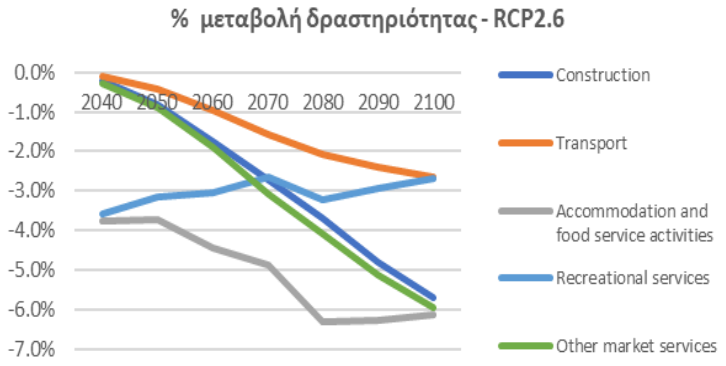
The result of the simulation for both climate scenarios is negative in terms of GDP compared to the GDP of the reference scenario. In the RCP2.6 climate scenario the cumulative reduction for the period 2040-2100 is equal to 2.1% while in the RCP8.5 climate scenario the reduction is equal to 7.9%.

In both scenarios, the estimated reduction in tourism revenue is the one that has the greatest impact on the final result.



Πηγη: GEM-E3-ISL

Figure 3.12: % change of the estimated reduction in tourism revenue in different scenarios through time



Πηγη: GEM-E3-ISL

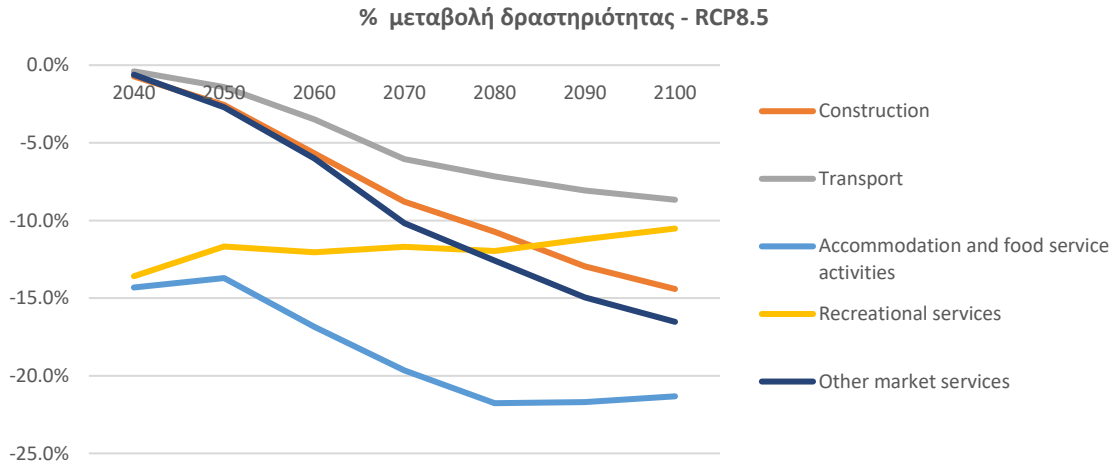


Figure 3.13: % change of different activities in different scenarios through time

As we see in the previous figure, employment is expected to be adversely affected by the aforementioned changes and unemployment to rise. The decrease in employment is mainly due to the contraction of tourism activity (compared to the reference scenario).

3.1.5 Market and non-market effects

A number of 224 tourists visiting Crete were interviewed out lining possible climate change impacts for the island (e.g., beach erosion, infectious diseases, forest fires, marine biodiversity loss, heat waves, etc.).Then, tourists had to indicate whether they would keep their plans to stay at the island or find an alternate destination if the impact had occurred, which allows predictions of the effects on tourism arrivals to be made for each island. Secondly, tourists were asked to choose between various policy measures funded through an additional payment per day of stay.

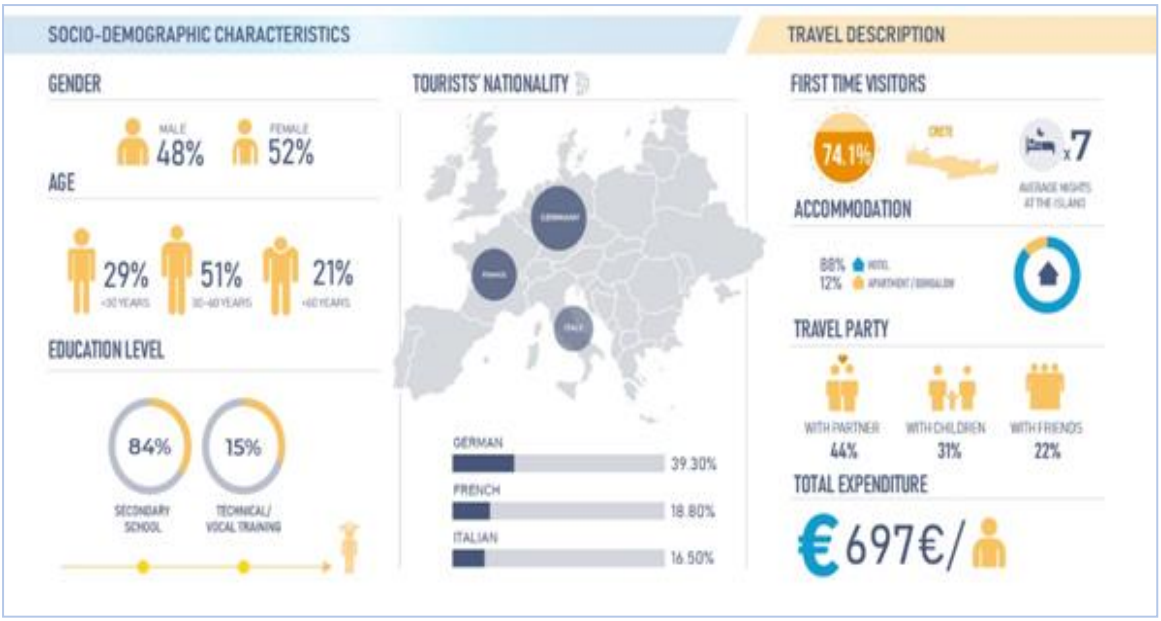


Figure 3.14: Socio demographic characteristics of Tourists

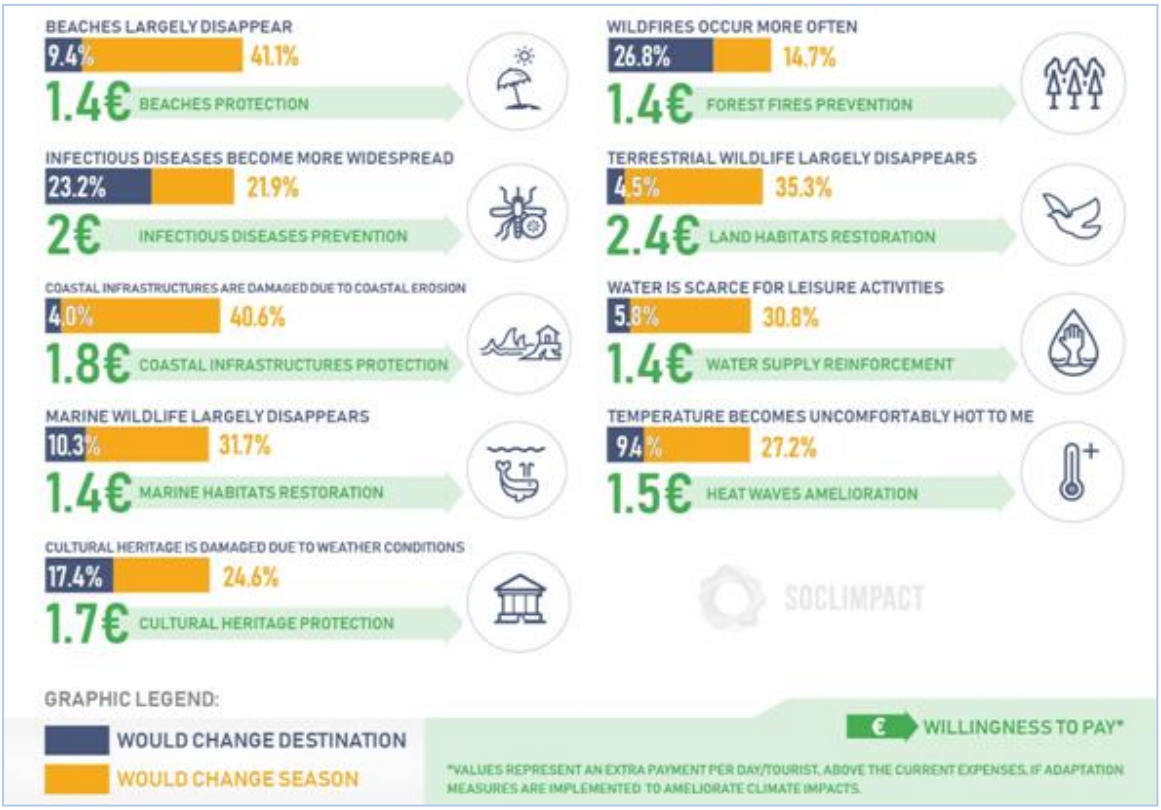


Figure 3.15: choices of tourists between various policy measures funded through an additional payment per day of stay.

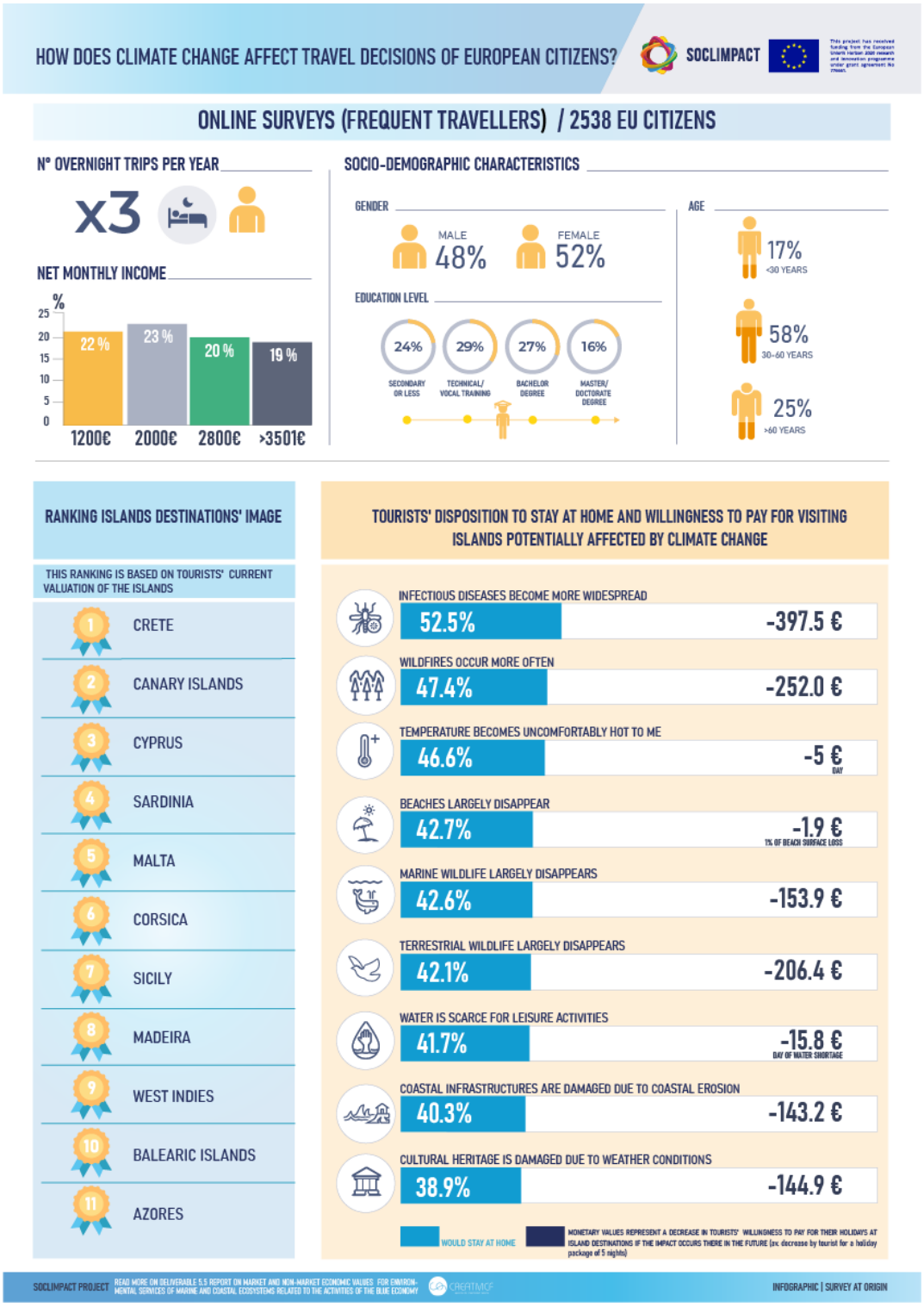


Figure 3.16: tourist's perception of the different islands

Tourists were asked in the survey to state their perception of the different islands, on a scale from 1(very negative perception) to 7 (very positive perception). In the successive question, they are asked their opinion of the islands, also on a scale from 1 to 7, with respect to the following characteristics: unpleasant/pleasant destination; gloomy/exciting destination.

When asked about the affective image of the destination, Crete is the one obtaining a higher punctuation.

Figure 3.17:Recent photos of impacts of climate change in the Region of Crete

Additionally, through the web seminars there was a linking of **SOCLIMPACT project** with **"Regional Plan for Adaptation on Climate Change and corresponding strategic study of environmental impacts"** of Region of Crete (a study which is in progress and the consultant attended both our webinars. The regional plan has targets:

- Systematization and improvement of the decision-making process (short-term and long-term) decisions related to the adaptation and their implementation in the actions of the Region of Crete
- Linking adaptation to promoting a sustainable development model
- Promoting adaptation actions and policies in all sectors of the economy with an emphasis on the most vulnerable
- Establish a mechanism for monitoring, evaluating and updating actions and adaptation policies
- Information and sensitization of the society

The goal is to use the findings of SOCLIMPACT Project and connect it with the Regional plan of Crete for Adaptation on climate change.

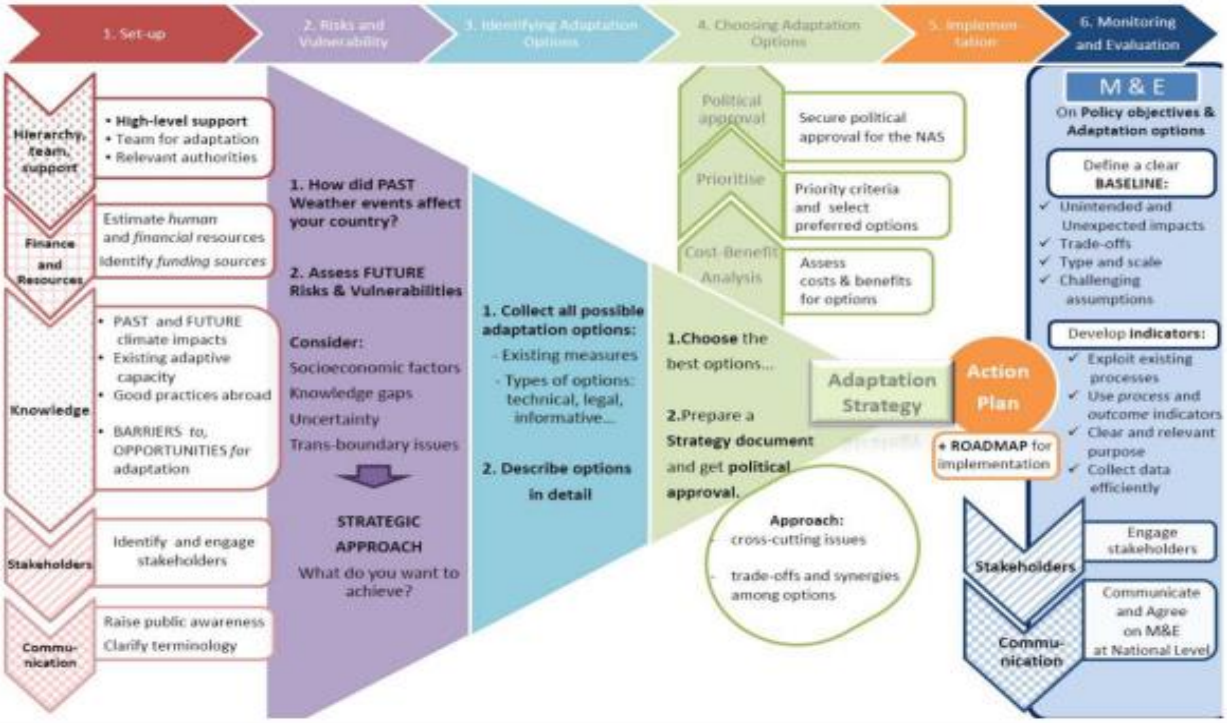


Figure 3.18: Steps of development of the Regional plan of Crete for adaptation on Climate Change

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This project has received funding from the European Union's Horizon 2020 research and innovation programme under Grant Agreement No776661

4 Final Adaptation Pathways

Each APT has a set of adaptation classes each one with two options/measures to choose from. Each individual stakeholder choices were clustered with other choices made by different stakeholders. If the majority of the stakeholders chose one option, then that measure is in the island adaptation pathway for that specific class in a given APT, per sector. The result for the series of choices in the three timeframes will define the pathway. If there is a tie between two options, then they were both be included and become part of the adaptation pathway in a given time frame. Furthermore, Local Knowledge measures will be included if they were chosen by at least 20% of all stakeholders.*

***Definition**: Measures which were chosen 50% or more per APT and per time frame*
Adaptation aims and used frameworks (Suckall et al. (2018)):
***(1) vulnerability reduction** - Five capitals of Sustainable Livelihoods Approach (SLA);*
***(2) Disaster Risk Reduction** - Hyogo and Sendai Frameworks;*
***(3) Social-Ecological Resilience** - Millennium Ecosystem Assessment (MEA) and Common International Classification of Ecosystem Services (CICES)*

4.1 Tourism

4.1.1 Selected Adaptation Pathways

Tourism pathways are based on choices made by 6 island stakeholders

ID	Name	Class number	Ratio	APT A			APT B			APT C			APT D		
				S	M	L	S	M	L	S	M	L	S	M	L
T1	Economic Policy Instruments (EPIs)	1	69%					B						D	
T2	Financial incentives to retreat from high-risk areas	1	31%					B						D	
T9	Activity and product diversification	2	74%		A			B			C			D	
T10	Public awareness programmes	2	26%		A			B			C			D	
T11	Local circular economy	3	72%								C				
T12	Tourist awareness campaigns	3	28%								C				
T14	Water restrictions, consumption cuts and grey-water recycling	4	81%								C			D	
T13	Local sustainable fishing	4	19%								C			D	
T15	Beach nourishment	5	67%					B							
T16	Desalination	5	33%					B							
T17	Coastal protection structures	6	53%		A			B			C			D	
T18	Drought and water conservation plans	6	47%		A			B			C			D	
T19	Mainstreaming Disaster Risk Management (DRM)	7	78%								C				
T20	Using water to cope with heat waves	7	22%								C				
T22	Health care delivery systems	8	56%		A										
T21	Fire management plans	8	44%		A										
T24	Pre-disaster early recovery planning	9	69%		A									D	
T23	Post-Disaster recovery funds	9	31%		A									D	
T4	Monitoring, modelling and forecasting systems	10	57%		A			B			C			D	
T3	Adaptation of groundwater management	10	43%		A			B			C			D	
T6	River rehabilitation and restoration	11	56%					B			C				
T5	Dune restoration and rehabilitation	11	44%					B			C				
T7	Adaptive management of natural habitats	12	67%								C				
T8	Ocean pools	12	33%								C				

Figure 4.1: Adaptation options for the tourism sector

Options are identified with an ID number, full name, and class of adaptation number. Adaptation objectives are identified in each option by colour: **vulnerability reduction (red),** Disaster **Risk Reduction (blue);**

Social-Ecological Resilience (green); Each ATP (APT A; APT B ;APT C; APT D) is represented in three timeframes: S - Short term (up to 2030), M- Medium term (up to 2050), L - Long term (until 2100). Bold letters in each ATP indicate the option was available to be selected. Highlighted options indicate the measure was selected in each ATP and timeframe: ATP A (light blue); ATP B (light green); ATP C (Light orange)and ATP D (light purple).Space with colour: option was selected for the timeframe: Short term, Medium term, or Long term. Bold letter: option is available in the APT.

Under APT B and D scenarios, the financial capital measures that were selected to address **vulnerability reduction**, indicate that the region of Crete is initially centred on the development of Economic Policy Instruments and later on Financial incentives to retreat from high risk areas.

To adapt via Human Capital (class 2), diversification of the activities and products in opposition to awareness campaigns should be implemented. However, in Minimum Intervention scenario (APT A) and Efficiency Enhancement scenario(APT C), investment in public awareness can be appropriate for short term.

For Social Capital (class 3), local circular economy gains relevance in all periods. This reflects the effort of the Region in the development of the circular economy on the island.

The option related with water restrictions and cuts (Natural Capital) was selected for all periods in a System Restructuring scenario (ATP D) and in an Efficiency Enhancement scenario(APT C) vs local sustainable fishing. This obviously reflects the Region's inability to take management measures for sustainable fishing as this depends exclusively on national and European regulations.

Beach nourishment was selected for all time periods within the Physical Capital options taken in APT B.

For **Disaster Risk Reduction**, and to manage long term risk, the decisions need to be sensible to the level of investment and reflects the climate change risk identified for the region. Coastal protection is a priority for the region throughout all the scenarios

The Efficiency Enhancement scenario (ATP C) is the only scenario which considers the Preparedness class. In all time periods, mainstreaming DRM was selected in detriment of using water to cope with heat waves. This result, follows the risk response rational, addressing disasters management in a first stage.

Health care delivery systems in Minimum Intervention scenario (APT A) over comes the Fire management plans with small difference and reflects the climate-risk context of the region with the covid-19 situation.

Generically, to address DRR on tourism sector, it is necessary to continue to promote planning and allocate funds to develop climate change resilience in the region.

In **Social-Ecological Resilience,** groundwater management is not urgent for the sector in the short term. The Region should in the next decades invest efforts in information systems to improve climate information reliability.

Options for regulation of natural services in the Tourism sector will benefit from the maintenance of the rivers/valleys functions, creating recreational areas with a positive impact on tourism attractiveness.

In medium investment and medium commitment to policy change scenario(APT C - Efficiency Enhancement) the region considered to dedicate efforts to preserve and minimize the impacts on biodiversity and ecosystems, while also preserving the attractiveness of the region.

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4.1.2 Most selected options

ID	Name	Class number	Ratio
T14	Water restrictions, consumption cuts and grey-water recycling	4	81%
T19	Mainstreaming Disaster Risk Management (DRM)	7	78%
T9	Activity and product diversification	2	74%
T11	Local circular economy	3	72%
T24	Pre-disaster early recovery planning	9	69%
T1	Economic Policy Instruments (EPIs)	1	69%
T7	Adaptive management of natural habitats	12	67%
T15	Beach nourishment	5	67%
T4	Monitoring, modelling and forecasting systems	10	57%
T6	River rehabilitation and restoration	11	56%
T22	Health care delivery systems	8	56%
T17	Coastal protection structures	6	53%
T18	Drought and water conservation plans	6	47%
T21	Fire management plans	8	44%
T5	Dune restoration and rehabilitation	11	44%
T3	Adaptation of groundwater management	10	43%
T16	Desalination	5	33%
T8	Ocean pools	12	33%
T2	Financial incentives to retreat from high-risk areas	1	31%
T23	Post-Disaster recovery funds	9	31%
T12	Tourist awareness campaigns	3	28%
T10	Public awareness programmes	2	26%
T20	Using water to cope with heat waves	7	22%
T13	Local sustainable fishing	4	19%

Figure 4.2: Analysis by symmetry

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APT	Class	Short term (up to 2030)	Medium term (up to 2050)	Long term (up to 2100)
A	2		(T9) Activity and product diversification	(T9) Activity and product diversification
	6		(T17) Coastal protection structures	(T17) Coastal protection structures
	8		(T22) Health care delivery systems	(T22) Health care delivery systems
	9	(T24) Pre-disaster early recovery planning	(T24) Pre-disaster early recovery planning	(T24) Pre-disaster early recovery planning
	10	(T4) Monitoring, modelling and forecasting systems	(T4) Monitoring, modelling and forecasting systems	(T4) Monitoring, modelling and forecasting systems
APT	**Class**	**Short term (up to 2030)**	**Medium term (up to 2050)**	**Long term (up to 2100)**
B	1	(T1) Economic Policy Instruments (EPIs)	(T1) Economic Policy Instruments (EPIs)	(T1) Economic Policy Instruments (EPIs)
	2	(T9)Activity and product diversification	(T9)Activity and product diversification	(T9)Activity and product diversification
	5	(T15)Beach nourishment	(T15)Beach nourishment	(T15)Beach nourishment
	6	(T17)Coastal protection structures	(T17)Coastal protection structures	(T17)Coastal protection structures
	10	(T4) Monitoring, modelling and forecasting systems	(T4) Monitoring, modelling and forecasting systems	(T4) Monitoring, modelling and forecasting systems
	11	(T6) River rehabilitation and restoration	(T6) River rehabilitation and restoration	(T6) River rehabilitation and restoration
APT	**Class**	**Short term (up to 2030)**	**Medium term (up to 2050)**	**Long term (up to 2100)**
C	2		(T9) Activity and product diversification	(T9) Activity and product diversification
	3	(T11) Local circular economy	(T11) Local circular economy	(T11) Local circular economy
	4	(T14)Water restrictions, consumption cuts and grey-water recycling	(T14)Water restrictions, consumption cuts and grey-water recycling	(T14)Water restrictions, consumption cuts and grey-water recycling
	6		(T17) Coastal protection structures	(T17) Coastal protection structures
	7	(T19)Mainstreaming Disaster Risk Management (DRM)	(T19)Mainstreaming Disaster Risk Management (DRM)	(T19)Mainstreaming Disaster Risk Management (DRM)
	10	(T4) Monitoring, modelling and forecasting systems	(T4) Monitoring, modelling and forecasting systems	(T4) Monitoring, modelling and forecasting systems
	11	(T6)River rehabilitation and restoration		
	12	(T7)Adaptive management of natural habitats	(T7)Adaptive management of natural habitats	(T7)Adaptive management of natural habitats
APT	**Class**	**Short term (up to 2030)**	**Medium term (up to 2050)**	**Long term (up to 2100)**
D	1	(T1) Economic Policy Instruments (EPIs)	(T1) Economic Policy Instruments (EPIs)	(T1) Economic Policy Instruments (EPIs)
	2	(T9)Activity and product diversification	(T9)Activity and product diversification	(T9)Activity and product diversification
	4	(T14)Water restrictions, consumption cuts and grey-water recycling	(T14)Water restrictions, consumption cuts and grey-water recycling	(T14)Water restrictions, consumption cuts and grey-water recycling
	6		(T17) Coastal protection structures	(T17) Coastal protection structures
	9		(T24) Pre-disaster early recovery planning	(T24) Pre-disaster early recovery planning
	10	(T4) Monitoring, modelling and forecasting systems	(T4) Monitoring, modelling and forecasting systems	

Figure 4.3: Table with description under the adaptation final pathway

APT A: Minimum intervention (low investment, low commitment to policy change)

APT B: Economic Capacity Expansion (high investment, low commitment to policy change)

APT C: Efficiency Enhancement (medium investment, medium commitment to policy change)

APT D: System Restructuring (high investment, high commitment to policy change)

4.1.3 Sustainability performance

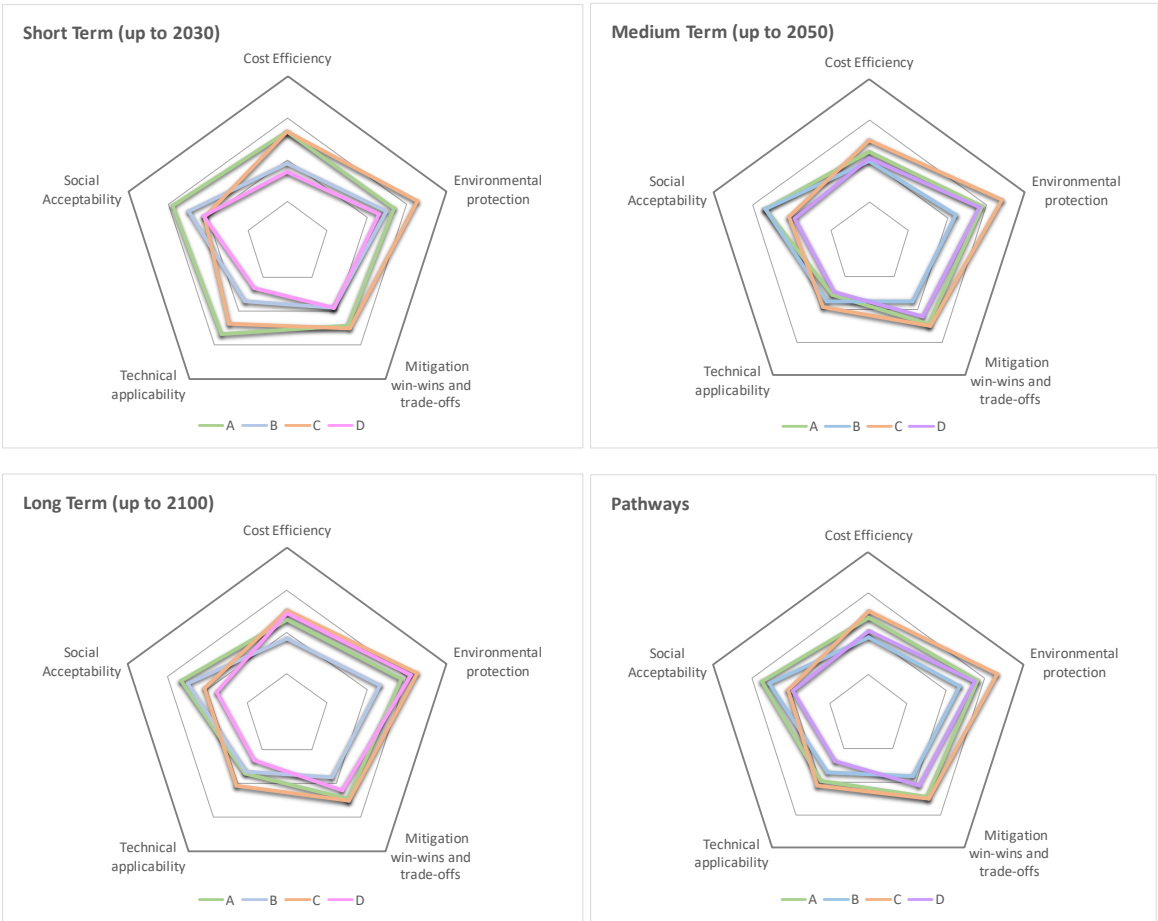

Figure 4.4: Pathways evaluation for tourism sector considering: Cost Efficiency; Environmental protection; Mitigation (GHG emissions) win-wins and trade-offs; Technical applicability; Social acceptability. The policy pathways scenarios: APT A - Minimum Intervention; APT B - Economic Capacity Expansion (ECE); APT C- Efficiency Enhancement (EE); APT D - System Restructuring (SR), for different timeframes: short, medium, and long term

All four adaptation pathways for Crete's tourism sector up to 2100 reveal a similar structure in terms of their sustainability performance. These pathways are comprised of measures that have a relatively high social acceptability and low technical acceptability and cost efficiency but performs well in terms of future environmental protection. These sector pathways will have difficulty in meeting the archipelago's mitigation

objectives although they perform well in terms of future environmental protection because they have low technical applicability up to 2100. This particularly relevant in APT A and D pathways, curiously those responding to scenarios with the lowest (highest) investment and policy change levels, respectively. In fact, the pathway with the highest investment and policy change levels and that preconizes a system restructuring (APT D) underperforms the other pathways in all sustainability criteria.

4.2 Maritime Transport

4.2.1 Selected Adaptation Pathways

Maritime Transport pathways are based on choices made by 5 island stakeholders

ID	Name	Class number	Ratio	APT A			APT B			APT C			APT D		
				S	M	L	S	M	L	S	M	L	S	M	L
MT2	Financial incentives to retreat from high-risk areas	1	60%					B						D	
MT1	Insurance mechanisms for ports	1	40%					B						D	
MT10	Social dialogue for training in the port sector	2	63%		A			B			C			D	
MT9	Awareness campaigns for behavioural change	2	37%		A			B			C			D	
MT12	Climate resilient economy and jobs	3	53%								C				
MT11	Diversification of trade using climate resilient commodities	3	47%								C				
MT13	Refrigeration, cooling and ventilation systems	4	50%								C			D	
MT14	Restrict development and settlement in low-lying areas	4	50%								C			D	
MT16	Increase operational speed and flexibility in ports	5	53%					B							
MT15	Sturdiness improvement of vessels	5	47%					B							
MT17	Climate proof ports and port activities	6	65%		A			B			C			D	
MT18	Consider expansion/retreat of ports in urban planning	6	35%		A			B			C			D	
MT20	Early Warning Systems (EWS) and climate change monitoring	7	60%								C				
MT19	Reinforcement of inspection, repair and maintenance of	7	40%								C				
MT22	Prepare for service delays or cancellations	8	80%		A										
MT21	Inteligent Transport Systems (ITS)	8	20%		A										
MT23	Backup routes and infrastructures during extreme weather	9	63%		A									D	
MT24	Post-Disaster recovery funds	9	37%		A									D	
MT3	Marine life friendly coastal protection structures	10	52%		A			B			C			D	
MT4	Combined protection and wave energy infrastructures	10	48%		A			B			C			D	
MT6	Coastal protection structures	11	60%					B			C				
MT5	Hybrid and full electric ship propulsion	11	40%					B			C				
MT7	Integrate ports in urban tissue	12	67%								C				
MT8	Ocean pools	12	33%								C				

Figure 4.5: Adaptation options for Maritime Transport sector

Options are identified with an ID number, full name, and class of adaptation number. Adaptation objectives are identified in each option by colour: ***vulnerability reduction (red),*** *Disaster* ***Risk Reduction (blue);Social-Ecological Resilience (green);*** *Each ATP(APT A; APT B;APT C; APT D) is represented in three timeframes: S - Short term (up to 2030),M- Medium term(up to 2050), L - Long term (until 2100). Bold letters in each ATP indicate the option was available to be selected. Highlighted options indicate the measure was selected in each ATP and timeframe: ATP A (light blue); ATP B (light green); ATP C (Light orange)and ATP D (light purple).Space with colour: option was selected for the timeframe: Short term, Medium term, or Long term. Bold letter: option is available in the APT.*

The maritime transport sector adaptation pathways are characterized by a heterogeneity across the four potential adaptation policy trajectories (APTs) which they built upon.

Vulnerability reduction under APT B and D scenarios, Region of Crete is initially centred on Financial incentives to retreat from high risk areas.

To adapt via Human Capital (class 2), social dialogue for training in the port sector in opposition to awareness campaigns should be implemented.

For Social Capital (class 3), is focus on trade diversification and climate resilient jobs.

Under the Efficiency Enhancing (APT C) scenario (medium investment and medium change in policy commitment)and the **System Restructuring (APT D)**after an initial focus on the preservation of

marketable natural resources via the investment in refrigeration and/or cooling systems there is a shift to restrictions to the development in high-risk areas (**natural capital**).

Crete's maritime transport pathway favours investments in the operationality and flexibility of ports in detriment of improvement on vessels (physical capital).

Disaster risk reduction focuses on **managing risks** via climate proofing of infrastructure and activities, while developing alternative routes during extremes events as a means of assuring **post-disaster recovery**. This strategy is complemented by **disaster responses** that include new procedures to handle service disturbances and the development of early warning systems.

Ecosystem resilience **and provisioning services** take the form of tailored protection structures, first by using marine life friendly materials and, coastal protection structures.

4.2.2 Most selected options

ID	Name	Class number	Ratio
MT22	Prepare for service delays or cancellations	8	80%
MT7	Integrate ports in urban tissue	12	67%
MT17	Climate proof ports and port activities	6	65%
MT23	Backup routes and infrastructures during extreme weather	9	63%
MT10	Social dialogue for training in the port sector	2	63%
MT6	Coastal protection structures	11	60%
MT20	Early Warning Systems (EWS) and climate change monitoring	7	60%
MT2	Financial incentives to retreat from high-risk areas	1	60%
MT16	Increase operational speed and flexibility in ports	5	53%
MT12	Climate resilient economy and jobs	3	53%
MT3	Marine life friendly coastal protection structures	10	52%
MT13	Refrigeration, cooling and ventilation systems	4	50%
MT14	Restrict development and settlement in low-lying areas	4	50%
MT4	Combined protection and wave energy infrastructures	10	48%
MT11	Diversification of trade using climate resilient commodities	3	47%
MT15	Sturdiness improvement of vessels	5	47%
MT1	Insurance mechanisms for ports	1	40%
MT19	Reinforcement of inspection, repair and maintenance of	7	40%
MT5	Hybrid and full electric ship propulsion	11	40%
MT9	Awareness campaigns for behavioural change	2	37%
MT24	Post-Disaster recovery funds	9	37%
MT18	Consider expansion/retreat of ports in urban planning	6	35%
MT8	Ocean pools	12	33%
MT21	Inteligent Transport Systems (ITS)	8	20%

Figure 4.6: Analysis by symmetry

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APT	Class	Short term (up to 2030)	Medium term (up to 2050)	Long term (up to 2100)
A	2	(MT10) Social dialogue for training in the port sector	(T1) Economic Policy Instruments (EPIs)	
	6	(MT17)Climate proof ports and port activities	(MT17)Climate proof ports and port activities	(MT17)Climate proof ports and port activities
	8	(MT22) Prepare for service delays or cancellations	(MT22) Prepare for service delays or cancellations	(MT22) Prepare for service delays or cancellations
	9	(MT23) Backup routes and infrastructures during extreme weather	(MT23) Backup routes and infrastructures during extreme weather	(MT23) Backup routes and infrastructures during extreme weather
	10	(MT3) Marine life friendly coastal protection structures	(MT3) Marine life friendly coastal protection structures	
APT	**Class**	**Short term (up to 2030)**	**Medium term (up to 2050)**	**Long term (up to 2100)**
B	1	(MT2)Financial incentives to retreat from high-risk areas	(MT2)Financial incentives to retreat from high-risk areas	
	2	(MT10) Social dialogue for training in the port sector	(MT10) Social dialogue for training in the port sector	(MT10) Social dialogue for training in the port sector
	5			(MT16) Increase operational speed and flexibility in ports
	6	(MT17)Climate proof ports and port activities	(MT17)Climate proof ports and port activities	
	10	(MT3) Marine life friendly coastal protection structures		
	11	(MT6)Coastal protection structures		
APT	**Class**	**Short term (up to 2030)**	**Medium term (up to 2050)**	**Long term (up to 2100)**
C	2	(MT10) Social dialogue for training in the port sector	(MT10) Social dialogue for training in the port sector	
	3	(MT12) Climate resilient economy and jobs		(MT12) Climate resilient economy and jobs
	4	(MT13) Refrigeration, cooling and ventilation systems	(MT13) Refrigeration, cooling and ventilation systems	
	4			(MT14) Restrict development and settlement in low-lying areas
	6	(MT17)Climate proof ports and port activities	(MT17)Climate proof ports and port activities	
	7		(MT20) Early Warning Systems (EWS) and climate change monitoring	(MT20) Early Warning Systems (EWS) and climate change monitoring
	10	(MT3)Marine life friendly coastal protection structures	(MT3)Marine life friendly coastal protection structures	
	11	(MT6) Coastal protection structures	(MT6) Coastal protection structures	
	12	(MT7) Integrate ports in urban tissue	(MT7) Integrate ports in urban tissue	
APT	**Class**	**Short term (up to 2030)**	**Medium term (up to 2050)**	**Long term (up to 2100)**
D	1	(MT2)Financial incentives to retreat from high-risk areas	(MT2)Financial incentives to retreat from high-risk areas	(MT2)Financial incentives to retreat from high-risk areas
	2	(MT10) Social dialogue for training in the port sector	(MT10) Social dialogue for training in the port sector	(MT10) Social dialogue for training in the port sector
	4	(MT13) Refrigeration, cooling and ventilation systems		
	4		(MT14) Restrict development and settlement in low-lying areas	(MT14) Restrict development and settlement in low-lying areas
	6	(MT17)Climate proof ports and port activities		
	9		(MT23) Backup routes and infrastructures during extreme weather	(MT23) Backup routes and infrastructures during extreme weather
	10	(MT3)Marine life friendly coastal protection structures		

Figure 4.7: Description under the adaptation final pathway.

APT A: Minimum intervention (low investment, low commitment to policy change)

APT B: Economic Capacity Expansion (high investment, low commitment to policy change)

APT C: Efficiency Enhancement (medium investment, medium commitment to policy change)

APT D: System Restructuring (high investment, high commitment to policy change)

4.2.3 Sustainability performance

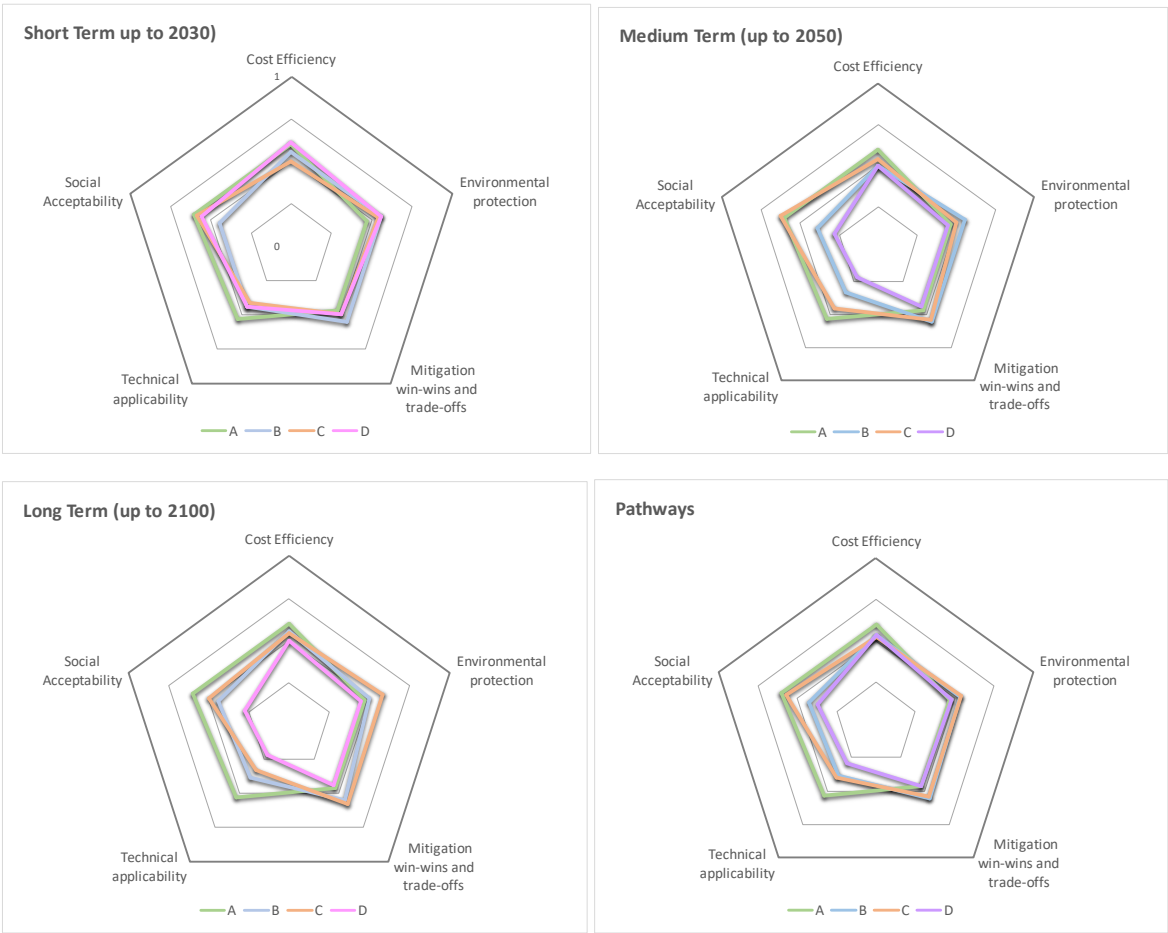

Figure 4.8: Pathways evaluation for Maritime Transport sector considering: Cost Efficiency; Environmental protection; Mitigation (GHG emissions) win-wins and trade-offs; Technical applicability; Social acceptability. The policy pathways scenarios: APT A - Minimum Intervention; APT B - Economic Capacity Expansion (ECE); APT C- Efficiency Enhancement (EE); APT D - System Restructuring (SR), for different timeframes: short, medium, long term

All four adaptation pathways for the Crete's maritime transport sector up to 2100 reveal a similar structure in terms of their sustainability performance. These pathways are comprised of measures that have a relatively medium **social acceptability** and **cost efficiency** and low **technical acceptability**. These sector

pathways will have difficulty in performing well in terms of future **environmental protection because they have low technical applicability.** This particularly relevant in APT B, C and D pathways, responding to scenarios with the medium and high investment and policy change levels. The pathway with the highest investment and policy change levels and that preconizes a system restructuring (APT D) underperforms the other pathways in all sustainability criteria.

5 Discussion and Conclusions

The two regional workshops held in Crete helped determine the most appropriate measures to be included in several adaptation pathways for the tourism and maritime transport sectors based on the degree of commitment to policy change and level of investment across three timeframes: the short-term (until 2030), the mid-term (until 2050), and the long-term (until 2100).

For the tourism sector, stakeholders selected Water restrictions, consumption cuts and grey-water recycling as one of the most important measures to be included in the adaptation pathways despite being available only for APT C and APT D. Mainstreaming Disaster Risk Management (DRM) it is an option only available in APT C, but it is considered as a priority. Activity and product diversification and Monitoring, modelling and forecasting systems are both selected for all timeframes regardless of the adaptation pathway.

For the maritime transport sector prepare for service delays or cancellations was selected by stakeholders as an important measure to be included in APT A in all timeframes as it was considered a sensible action to take. Interestingly Climate proof ports and port activities, is available in all APTs and was included for all timeframes of APT A, and the short term of APT B,APT C and APT D. Coastal protection structures and Marine life friendly coastal protection structures were both included in short and medium time frames.

6 Regional workshops- Webinars

6.1 1st Webinar

1st Webinar Objectives

1. The context of the Project: Sectors, Models and Outputs
2. Background material to support your decisions
3. Present the Online Survey Tool
4. Design of adaptation pathways for Crete
5. Adaptation options up to 2030, 2050 and until the end of the century
6. How to fill in and submit the Online Survey Tool

1st Webinar Agenda

6.2 2nd Webinar

2nd Webinar Objectives

- Present the final Pathways Adaptation
- Discuss the Pathways Adaptation results on Tourism and Maritime Transport Sectors
- Discuss about the Pathways Adaptation application within Covid-19 context

2nd webinar agenda

6.3 List of participants

First Name	Last Name	Organization	Sectors
George	Alexakis	Region of Crete	All
Maria	Symeonidou	Heraklion Chamber of Commerce and Industry	All
Pepi	Birliraki	Municipality of Rethymno	All
Lina	Anezaki	Region of Crete	SCP
Aristides	Stratakis	Region of Crete	SCP
Maria	Kalaitzaki	Region of Crete	SCP
Aliki	Karousou	Region of Crete	SCP
Eleni	Hatziyanni	DG Mare	All
Eleni	Kargaki	Region of Crete	All
Antonis	Sakalis	Enviroplan	All
Artemisia	Skoumpaki	Harbour Management Organisation of Perfecture of Chania	All
Ioannis	Verikokidis	Department of Civil Protection in Regional Unit of Chania	All
Manolis	Lamprakis	Fisheries Department Region of Crete	All
Maria	Mastronikola	Aldemar Resorts	Tourism
Anna	Karali	NOA	SCP
Ioannis	Charalampidis	E3M	SCP

This project has received funding from the European Union's Horizon 2020 research and innovation programme under Grant Agreement No776661

SOCLIMPACT

Downscaling climate impacts and decarbonisation pathways in EU islands, and enhancing socioeconomic and non-market evaluation of Climate Change for Europe, for 2050 and beyond

SOCLIMPACT

This project has received funding from the European Union's Horizon 2020 research and innovation programme under Grant Agreement No776661

Work Package 7:

This is a result of Tasks 7.3. This deliverable will include the agendas, the list of participants, and the workshops outputs including the decisions taken.

Deliverable 7.3.

Workshop report - Cyprus

Island Focal Point:

Cyprus	**INTERFUSION**	**Constantinos Stylianou; Haris Neophytou; Yiannis Konnaris**

1 Introduction

This deliverable reports the process of the co-development of Climate Change sector adaptation pathway trajectories with stakeholders in Cyprus. The process describes the two regional workshops that were conducted: the first to present to the stakeholders the project's results and the survey tool for collecting adaptation options choices, and the second to present them with the analysis of adaptation options after aggregating stakeholders' choices and discussion of the pathways. These regional workshops are part of SOCLIMPACT Task 7.3 - Engage islands' stakeholders in the design of alternative pathways and were organized by Interfusion Services (the Island Focal Point(IFP) of Cyprus) with the support of the Cyprus Institute. The workshops used the background material prepared in SOCLIMPACT Task 7.2 - Background material for regional workshops and include the main results from previous WPs.

The key objectives of the regional workshops were to:

1. Identify and present the packages of adaptation and risk management options for the island, up to 2030 (short-term), then until 2050 (mid-term) and, finally, until the end of the century (long-term).
2. Develop detailed integrated adaptation pathways for Cyprus, which should include trade-offs with decarbonization policies, again for the short-, mid-, and long-term.
3. Evaluate and rank pathways for selected Blue Economy sectors, namely for tourism and energy.

The two regional workshops in Cyprus were conducted online in Greek. Originally, the workshops were planned to be held as physical meetings; however, the decision to have the workshops online was taken due to the COVID-19 pandemic and the subsequent health and travel limitations that were imposed. In addition, a survey was developed to facilitate the collection of data regarding the adaptation pathways from the stakeholders. The first workshop was held on 13 October 2020 and the second workshop took place on 5 November 2020.

The demonstration of the survey tool took place during the first regional workshop. To begin with, researchers explained to the stakeholders the concept of Adaptation Policy Trajectories (APTs) and how they were formed and adapted for SOCLIMPACT. The researchers then explained the twelve classes of adaptation so that the stakeholders could better understand how and why they would provide their choices for adaptation measures. Next, the four APTs narratives were presented in detail emphasizing which specific classes of adaptation were relevant in each case. After this, the stakeholders were shown the list of adaptation options available for each class of adaptation involved in each APT and the process of selecting one of the two options for the three available time horizons (short-term, mid-term and long-term). Throughout the workshop, the stakeholders were given additional material prepared by partners for reference, such as the infographics and videos available, that were to be used by the stakeholders to make more informed decisions. This material is provided in section 2.

The survey tool was distributed to participating stakeholders by email shortly after the conclusion of the online meeting with instructions on how to complete and return it for processing. Each stakeholder was provided with the survey corresponding to their sector. Once all surveys were collected from the stakeholders, the options were aggregated per sector for each time horizon as explained in section 4.

2 Summary of Background Material

This section presents all the relevant information used during the first regional workshops provided to the stakeholders to support their decisions for selecting adaptation options, and, subsequently, the formation of the adaptation pathways for Cyprus.

2.1 Adaptation Policy Trajectories, Objectives, and Adaptation Classes

An introduction was given to the concept of Climate Change adaptation policy trajectories that was based on the framework developed by Suckall et al. (2018) and the two main axes affecting the policy decision-making process, namely, the level of investment and the level of commitment to significant policy change.

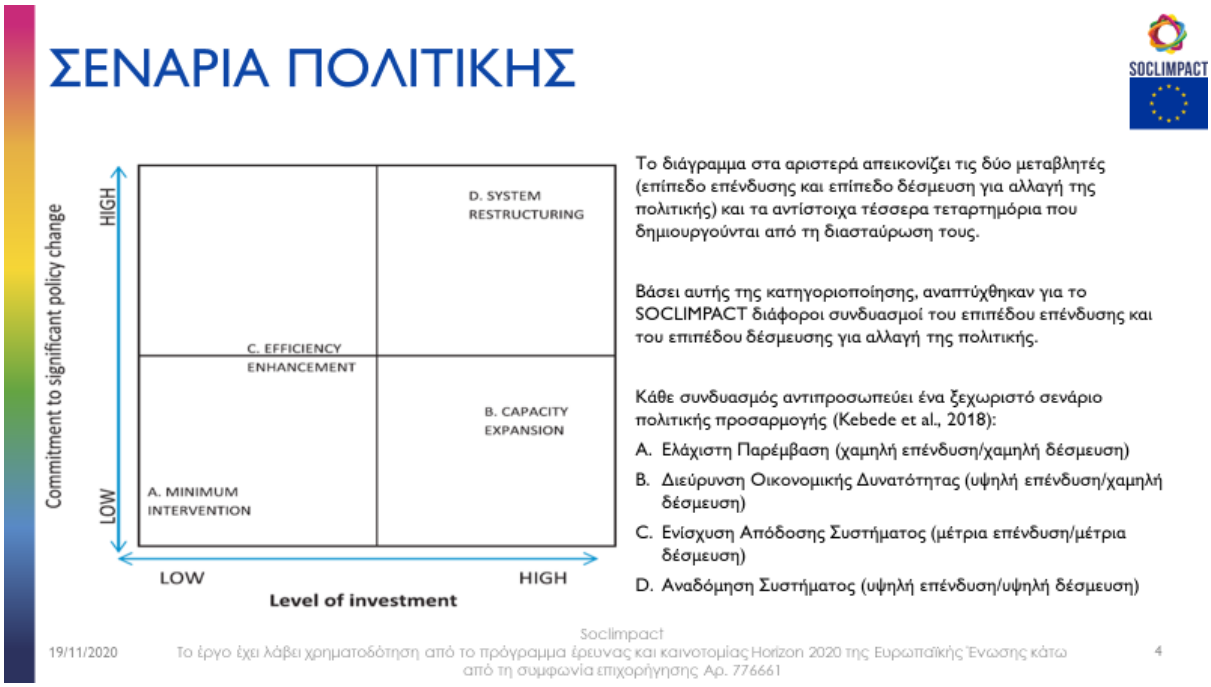

Figure 105: Introduction to adaptation policy trajectories.

The three objectives of Climate Change adaptation (vulnerability reduction, disaster risk reduction, and social-ecological resilience) were also explained together with the various adaptation classes that comprise each objective.

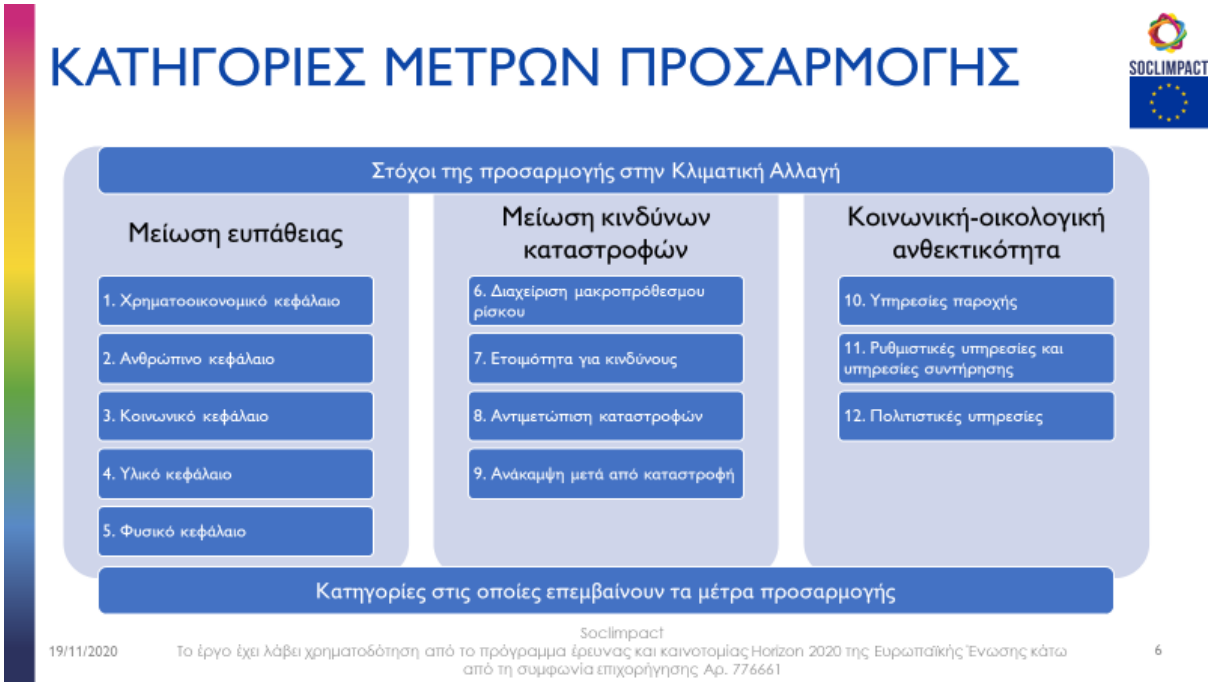

Figure 106: The three objectives of Climate Change adaptation and twelve classes of adaptation.

2.2 Evaluation Criteria

The stakeholders were also presented with the five criteria that are used for the evaluation of each adaptation measure, which in turn would characterize the sustainability performance of each adaptation pathway. The criteria are displayed in Table 13.

Table 13: Description of the criteria used to evaluate the adaptation pathways performance.

Criteria	Description	
Cost Efficiency	Ability to efficiently address current or future climate hazards/risks in the most economical way.	Higher score = higher cost efficiency
Environmental protection	Ability to protect the environment, now and in the future.	Higher score = higher environmental protection
Mitigation (GHG emissions) win-wins and trade-offs	Current ability to meet (win-win) or not (trade-off) Cyprus' mitigation objectives.	Higher score = higher mitigation win-wins and lower trade-offs
Technical applicability	Current ability to technically implement the option/measure in Cyprus.	Higher score = higher technical applicability
Social acceptability	Current social acceptability of the option/measure in Cyprus.	Higher score = higher social acceptability

2.3 Project Results

Several project results were presented to stakeholders that were taken mainly from the background material developed during D7.2 for the purpose of helping stakeholders make their decisions regarding adaptation options. The results concerned climate, socio-economic and adaptation information (shown in Table 14).

Table 14: Summary of the supporting information presented to stakeholders.

Variable	Description	Source
Humidity index	Measure of the number of days with humidex greater than 35 degrees C, which could result in conditions of discomfort and imminent danger for humans.	D4.3 Atlases of newly developed hazard indices and indicators
Beach reduction	Measure of the effect of sea level rise and wind wave on coastal areas resulting in projected percentage of beach loss.	D4.4d Report on the evolution of beaches
Vector suitability index	Measure of how favourable future climatic conditions for will be for the Asian Tiger mosquito.	D4.3 Atlases of newly developed hazard indices and indicators
Fire weather index	Measure of the danger of fire (FWI).	D4.4e Report on potential fire behaviour and exposure
Seagrass evolution	Measure of the density of seagrass (Posidonia) per sq. km located in the coasts of the island	D4.4e Report on estimated seagrass density
Tourists' reaction to Climate Change	Measure of the percentage of tourists stating that they would change destination and their willingness to pay extra per day for the implementation of adaptation measures in order to ameliorate climate impacts.	D5.5 Market and non-market analysis (surveying)
Cooling degree days	Measure of how much (in degrees), and for how long (in days), outdoor air temperature is higher than 18°C.	D4.3 Atlases of newly developed hazard indices and indicators
Photovoltaic productivity (land and sea)	Measure of the energy produced yearly over the installed power capacity.	D4.4a Report on solar and wind energy
Standardized precipitation-evapotranspiration index	Measure of the increases in water demand for islands' residents, tourists, and agriculture, while it also provides an indication on the available water stored in dams or underground resources.	D4.3 Atlases of newly developed hazard indices and indicators
Energy droughts (land, sea and combined)	Measure of the mean frequency of severe productivity drought days (%) in the reference period, as well as the estimations of the ensemble mean frequency of drought days (%) for the RCP scenarios.	D4.4a Report on solar and wind energy
Extreme temperatures	Measure of the percentage of days per year when the mean daily temperature is above the 98th percentile of mean daily temperature.	D4.3 Atlases of newly developed hazard indices and indicators
Wind energy productivity (land and sea)	Measure of wind energy produced per year divided by the power capacity installed in kWh/kW.	D4.4a Report on solar and wind energy
Energy demand for cooling buildings	Measure of the energy in GWh/year needed to cool buildings.	D5.5 Market and non-market analysis (surveying)
Desalination energy demand	Measure of the energy in GWh/year needed to produce more drinking water.	D5.5 Market and non-market analysis (surveying)

Stakeholders were provided with information in the survey tool regarding the **climate outlook** of the island, which includes details such as the average temperature and precipitation, wind speed, and wind rose. The information can be found in the climate factsheet here.

In addition, stakeholders were given a **catalogue of hazard indicators** for different Climate Change scenarios and time horizons, which were generated as part of WP4. For the energy sector (Figure 107), indicators such as cooling degree days and photovoltaic productivity (land and sea) were provided. This information is explained in detail in the energy factsheet here. For the tourism sector (Figure 108), indicators such as beach reduction and humidity index were provided. The tourism factsheet here contains an in-depth presentation of this information.

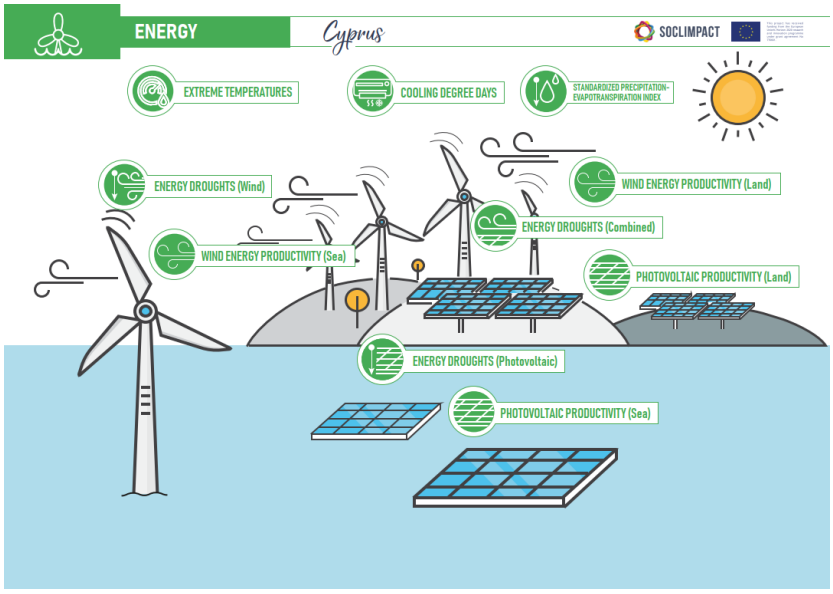

Figure 107: Hazards indicators for the energy sector presented to stakeholders in Cyprus.

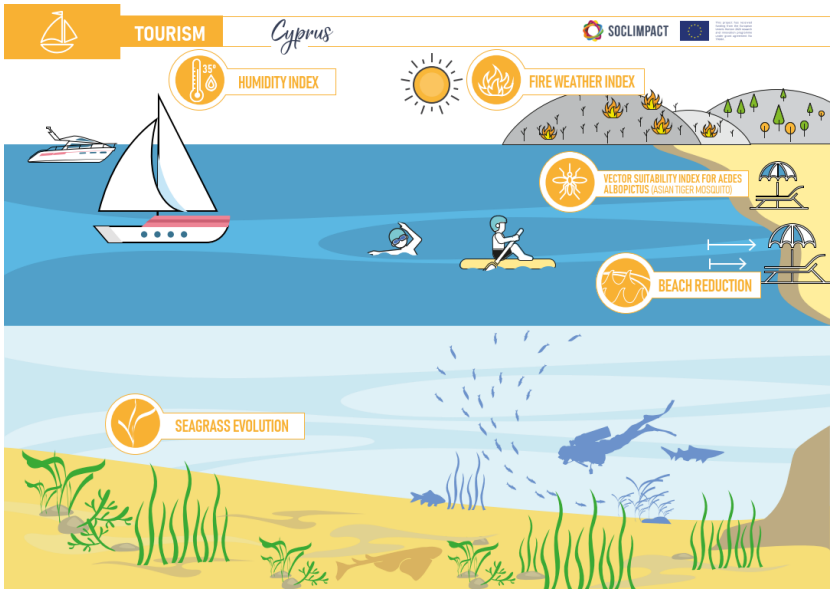

Figure 108: Hazards indicators for the tourism sector presented to stakeholders in Cyprus.

The climate-related information concluded with presentations of the **impact chains** of each sector constructed in WP3 and operationalized in WP4. Specifically, for the energy sector, this included one risk, namely, the risk of increased energy demand due to increased cooling and desalination demand. For the tourism sector, this included three risks: the risk of loss of competitiveness of destinations due to a decrease in thermal comfort, the risk of loss of attractiveness due to the degradation of marine habitats, and the risk of loss of attractiveness due to increased danger of forest fires in touristic areas. All impact chains and corresponding operationalizations are reported here.

Finally, several **socio-economic results** were presented. For the energy sector these included the estimations of changes in energy demand for cooling buildings and water supply under different Climate Change scenarios and time horizons. Both projections are analysed here. For the tourism sector, information regarding Climate Change impacts on tourists' choice and expenditure decision at the island were presented. This information was obtained after analysing tourists' responses to a survey and contains values representing an extra payment per day/tourist above the current expenses if adaptation measures were to be implemented to mitigate climate impacts. The results of the survey are available here. This was accompanied with the report on how Climate Change could affect travel decisions of European citizens towards island destinations, which can be found here.

3 Sector Adaptation Pathways

3.1 Tourism

The adaptation pathways for the tourism sector were developed based on the choices made by six expert stakeholders from various organizations and SMEs, including the Cyprus Sustainable Tourism Initiative, the Cyprus Tourism Organization and the Cyprus Marine Environment Protection Association.

3.1.1 Selected Adaptation Pathways

Based on the choices of the stakeholders, the adaptation pathways for the tourism sector in Cyprus seem to be consistent with the characteristics of the adaptation pathway trajectories (APTs).

ID	Name	Class number	APT A			APT B			APT C			APT D		
			S	M	L	S	M	L	S	M	L	S	M	L
T1	Economic Policy Instruments (EPIs)	1					**B**						**D**	
T2	Financial incentives to retreat from high-risk areas	1					**B**						**D**	
T9	Activity and product diversification	2		**A**			**B**			**C**			**D**	
T10	Public awareness programmes	2		**A**			**B**			**C**			**D**	
T11	Local circular economy	3								**C**				
T12	Tourist awareness campaigns	3								**C**				
T14	Water restrictions, consumption cuts and grey-water recycling	4								**C**			**D**	
T13	Local sustainable fishing	4								**C**			**D**	
T15	Beach nourishment	5					**B**							
T16	Desalination	5					**B**							
T18	Drought and water conservation plans	6		**A**			**B**			**C**			**D**	
T17	Coastal protection structures	6		**A**			**B**			**C**			**D**	
T20	Using water to cope with heat waves	7								**C**				
T19	Mainstreaming Disaster Risk Management (DRM)	7								**C**				
T22	Health care delivery systems	8		**A**										
T21	Fire management plans	8		**A**										
T24	Pre-disaster early recovery planning	9		**A**									**D**	
T23	Post-Disaster recovery funds	9		**A**									**D**	
T4	Monitoring, modelling and forecasting systems	10		**A**			**B**			**C**			**D**	
T3	Adaptation of groundwater management	10		**A**			**B**			**C**			**D**	
T5	Dune restoration and rehabilitation	11					**B**			**C**				
T6	River rehabilitation and restoration	11					**B**			**C**				
T7	Adaptive management of natural habitats	12								**C**				
T8	Ocean pools	12								**C**				

Figure 109: Adaptation options for the tourism sector. Options are identified with an ID number, full name, and class of adaptation number. Adaptation objectives are identified in each option by colour: vulnerability reduction (red), disaster risk reduction (blue); social-ecological resilience (green). Each APT (A-D) is represented as three timeframes: S – short-term (until 2030), M – mid-term (until 2050), L – long-term (until 2100). Bold letters in each APT indicate the option was available to be selected. Highlighted cells indicate the measure was selected for the corresponding APT for the particular timeframe: APT A (light blue); APT B (light green); APT C (light orange) and APT D (light purple).

For the case of APT A, vulnerability reduction is achieved via human capital and specifically, by implementing programmes to raise public awareness in the short-term, though the diversification of tourist activities and products are deemed necessary in the mid- and long-term to combat the issue of seasonality

that is heavily observed on the island. Measures for disaster risk reduction are almost identical for all three timeframes of APT A. Specifically, drought and water conservation plans are recommended in this APT as it is considered a more feasible and cost-efficient option for managing long term risk, particularly as Cyprus will face an increase in temperature. Similarly, Pre-disaster early recovery planning is preferred as a means to deal with post-disaster recovery and rehabilitation. The reason being that proactive measures (such as best practices and knowledge bases) rather than reactive measures will be less costly and more environmentally protective, thus safekeeping the attractiveness of Cyprus as a tourist destination. With regards to response adaptation, the short-term option of fire management plans is generally beneficial for the island given the Fire Weather Index (FWI) projections. However, the mid-term and long-term measure should focus on reinforcing and improving the healthcare delivery system in order to deal with the possible increase in heatstroke episodes that the risk of rise in temperature will cause. Finally, for satisfying the social-ecological resilience objective, stakeholders opted for monitoring, modelling, and forecasting systems as the measure for provisioning services for all three timeframes. It is deemed necessary that reliable and timely climate information and the ability to assess climate hazard impacts under this APT (low commitment and low investment) would be more suitable for mitigating GHG emissions, as well as a more technically applicable and socially acceptable measure.

For the case of APT B, vulnerability reduction consists of adaptation via financial capital, human capital, and physical capital. Stakeholders recommended economic policy instruments (EPIs) as a financial capital measure throughout the three timeframes given that high investment is a characteristic of this APT. This is due to climate hazard projections indicating that risks will be continually increasing. Also, financial incentives to retreat from high-risk areas is not considered to be as a socially accepted or technically applicable measure. With respect to human capital, the implementation of public awareness programmes is a desired measure for the short-term, whereas activity and product diversification is more suitable for the mid- and long-term. Again, it is important to deal with the issue of seasonality but also to be in line with commitments to the Paris Agreement and EU directives. The only class of adaptation for disaster risk reduction involves managing long-term risk. Here, the short- and mid-term option selected for this APT (low commitment, high investment) is the construction of coastal protection structures, mainly because the SLR and wind wave projections indicate extensive beach reduction at coastal areas, which in turn would decrease the attractiveness of the island as a tourist destination. For the long-term, the development of drought and water conservation plans is the most appropriate measure, again, based on the increase in mean daily temperature on the island. Regarding social-ecological resilience, provisioning services and regulating and maintenance services are the two adaptation classes involved. For adaptation via provisioning services, monitoring, modelling, and forecasting systems was chosen as the measure for all three timeframes. For adaptation via regulating and maintenance services, the measure chosen was dune restoration and rehabilitation for all three timeframes. In addition, for the long-term the pathway also includes the measure for river rehabilitation and restoration given that in the future there will be both higher temperatures and water demand. Hence this measure will increase available leisure areas for improved thermal comfort and also increase water availability.

For the case of APT C, vulnerability reduction includes human capital, social capital, and natural capital. With respect to adaptation via human capital, this pathway includes the same choices of APT B for the same reasons, that is, public awareness programmes for the short-term, but activity and product diversification for the mid- and long-term. For social capital adaptation, the most suitable short-term measure is the preparation of tourist awareness campaigns to inform tourists about Climate Change. This measure, while not directly protecting the environment or the mitigating GHG emissions, is more relevant in the short-term since changing visitors' attitudes and behaviours is considered a more immediate action. In the mid- and long-term, the creation of a local circular economy is preferred since it becomes more vital to promote and adopt decarbonization practices through waste elimination and continual resource utilization. As for adaptation via natural capital, stakeholders recommend the pathway water restrictions, consumption cuts and grey-water recycling for all three timeframes. This measure will be able to tackle the issue of increases in water demand as a result of extremely dry weather (based on SPEI projections) in the future. Disaster risk reduction is achieved through managing long-term term risk and preparedness. The

most appropriate measure for managing long-term risk was chosen to be the construction of coastal protection structures up until 2030, whereas the development of drought and water conservation plans up were chosen as the most suitable until both 2050 and 2100. This is similar to the choices for APT B, with the only difference being the mid-term measure. Since APT C has medium commitment and medium investment (as opposed to high investment in APT B) the construction of coastal protection structures is considered a more costly adaptation measure. Adaptation via preparedness contains the measure using water to cope with heat waves for all three timeframes. Additionally, for the mid-term mainstreaming disaster risk management is also included in this pathway. All three classes of adaptation concerning social-ecological resilience are included in APT C. For provisioning services adaptation, similarly to APTs A and B, all three timeframes consist of the measure for implementing monitoring, modelling, and forecasting systems. For adaptation via regulating and maintenance services, the measure for dune restoration and rehabilitation is chosen for all three timeframes. Moreover, the mid- and long-term also include the measure for river rehabilitation and restoration based on the forecasts for temperature and water demand (both increasing). Finally, for cultural services adaptation, the preferred measure is adaptive management of natural habitats in order to deal with the impacts and pressures of human activities on the island's biodiversity and ecosystems that are aggravated by Climate Change. This measure is more relevant based on the projections for hazards like fire weather index, seagrass evolution, and beach reduction.

For APT D, financial capital, human capital, and natural capital are the classes of adaptation contributing towards vulnerability reduction. For financial capital adaptation, similarly to APT B, implementing economic policy instruments is the most suitable measure for all three timeframes since it is technically easier to apply and considered to be more socially acceptable. Furthermore, this specific APT assumes high investment and high commitment, therefore the measure is also cost-effective. For adaptation via human capital, stakeholders suggest the improving the activity and product diversification of the island for all three timeframes. Since there will be high commitment to policy change, as well as more investment, this measure is more suitable to deal with seasonality, infrastructure overload, and the burden on ecosystems that the tourism industry faces. With regards natural capital adaptation, water restrictions, consumption cuts, and grey-water recycling is a more appropriate measure for the short-term since it will be necessary to deal with the increase in temperature and water demand. However, the mid- and long-term will benefit from measures promoting local sustainable fishing. The restructuring of the system will protect ecosystem services and decrease external dependency. Adaptations to deal with disaster risk reduction concern managing long-term risks and post-disaster recovery and rehabilitation. For the former, the construction of coastal protection structures will serve the island better in short-term, as there will be a need to protect the coast from beach reduction. If this is taken care of, then focus can shift towards development of drought and water conservation plans in the mid- and long-term to combat the problem of rising temperatures and water demand in the future. For the latter, just as in APT A, post-disaster early recovery planning is the most appropriate measure for the same reasons – maintaining Cyprus as an attractive tourist destination. With respect to social-ecological resilience, provisioning services is the only contributing class of adaptation. Here, for the short- and mid-term, it is preferred to invest in the development of monitoring, modelling, and forecasting systems so that accurate climate data is obtained as fast as possible. However, in the long-term, a measure for adaptation of groundwater management will offer better environmental protection.

3.1.2 Sustainability Performance

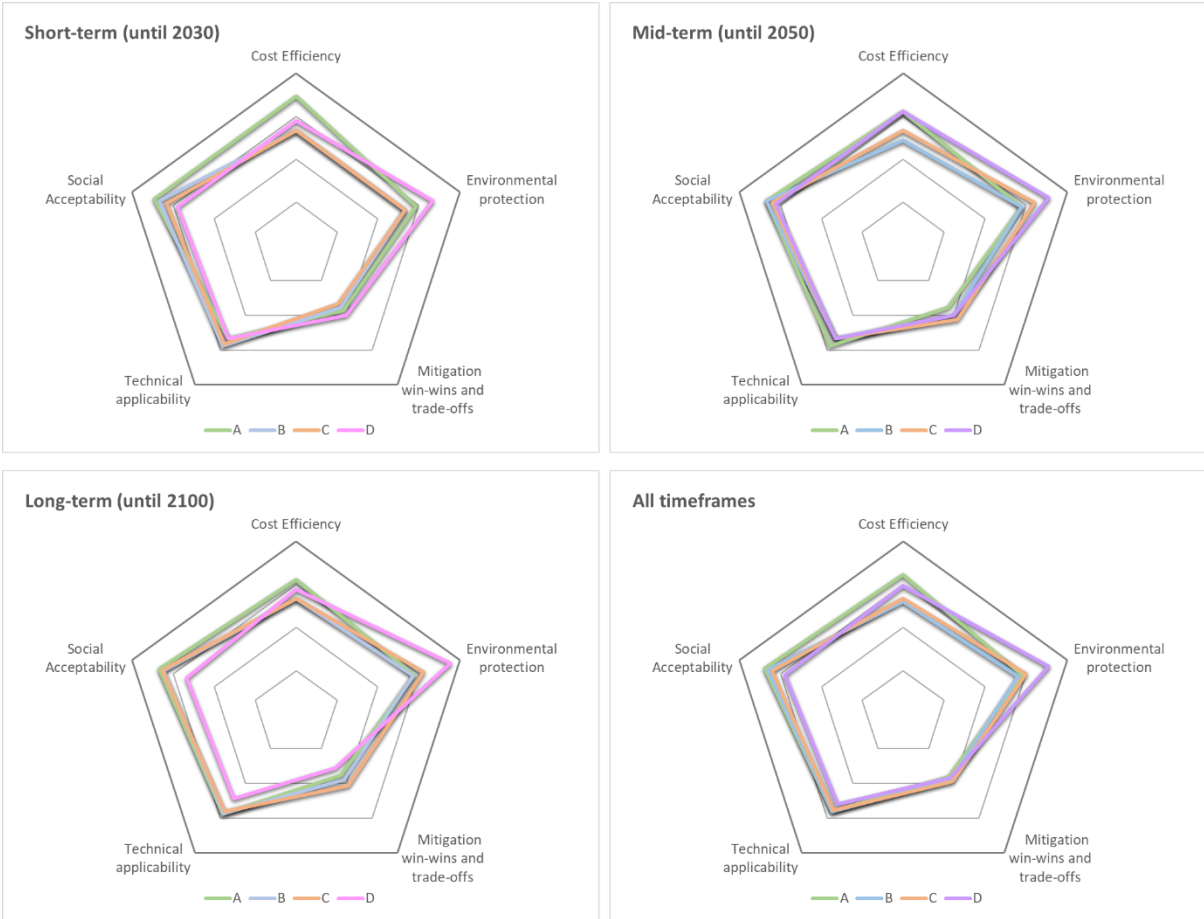

Figure 110: Pathways evaluation for the tourism sector considering the five criteria: cost efficiency, environmental protection, mitigation (GHG emissions) win-wins and trade-offs, technical applicability, and social acceptability. The adaptation pathway trajectory scenarios: APT A - Minimum Intervention; APT B - Economic Capacity Expansion; APT C - Efficiency Enhancement; APT D - System Restructuring, for different timeframes: short-term, mid-term, and long-term.

The four APTs perform similarly to a large degree in all three timeframes with respect to the evaluation of the five criteria. Overall, it can be observed that the four APT scenarios have a low-to-average level of mitigation (GHG emissions) win-wins and trade-offs. In addition, they exhibit an average-to-high performance with regards to cost efficiency, technical applicability, and social acceptability. Finally, the scenarios have a high level of environmental protection.

APT A consists of adaptation measures that have been evaluated with:

- a high level of social acceptability and cost efficiency.
- an average-to-high level of environmental protection and technical applicability.
- a low-to-average level of mitigation (GHG emissions) win-wins and trade-offs.

APT B consists of adaptation measures that have been evaluated with:

- a high level of social acceptability.
- an average-to-high level of cost efficiency, environmental protection, and technical applicability.
- a low-to-average level of mitigation (GHG emissions) win-wins and trade-offs.

APT C consists of adaptation measures that have been evaluated with:

- a high level of social acceptability.

- an average-to-high level of cost efficiency, environmental protection, and technical applicability.
- a low-to-average level of mitigation (GHG emissions) win-wins and trade-offs.

APT D consists of adaptation measures that have been evaluated with:

- a high level of environmental protection.
- an average-to-high level of cost efficiency, technical applicability, and social acceptability.
- a low-to-average level of mitigation (GHG emissions) win-wins and trade-offs.

Given that APT A is characterized by low investment and low commitment it is expected that the measures included in this scenario are not ranked highly with respect to their ability to mitigate emissions and protect the environment. APT D, on the other hand, consists of measures that are rated highly with respect to environmental protection, which is in line with the high commitment and high investment assumed in this pathway trajectory.

3.2 Energy

The adaptation pathways for the energy sector were developed based on the choices made by four expert stakeholders. The stakeholders involved were from research organizations and government services, such as the Cyprus Institute and the Energy Department of the Ministry of Energy, Commerce and Industry.

3.2.1 Selected Adaptation Pathways

By analysing the adaptation measures chosen by stakeholders, the adaptation pathways for the energy sector in Cyprus are fairly heterogenous, though there are some instances where some options are chosen irrespective of the characteristics of their adaptation pathway trajectories (APTs).

ID	Name	Class number	APT A			APT B			APT C			APT D		
			S	M	L	S	M	L	S	M	L	S	M	L
E1	Financial support for buildings with low energy needs	1					B						D	
E2	Financial support for smart control of energy in houses and	1					B						D	
E9	Green jobs and businesses	2		A			B			C			D	
E10	Public information service on climate action	2		A			B			C			D	
E11	Small scale production and consumption (prosumers)	3								C				
E12	Risk reporting platform	3								C				
E13	Energy storage systems	4								C			D	
E14	Collection and storage of forest fuel loads	4								C			D	
E16	Demand Side Mangement (DSM) of Energy	5					B							
E15	SeaWater Air Conditioning (SWAC).	5					B							
E18	Upgrade evaporative cooling systems	6		A			B			C			D	
E17	Review building codes of the energy infrastructure	6		A			B			C			D	
E20	Grid reliability	7								C				
E19	Early Warning Systems (EWS)	7								C				
E22	Energy-independent facilities (generators)	8		A										
E21	Study and develop energy grid connections	8		A										
E23	Energy recovery microgrids	9		A									D	
E24	Local recovery energy outage capacity	9		A									D	
E4	Underground tubes and piping in urban planning	10		A			B			C			D	
E3	Energy efficiency in urban water management	10		A			B			C			D	
E5	Biomass power from household waste	11					B			C				
E6	Urban green corridors	11					B			C				
E8	Heated pools with waste heat from power plants	12								C				
E7	Educational garden plots	12								C				

Figure 111: Adaptation options for the energy sector. Options are identified with an ID number, full name, and class of adaptation number. Adaptation objectives are identified in each option by colour: vulnerability reduction (red), disaster risk reduction (blue); social-ecological resilience (green). Each APT (A-D) is represented as three timeframes: S – short-term (until 2030), M – mid-term (until 2050), L – long-term (until 2100). Bold letters in each APT indicate the option was available to be selected. Highlighted cells indicate the measure was selected for the corresponding APT for the particular timeframe: APT A (light blue); APT B (light green); APT C (light orange) and APT D (light purple).

For the case of APT A, vulnerability reduction is attained by promoting green jobs and businesses in all timeframes. This is because they can provide multiple benefits regarding sustainable development but also for combating the current COVID-19 pandemic. Additionally, in the short-term, the provision of a public information service on climate action is also a recommended measure as it could yield immediate results for supporting residential, hotels and commercial buildings to adapt to Climate Change. Disaster risk reduction for this APT is achieved by focusing on managing long-term risk, response, and post-disaster recovery and rehabilitation. For managing long-term risk, stakeholders deemed the inclusion of both available options as critical for all three timeframes. The review of building codes of the energy infrastructure for Cyprus is an ongoing process that is necessary for protecting the environment and mitigating GHG emissions. On the other hand, the upgrading the evaporative cooling systems is considered necessary until the end of the century given that water scarcity and heat waves are hazards that will severely impact the island. Hence, the technology to deal with this will need continuous improving over time. With respect to disaster response, being able to locally produce energy has both cost and environmental benefits, therefore, a measure for constructing energy-independent facilities (generators) is included for all timeframes. Also, the study and development of energy grid connections between islands is recommended in the short-term (contributing towards the increase of renewable energy resources (RES)) and in the long-term (for the purpose of improving the reliability of the energy system). The preferred measure for adaptation via post-disaster recovery and rehabilitation is the operation of energy recovery microgrids for all three timeframes. This measure benefits the local generation of energy and reduces costs, which is in line with the characteristics of this pathway trajectory (low commitment and low investment). In the short-term, increasing and improving the capacity of the island to recover from energy outages is also important based on the exacerbation of climate events projected. Finally, provisioning services adaptation is the class associated with social-ecological resilience in this APT. In the short-term, the measure selected involves

bolstering the energy efficiency of urban water management due to the projected decrease in water availability on the island. In the mid- and long-term, the focus shifts towards the implementation of underground tubes and piping in urban planning given their Climate Change resilience.

For the case of APT B, vulnerability reduction consists of adaptation via financial capital, human capital, and physical capital. For financial capital, the measure suggested concerns financial support for buildings with low energy needs for the short-term as this measure contributes towards the protection of the environment. However, for the mid- and long-term, the measure suggested involves financial support for smart control of energy in houses and buildings. This measure will help cut costs and mitigate GHG emissions. Regarding human capital, the selection of measures is identical to APT A, with promoting green jobs and businesses in all timeframes and the dissemination of public information service on climate action as an immediate measure in the short-term. For physical capital adaptation, a short-term measure of seawater air conditioning is included since this measure performs better in heat wave conditions. Furthermore, for all timeframes, the implementation of demand-side management of energy as a strategy for improving the coordination of energy producers and energy consumers is also recommended since it is more socially acceptable, contributes more, and is a more practical solution in the long-run. Disaster risk reduction only involves managing long-term risk in this APT. For the short- and mid-term, the option selected here is the review of building codes of the energy infrastructure, since this measure is more technically applicable and cost-efficient in the immediate future and will help climate-proof the energy system of the island. For the mid- and long-term, the option of upgrading evaporative cooling systems is chosen to combat reduced water availability and increasing temperatures. With respect to social-ecological resilience, the two classes of adaptation included in this APT are provisioning services and regulating and maintenance services. For the former, the options selected follow the options selected in APT A. Specifically, energy efficiency of urban water management needs to be addressed in the immediate future, whereas the inclusion of underground tubes and piping in urban planning needs to be addressed in the distant future. For the former, the promotion of biomass power from household waste is the short-term measure recommended since it is a good GHG emissions mitigating alternative. In the mid- and long-term, however, the construction of urban green corridors is the measure of choice since it will be effective in combating the projected increase in air temperature on the island.

For the case of APT C, adaptation via human capital, social capital, and natural capital comprise the objective for vulnerability reduction. Regarding human capital adaptation, short- and mid-term measures consist of the promotion of green jobs and businesses, as well as of the provision of as public information service on climate action. The fact that there is medium commitment to policy change and medium investment makes the latter measure also viable for the long-term. Adaptation via social capital involves a measure to promote small-scale production and consumption for all timeframes. This measure will be able to deal with Climate Change events forecast for the island (particularly, heat waves). The transition to local energy production will have significant benefits on multiple levels and will contribute much more to the usage of RES, the decrease of GHG emissions, and the creation of jobs at the local level. In addition, the mid- and long-term pathways also contain the development of a risk reporting platform as a measure. As for adaptation via natural capital, the development of energy storage systems is recommended for all timeframes, which is in line with the EU's energy policy aiming for increase Renewable Energy Sources (RES) usage. Furthermore, the collection and storage of forest fuel loads is also included for the mid- and long-term pathways, as a way to deal with highly potential wildfire hazards that are projected for the island. The objective for disaster risk reduction is obtained with adaptation for managing long-term term risk and preparedness. For the former, it is suitable to have a measure for reviewing building codes of the energy infrastructure in the short-term and a measure for upgrading evaporative cooling systems in the mid- and long-term. For the latter, stakeholders selected for all timeframes to include a measure to ensure grid reliability since it important to upgrade the grid and guarantee it is constantly stable. In the short-term, it is also important to invest in Early Warning Systems (EWS) given the various immediate climate hazards. Furthermore, stakeholders suggested that investment in EWS in the long-term will also be necessary for the purpose of upgrading based on new knowledge. APT C includes all three classes of adaptation relating to social-ecological resilience. For adaptation via provisioning services, the selection of measures follows

APT A and APT B, with the short-term consisting of improving energy efficiency in urban water management and the mid- and long-term consisting of implementing underground tubes and piping in urban planning. Regarding regulating and maintenance services adaptation, promoting the generation of biomass power from household waste is more appropriate for all timeframes, since this APT is characterized by medium investment and medium commitment to policy change. In addition, for the mid- and long-term, the ATP also includes the creation of urban green corridors. Finally, for cultural services, the short-term measure more suitable for this APT is the provision of educational garden plots, whereas the mid- and long-term

For the case of APT D, three adaptation classes are included for vulnerability reduction: financial capital, human capital, and natural capital. Concerning financial capital adaptation, the inclusion of measures is similar to those included in APT B, with providing financial support for smart control of energy in houses and buildings in the mid- and long-term and providing financial support for buildings with low energy needs in the short-term. However, because this APT has a high degree of commitment to policy change (as opposed to a low degree of commitment in APT B), it also includes providing financial support for buildings with low energy needs in the mid- and long-term. With respect to adaptation via human capital, the choice of measures is the same as in APT A and APT B: providing a public information service on climate action in the short-term and promoting green jobs and businesses for all timeframes. The measures selected by stakeholders for natural capital adaptation is exactly as in the case of APT C for the same reasons. The development of energy storage systems is preferred for all timeframes, whereas the collection and storage of forest fuel loads is also selected for the mid- and long-term pathways. Disaster risk reduction objectives are met through managing long-term risks and post-disaster recovery and rehabilitation. For the former, again this pathway consists of measures identical to that of APT C – the short-term involves reviewing building codes of the energy infrastructure, whereas the mid- and long-term involve upgrading evaporative cooling systems. For the latter, the operation of energy recovery microgrids is recommended for all three timeframes (as in APT A), however, as this APT has a high level of investment, it is also recommended that the mid- and long-term also includes increasing and improving the capacity of the island to recover from energy outages. Regarding social-ecological resilience objectives, the only class of adaptation involves provisioning services, wherein, the selection of measures is the same as the other three APTS. Specifically, the short-term measure of improving the energy efficiency of urban water management is preferred, whereas the inclusion of underground tubes and piping in urban planning is suggested for the mid- and long-term.

3.2.2 Sustainability Performance

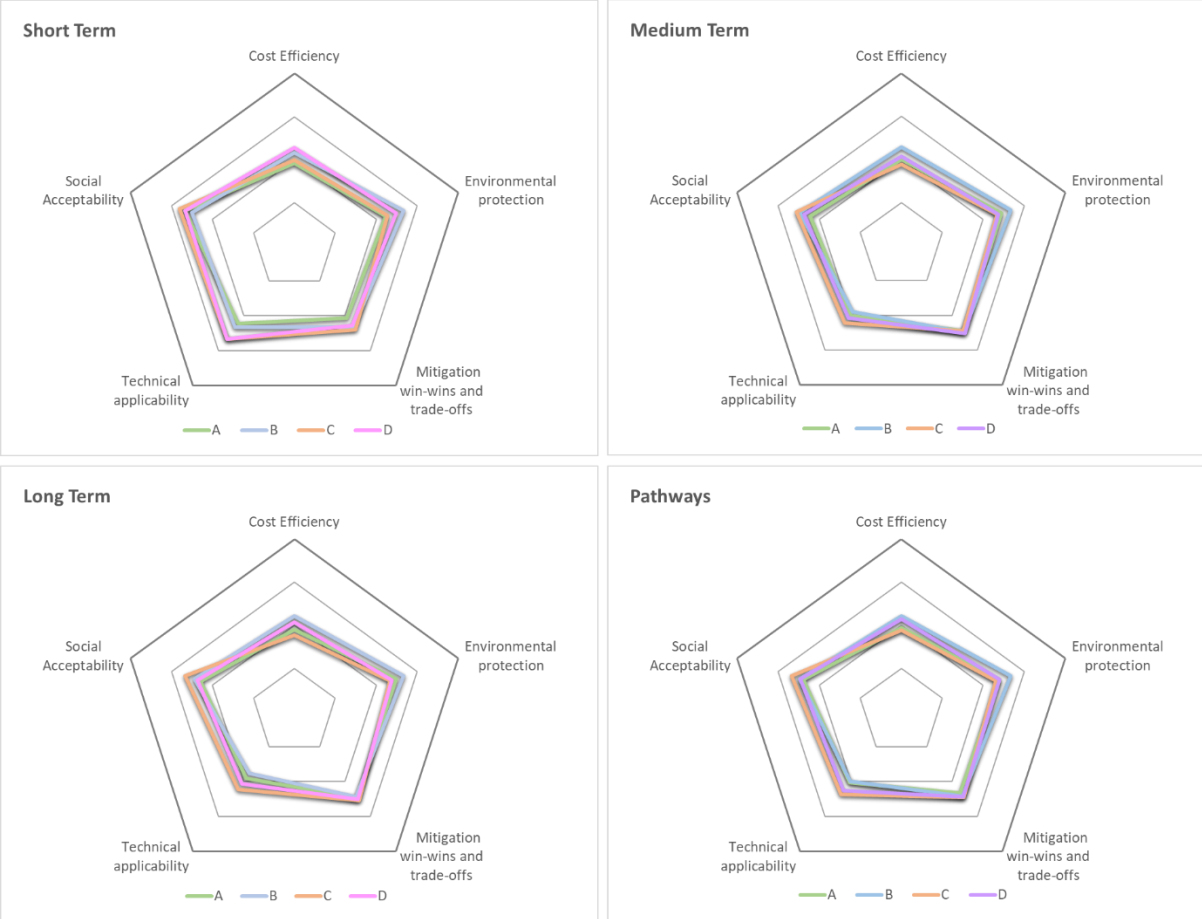

Figure 112: Pathways evaluation for the tourism sector considering the five criteria: cost efficiency, environmental protection, mitigation (GHG emissions) win-wins and trade-offs, technical applicability, and social acceptability. The adaptation pathway trajectory scenarios: APT A - Minimum Intervention; APT B - Economic Capacity Expansion; APT C - Efficiency Enhancement; APT D - System Restructuring, for different timeframes: short-term, mid-term, and long-term.

In the majority of the cases, the measure selected for the short-term is based on the fact that there are policies and guidelines already set forth either locally or by the EU containing targets that must be achieved in the immediate future. Thus, the stakeholders' choices were reliant on these targets. Furthermore, the mid- and long-term are indistinguishable for the case of energy, so the measures for the mid- and long-term are identical in most of the cases and were chosen by stakeholders based the level of investment and degree of commitment to policy change characterizing each APT. Overall, it can be observed that the four APT scenarios consist of measures with a low-to-average cost efficiency but an average mitigation (GHG emissions) win-wins and trade-offs and social applicability in all three timeframes. In addition, scenarios with low levels of investment contain measures that have low technical applicability.

APT A consists of adaptation measures that have been evaluated with:

- an average level of environmental protection, mitigation (GHG emissions) win-wins and trade-offs, and social acceptability.
- a low-to-average level of cost efficiency and technical applicability.

APT B consists of adaptation measures that have been evaluated with:

- an average level of environmental protection, mitigation (GHG emissions) win-wins and trade-offs, and social acceptability.
- a low-to-average level of cost efficiency and technical applicability.

APT C consists of adaptation measures that have been evaluated with:

- an average level of environmental protection, mitigation (GHG emissions) win-wins and trade-offs, technical applicability, and social acceptability.
- a low-to-average level of cost efficiency.

APT D consists of adaptation measures that have been evaluated with:

- an average level of environmental protection, mitigation (GHG emissions) win-wins and trade-offs, technical applicability, and social acceptability.
- a low-to-average level of cost efficiency.

Analysis of the results show that the measures selected in the short-term for APT A and APT B have an identical sustainability performance, as do the measures for APT C and APT D. Furthermore, for the mid- and long-term all four scenarios perform similarly to a certain extent. Thus, unlike for the case of tourism, the selection of measures seems to not take into account the characteristics of the adaptation pathway to such a large degree. Again, this is attributed to the targets set out by the EU and the Cypriot government with respect to energy and Climate Change.

4 Discussion and Conclusions

The two regional workshops held in Cyprus helped determine the most appropriate measures to be included in several adaptation pathways for the tourism and energy sectors based on the degree of commitment to policy change and level of investment across three timeframes: the short-term (until 2030), the mid-term (until 2050), and the long-term (until 2100). Stakeholders from research centres, government departments, and other types of organizations having links to the tourism and energy industries were involved.

For the tourism sector, stakeholders selected **pre-disaster early recovery planning** as one of the most important measures to be included in the adaptation pathways. Despite being available only for APT A and APT D (which are incidentally opposite of each other in terms of investment and commitment levels), the majority of stakeholders included this as a measure in both APTs in all three timeframes. Thus, we can conclude that this particular measure is significant despite the government strategy that will be followed in the future regarding Climate Change. Similarly, **adaptive management of natural habitats** and **economic policy instruments** are both selected for all timeframes regardless of the adaptation pathway. For the former, it is an option only available in APT C, but it is considered vital for the preservation of the ecosystem services. For the latter, it is an option available in APT B and APT D (which are both characterized by high investment) and is considered a much more sustainable action. Other measures that had a high selection ratio in the tourism sector include **dune restoration and rehabilitation**, **local circular economy**, and **monitoring, modelling, and forecasting systems**. Interestingly, this last measure is available in all APTs and was included for all timeframes of APT A, APT B, and APT C, and for the short- and mid-term of APT D (i.e., eleven out of the twelve possible timeframes).

For the energy sector, the option for **demand-side management of energy** was selected by stakeholders as an important measure to be included in APT B in all timeframes as it was considered a more useful and sensible action to take. Also, **heated pools with waste heat from power plants** is a popular option available only for APT C. **Energy recovery microgrids** is a measure that stakeholders decided was important regardless of the government strategy adopted since it was selected for all timeframes in both APT A (low investment, low commitment) and APT D (high investment, high commitment). Other measures with high selection ratios for the energy sector consist of **energy storage systems**, **small scale production and consumption**, and **green jobs and businesses**. This last measure was selected eleven out of a possible twelve timeframes as it was available for all APTs. Specifically, it was chosen for all three timeframes of APT A, APT B, and APT D, and for the short- and mid-term of APT C.

5 References

Suckall, N., Tompkins, E. L., Nicholls, R. J., Kebede, A. S., Lázár, A. N., Hutton, C., Vincent, K., Allan, A., Chapman, A., Rahman, R., Ghosh, T., & Mensah, A. (2018). A framework for identifying and selecting long term adaptation policy directions for deltas. *Science of the Total Environment*, *633*, 946–957. https://doi.org/10.1016/j.scitotenv.2018.03.234

Other references

6 Regional Workshops

This section presents the objectives and contents of the two regional workshops held in Cyprus.

6.1 First Regional Workshop

The objectives of the first regional workshop were to:

1. Provide a recap of the SOCLIMPACT project to stakeholders – goals, partners, islands, Blue Economy sectors, work packages.
2. Present the background material for supporting stakeholders' decisions – results from WP4 and WP5.
3. Explain in detail the Online Survey Tool designed to collect the adaptation pathway measures recommended by stakeholders under the four different trajectories and three timeframe – APT scenarios, adaptation classes, evaluation criteria, and adaptation options

The agenda of the first regional workshop is presented in Figure 113.

CYPRUS ONLINE LWG REGIONAL WORKSHOP 1

Co-developing Climate Change Adaptation Pathways in Cyprus

Tuesday, 13 October 2020

Agenda

11:00-11:05	***Brief welcoming*** Haris Neophytou, SOCLIMPACT Scientific Leader (Interfusion Services)
11:05-11:15	***General introduction to project*** Prof. Dr Despina Serghides, SOCLIMPACT Scientific Leader (CYI)
11:15-11:30	***Climate hazards, risks, and socio-economic impacts for Cyprus*** Dr George Zittis & Dr Elias Giannakis, SOCLIMPACT Researchers (CYI)
11:30-11:40	***Short break***
11:40-12:40	***Presentation of the Online Survey Tool*** Dr Constantinos Stylianou, SOCLIMPACT Researcher (Interfusion Services)
12:40-13:00	***Round table discussion, questions from participants, and next steps*** Haris Neophytou, SOCLIMPACT Scientific Leader (Interfusion Services)

Figure 113: First regional workshop agenda held 13 October 2020.

6.2 Second Regional Workshop

The objectives of the second regional workshop were to:

1. Present the final adaptation pathways for Cyprus as determined by the stakeholders' decisions for each individual APT for the three timeframes.
2. Discuss the results and ask for clarifications for certain decisions.

The agenda of the second regional workshop is presented in Figure 114.

CYPRUS ONLINE LWG REGIONAL WORKSHOP 2

Co-developing Climate Change Adaptation Pathways in Cyprus

Thursday, 5 November 2020

Agenda

11:00-11:05	***Brief welcoming*** Haris Neophytou, SOCLIMPACT Scientific Leader (Interfusion Services)
11:05-11:50	***Adaptation pathways for the tourism sector and discussion*** Dr Constantinos Stylianou, SOCLIMPACT Researcher (Interfusion Services)
11:50-12:00	***Short break***
12:00-12:45	***Adaptation pathways for the energy sector and discussion*** Dr Constantinos Stylianou, SOCLIMPACT Researcher (Interfusion Services)
12:45-12:55	***Socio-economic impacts for Cyprus*** Haris Neophytou, SOCLIMPACT Scientific Leader (Interfusion Services)
12:55-13:00	***Closing*** Haris Neophytou, SOCLIMPACT Scientific Leader (Interfusion Services)

Figure 114: Second regional workshop agenda held 5 November 2020.

7 List of participants

Table 15 below lists the participants of the two regional workshops.

Table 15: List of regional workshop participants in Cyprus.

Name	Organization	Sector
Mr Philippos Droushiotis	Cyprus Sustainable Tourism Initiative	Tourism
Mr Nestoras Fylaktos	The Cyprus Institute	Energy
Dr Elias Giannakis	The Cyprus Institute	Energy
Dr Michael Ierides	Cyprus Marine Environment Protection Association	Tourism
Ms Maria Ioannidou	Energy Service	Energy
Dr Marios Karmellos	The Cyprus Institute	Energy
Mr Yiannis Konnaris	Interfusion Services	Tourism
Mr Vakis Loizides	Cyprus Tourism Organization	Tourism
Mr Haris Neophytou	Interfusion Services	Tourism
Mr George Partasides	Energy Service	Energy
Dr Despina Serghides	The Cyprus Institute	Energy
Dr Constantinos Stylianou	Interfusion Services	Tourism
Dr George Zittis	The Cyprus Institute	Energy

SOCLIMPACT
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8 Annexes - Cyprus

8.1 Criteria Evaluation of the Adaptation Options

8.1.1 Tourism Sector

Table 16: Criteria evaluation of the adaptation options for the tourism sector.

Options Characterization				Criteria				
ID	Name	Description	Class of adaptation	Cost Efficiency	Environmental protection	Mitigation (GHG emissions) win-wins and trade-offs	Technical applicability	Social Acceptability
T1	**Economic Policy Instruments (EPIs)**	Economic Policy Instruments (EPIs) are incentives designed and implemented with the purpose of adapting individual decisions to collectively agreed goals. Diferent type of instruments can be aplied, like: pricing (e.g. water tariffs), environmental taxes and charges, subsidies; trading (e.g tradable permit for pollution or water abstraction, compensation mechanisms, payments for environmental services); and voluntary agreements and risk management schemes such as insurances.	1. Financial capital	4	4	3	3	3
T2	**Financial incentives to retreat from high-risk areas**	Financial incentives to retreat from high-risk areas refers to the creation of financial incentives to retreat or relocate settlements, infrastructure and productive activities from the original location due to their high exposure to risks such as flood, sea-level rise and storm surges.	1. Financial capital	2	3	2	2	2
T3	**Adaptation of groundwater management**	Adaptation of groundwater management can be used to (1) conserve groundwater reservoirs, limiting water use and optimizing water reuse, and (2) restore or increase natural infiltration capacity. Both contribute to adaptation in circumstances of reduced precipitation and sea saltwater intrusion aggravated with groundwater over-exploitation. Different packages of interventions usually inlcude: freshwater injection, modifying pumping practice, delayed inflow, artificial recharge or efficient use of	10. Provisioning services	2	4	1	2	2
T4	**Monitoring, modelling and forecasting systems**	Monitoring, modelling and forecasting systems are information system that provide timely and reliable climate information, as well as up-to-date data on the occurrence and severity of extreme events, possible impacts and their duration. Different systems can be implemented to respond to different climate hazards, such as drought-related, water quality monitoring, water resources management and predicting and managing flood risks.	10. Provisioning services	3	3	3	3	4
		Dune restoration and rehabilitation refers to the strengthening of the flood safety and						

T5	**Dune restoration and rehabilitation**	Dune restoration and rehabilitation refers to the strengthening of the flood safety and sand reservoir functions of dunes. Dune erosion happens as a result of wind action, marine erosion, human activities and Sea Level Rise (SLR). Possible technics examples include: grass planting, thatching and fencing.	11. Regulating and Maintenance Services	**3**	**3**	**2**	**3**	**4**
T6	**River rehabilitation and restoration**	River rehabilitation and restoration are measures that emphasise the natural functions of rivers and create vegetated buffer zones alongside watercourses. This contributes to the improvement of micro-climatic conditions, reduces run-off and erosion, and increases groundwater recharge. For Tourism, this option also increases available leisure areas, increases thermal comfort areas and the availability of water.	11. Regulating and Maintenance Services	**3**	**3**	**2**	**3**	**4**
T7	**Adaptive management of natural habitats**	Adaptive management of natural habitats refers to the preservation of ecosystem services which are essential for human well-being. Human activities induce pressure and impacts on biodiversity and ecosystems that tend to be aggravated by climate change. Adaptive management measures include: understanding species response; make space for the development of rivers and coasts; aid gene flow; species translocation; targets and conservation mechanisms/plans.	12. Cultural services	**3**	**4**	**3**	**3**	**3**
T8	**Ocean pools**	Ocean pools are seawater pools located by the sea where waves can wash into the pool. The width, length and depth of ocean pools varies and often depends on their location on the coastline. These recreational structures are useful on SLR context, doubling as an additional protection of the coast and creating alternatives to beach leisure areas.	12. Cultural services	**3**	**3**	**2**	**2**	**4**
T9	**Activity and product diversification**	Activity and product diversification include actions to diversify the tourism activities and products and aim to reduce seasonality and overload in infrastructures and ecosystems. Shifting the dependency from 'sun, sea and sand' products to alternative leisure activities can reduce the impacts of heat waves, coastal erosion or ecosystem degradation, and thus help to maintain destination attractiveness.	2. Human capital	**3**	**4**	**3**	**3**	**3**
T10	**Public awareness programmes**	Public awareness programmes establish targeted programmes that raise awareness about climate change (specific values and protection needs) among guides, site managers and local communities.	2. Human capital	**4**	**3**	**2**	**4**	**3**
T11	**Local circular economy**	Local circular economy is an economic system aimed at eliminating waste and the continual use of resources that offers a valuable framework for reduced carbon emissions from materials (decarbonization) and increased resilience to climate change and its impacts.	3. Social capital	**3**	**4**	**4**	**4**	**4**
T12	**Tourist awareness campaigns**	Tourist awareness campaigns target behavioural change of visitors and aim to increase tourists (individuals and organisations) knowledge about climate change and the risk faced by tourism destinations. These campaigns can be targeted to regions affected by a particular climate threat, specific groups of visitors or the general tourism sector as a whole.	3. Social capital	**3**	**3**	**2**	**3**	**4**

T13	**Local sustainable fishing**	Local sustainable fishing refers to the promotion of fishing zones/rights for local small-scale fishers maintaining stocks and using sustainable methods. This option aims to add value to local resources and products, protect ecosystems services and decrease external dependency.	4. Natural capital	**3**	**4**	**2**	**3**	**3**
T14	**Water restrictions, consumption cuts and grey-water recycling**	Restrictions can be applied to allow water administration services to cope with water crises. Restriction (or rationing) of certain uses of water such as irrigation of lawns, car washing, filling swimming pools or hosing down pavement areas may be necessary during these times. Grey-water recycling (or reclamation) is the reuse of non-drinkable water (usually treated waste water) to cover water use needs that don't demand such a high-quality standard.	4. Natural capital	**3**	**4**	**2**	**3**	**2**
T15	**Beach nourishment**	Beach nourishment (or replenishment) is the artificial placement of sand to compensate for erosion. Beach nourishment also often aims at maintaining beach width (for tourism and recreational purposes). Several beach nourishment techniques can be used including beach, backshore and shoreface nourishment, and large scale coastal nourishment (e.g. using sand motors).	5. Physical capital	**2**	**3**	**2**	**3**	**4**
T16	**Desalination**	Desalination is the process of removing salt from sea or brackish water to make it useable for a range of purposes including drinking, and can contribute to adaptation in circumstances of current or future water scarcity problems. Technological examples include electrically driven technologies, like reverse osmosis, and thermally driven technologies, based mainly on vapor distillation processes.	5. Physical capital	**2**	**2**	**2**	**4**	**3**
T17	**Coastal protection structures**	Coastal protection structures such as groynes, breakwaters, artificial reefs and seawalls are different types of artificial structures, built in the shoreline (or rivers), which are designed to protect the coast from SLR or storms. Those structures can be used to, for example, drift and trap sediments, protect from erosion, absorb wave energy, or allow navigation.	6. Managing long term risk	**2**	**2**	**2**	**3**	**3**
T18	**Drought and water conservation plans**	Drought and water conservation plans refer to tourism-lead adaptation and/or involvement in drought management plans with the aim to reduce the economic, social, and environmental consequences of drought and water scarcity, and to reduce the loss of water and improve efficiency in the sector.	6. Managing long term risk	**3**	**3**	**2**	**3**	**3**
T19	**Mainstreaming Disaster Risk Management (DRM)**	Mainstreaming Disaster Risk Management (DRM) aims to plan and organize DRM along five stages including prevention, protection, preparedness, and response, recovery and review. Examples include interventions to limit urban development in flood prone areas; identify natural hazard prone areas; develop strategies, arrangements, and procedures to address crises; and post-emergency recovery activities.	7. Preparedness	**3**	**4**	**3**	**2**	**3**
T20	**Using water to cope with heat waves**	Water use to cope with heat waves in cities are a set of investments in water supply services and infrastructures that aim to increase urban resilience regarding heat waves. Different packages of grey interventions are usually applied, as for example: creating and/or repairing fountains for drinking water and cooling; water spray fountains; and wetting streets.	7. Preparedness	**3**	**2**	**2**	**3**	**4**

T21	**Fire management plans**	Fire management plans are management actions have wide range of application such as early warning detection, with escape routes and advice to local citizens and tourists, mobilization and suppression of unwanted and damaging fires, or use of fire to manage fuel. Additionally, these plans help to increase the understanding of the interactions of climate change with vegetation cover and fire regimes.	8. Response	**4**	**3**	**3**	**2**	**4**
T22	**Health care delivery systems**	Health care delivery systems are pre-emptive actions and adjustments that need to be made to health care systems, namely reinforcing less prepared aspects of its operation and/or logistics, in order to guarantee effectiveness and efficiency during, for example, high temperature and heat-wave situations.	8. Response	**3**	**2**	**2**	**3**	**4**
T23	**Post-Disaster recovery funds**	Post-Disaster recovery funds is the creation of recovery funds for the Tourism sector to recover after disasters, through initiatives that get the economy up and running quickly while building-back-better (e.g. rebuild damaged critical infrastructures such as ports and roads or recorver the landscape from fires). The aim is to minimize the economic and social impacts (which may include future loss of the touristic destination attractiveness) that can occur in a post-disaster context.	9. Post disaster recovery and rehabilitation	**3**	**2**	**1**	**3**	**4**
T24	**Pre-disaster early recovery planning**	Pre-disaster early recovery planning processes include the development of knowledge, good practices and objectives that aim to improve the living conditions of the affected communities, while facilitating the adjustments necessary to reduce the risk of future disasters. Examples of good practices are may include identifying critical ecosystems (goods and services) that require immediate restoration after a disaster or particularly vulnerable communities.	9. Post disaster recovery and rehabilitation	**4**	**4**	**2**	**3**	**4**

8.1.2 Energy Sector

Table 17: Criteria evaluation of the adaptation options for the energy sector.

Options Characterization				Criteria				
ID	Name	Description	Class of adaptation	Cost Efficiency	Environmental protection	Mitigation (GHG emissions) win-wins and trade-offs	Technical applicability	Social Acceptability
E1	**Financial support for buildings with low energy needs**	Financial schemes in the form of loans, subsidies or tax reliefs are ways to support the reduction of energy needs of new or existing buildings, making them address climate change in a more efficient manner. For example, architecture and construction materials that rely on passive thermal comfort reduce the use of energy for human comfort, so less air-conditioning is necessary in the cooling season.	1. Financial capital	3	4	3	3	3
E2	**Financial support for smart control of energy in houses and buildings**	The support of smart control of energy in houses and buildings allows for an efficient and automated use of energy that enables savings and creates synergies with utilities. For example, such a system could coordinate the automated opening vents with the air conditioning operation, avoiding energy consumption when possible. This will allow for the adaptation of buildings at a controlled cost, while complying with mitigation goals.	1. Financial capital	3	2	3	3	3
E3	**Energy efficiency in urban water management**	Energy efficiency in urban water management is the adaptation of urban design and construction for water conservation that avoids energy use under scarcity scenarios. For instance, Water Sensitive Urban Design (WSUD) aims to plan water conservation and storm water storage with integration with elements of urban design. This both to minimises hydrological impacts on the environment and the associated energy use of water supply.	10. Provisioning services	3	3	2	3	3
E4	**Underground tubes and piping in urban planning**	Underground tubes and piping are used for space heating/cooling across the globe and are more resilient to climate change. These systems can be Earth Air Heat Exchanger (EAHE) and Ground Source Heat Pump (GSHP) types. Both systems use tubes or pipes that usually need to be buried beyond the footprint of the building or house. The measure considers this need, and both allows and encourages the use of such space in urban planning.	10. Provisioning services	3	3	3	2	2
E5	**Biomass power from household waste**	Biomass power plants burn household waste, waste from parks and public gardens and sludge generated by sewage treatment plants. Towns and cities can also realise urban production and recreational woods, which can be used for producing biomass for co-generation (Combine Heat and Power) as well as tri-generation (Combined Cold Heat and Power) plants.	11. Regulating and Maintenance Services	2	3	4	2	2
E6	**Urban green corridors**	Urban green areas decrease the air temperature in a city and thus decrease energy needs. Warm air tends to transport pollution and particulate matter to higher layers of atmosphere, causing a cloud of smog. Creating green corridors also promotes biodiversity, increases the touristic value and decreases water run-off during storms.	11. Regulating and Maintenance Services	2	4	3	2	3

E7	**Educational garden plots**	Educational garden plots are sites where people, especially children, can garden with volunteers one afternoon a week after school. The harvest can be taken home. This creates well-being while having local fresh produce reduces the energy consumption and pollution. These garden plots can be further exploring to educate people about other climate action measures, directly and indirectly related with energy such as waste to energy, composting, water retention and green corridors.	12. Cultural services	**2**	**2**	**2**	**3**	**3**
E8	**Heated pools with waste heat from power plants**	Power plants need cooling and their waste heat can be used in swimming pools for public use and tourism. This creates an attractive leisure activity in off-peak winter times which diversifies the touristic offer and promote community well-being. This type of heat recovery design is called Combined Heat and Power (CHP). Pools provide a heat sink for the power plants which increases efficiency and is useful during heat waves.	12. Cultural services	**2**	**2**	**3**	**2**	**3**
E9	**Green jobs and businesses**	The promotion of green jobs and businesses consists in training people and supporting green businesses to implement energy solutions across the economy, both in mitigation and adaptation. One example can be the support of research projects to help businesses deal with new technologies relevant to climate action.	2. Human capital	**3**	**3**	**2**	**3**	**3**
E10	**Public information service on climate action**	Public information service on climate action aims to provide the general public with information about adaptation and mitigation options available for their activities and businesses. This includes information dissemination and counselling about available solutions and the public support. This type of information is relevant, for example, to support dwellings, hotels or commerce to adapt to climate change.	2. Human capital	**3**	**2**	**2**	**4**	**4**
E11	**Small scale production and consumption (prosumers)**	Small scale production and consumption (prosumers) aims to promote cooperation by creating economies of scale both in the production and consumption of energy. This allows for a greater use of local renewable resources and waste energy recovery which allow for a better resilience when dealing with climate change events such as heat waves.	3. Social capital	**3**	**3**	**3**	**3**	**3**
E12	**Risk reporting platform**	Risk reporting platform intends to promote the communication between the general public and the administration bodies concerning the risks related with climate change. It is a platform were the general public reports directly the risks as they become aware of. These can be for example related with cliff instability, trees falling over energy lines, uncleared bushes that can be ignited by power lines or unstable structures that may fall due to strong winds.	3. Social capital	**2**	**2**	**1**	**3**	**3**
E13	**Energy storage systems**	The development of energy storage systems can provide an alternative when the main power sources fail and need time to recover. This allows for a more resilient energy grid while enabling decarbonization and peak levelling at a controlled cost. This includes not only electric batteries (like those in cars and buses), but also other forms of energy storage such as thermal tanks (heat), ice banks (cold) or water height (reversed pumping).	4. Natural capital	**2**	**3**	**4**	**3**	**3**
E14	**Collection and storage of forest fuel loads**	Collection and storage of forest fuel loads intend to promote and regulate the collection and storage of wood and combustible material to reduce wildfire hazard. Actions may include: clearing of small trees out of dense areas, reduce the amount of fuel on the ground and increasing the spacing between trees. Materials collected can be used in energy to waste applications such as pellets, biogas or other energy solutions.	4. Natural capital	**3**	**3**	**3**	**3**	**3**

E15	**SeaWater Air Conditioning (SWAC).**	The Seawater Air Conditioning (SWAC) measure is an alternate-energy system design that uses cold water from the deep ocean to provide more efficient, decarbonized and reliable cooling. The sweater is piped to heat exchangers for process cooling or to provide condensation water in air conditioning systems. It replaces air cooling units or fresh water evaporative cooling towers which performances degrades in heat waves. Other subsequent or parallel seawater uses can be combined, like for swimming pools or desalinisation.	5. Physical capital	**1**	**3**	**3**	**2**	**2**
E16	**Demand Side Mangement (DSM) of Energy**	Demand Side Management (DSM) of energy is an operational strategy that better coordinates producers and consumers of energy. More renewable energy use is possible while ensuring the energy service reliability and controlled costs. DMS balances off-peak and peak demand using peek shaving, which is important, for example, during heat waves.	5. Physical capital	**3**	**3**	**3**	**2**	**3**
E17	**Review building codes of the energy infrastructure**	Review energy infrastructure building codes aims to climate-proof the energy system by reviewing regulatory codes and infrastructures considering the spatial distribution of climate risks. This should include establishment of new procedures, maintenance practices, operational changes, retrofitting and the use of climate and mapping services such as those produced by the Copernicus Emergency Management Service (EMS).	6. Managing long term risk	**3**	**3**	**3**	**3**	**3**
E18	**Upgrade evaporative cooling systems**	Upgrade of evaporative cooling systems that rely on a given range of air temperature and water availability is necessary given that this type of cooling systems are a technology that can be affected by climate change and become compromised due to heat waves and water scarcity.	6. Managing long term risk	**2**	**3**	**3**	**2**	**3**
E19	**Early Warning Systems (EWS)**	Early Warning Systems (EWS) is an information system that assesses climate risks and provides real time information to decision makers, companies, utilities and the general public. Climate data used to control and monitor the energy infrastructure can be relayed to the EWS. Using this data to monitor the evolution of climate related impacts in the energy sector increases the knowledge necessary to make long term climate adaptation decisions.	7. Preparedness	**2**	**3**	**3**	**3**	**4**
E20	**Grid reliability**	Grid reliability improvement aims to find and upgrade critical components and to enhance the energy system resilience to climate risks. This may include redundant circuitry or components that provide alternative dispatch of energy, equipment upgrades (e.g. better cooling to cope with heat waves) or power downrating (e.g. decrease power output of energy transformers so that they do not overheat during heat waves).	7. Preparedness	**2**	**2**	**3**	**3**	**3**
E21	**Study and develop energy grid connections**	Energy grid connections aims to develop interconnections between islands and/or with the mainland allowing for the creation of economies of scale, energy system reliability improvements and more Renewable Energy Sources (RES) penetration.	8. Response	**2**	**3**	**3**	**2**	**3**
E22	**Energy-independent facilities (generators)**	Energy-independent facilities (generators) make it possible for buildings to temporarily create their own energy supply. In case of an energy supply failure (power outage), essential amenities remain functional and can be optimized with Combined Heat and Power (CHP) designs and other decentralised energy generation solutions.	8. Response	**2**	**3**	**3**	**3**	**3**

E23	**Energy recovery microgrids**	Energy recovery microgrids are operational elements of the energy grids that rely on distributed generation to restore systems from power outages and to stabilize the grid. This allows for a flexible and swifter recovery from power outages caused by knock-out events (e.g. tree falls on energy lines), excess demand (e.g. during heat waves) or other causes.	9. Post disaster recovery and rehabilitation	**2**	**2**	**3**	**2**	**2**
E24	**Local recovery energy outage capacity**	Local recovery energy outage capacity consists in increasing and improving the ability of the islands to recover from energy outages caused by or worsen by climate extreme events, like severe sea or windstorms that can lead to island isolation and exacerbate logistical hurdles. To facilitate a swift recovery, it's useful to have more mobile backup power, power line replacements and other grid components, logistics, supplies and personnel.	9. Post disaster recovery and rehabilitation	**2**	**2**	**2**	**2**	**3**

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SOCLIMPACT

Downscaling climate impacts and decarbonisation pathways in EU islands, and enhancing socioeconomic and non-market evaluation of Climate Change for Europe, for 2050 and beyond

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Work Package 7:

This is a result of Tasks 7.3. This deliverable will include the agendas, the list of participants, and the outputs of the workshops including the decisions taken.

Deliverable 7.3.

Workshop Report - Fehmarn

Island Focal Point coordinated by Baltic Environmental Forum Germany

Damian Arikas; Matthias Grätz; Philipp Siegel

Final version - 30/11/2020

1 Introduction

This document describes the process and results of the SOCLIMPACT project Deliverable D7.3 "Engage island stakeholders" for the project case study island Fehmarn, Germany. Within the scope of this deliverable, a workshop and a webinar were conducted with stakeholders from Fehmarn to evaluate potential climate adaptation pathways for the island in general, and its tourism industry in particular.

To understand the attitudes towards and preferences for specific climate adaptation measures, stakeholders from the island were questioned about their preferences regarding specific choices of measures which could be utilised in the future to prepare for the consequences of climate change.

On Fehmarn, the main focus of the stakeholder consultation process was the Blue Economy sector "Tourism", as the other three sectors covered by the SOCLIMPACT project (Energy, Maritime Transport, Aquaculture) are either of no relevance on the island (Aquaculture) or very specific. The island's electricity grid is connected to the German mainland and Maritime Transport is insignificant because of the land connection via the Fehmarnbelt bridge. Puttgarden, the island's ferry hub in the north connects Germany with Denmark and used to be an important European traffic route but its importance will get questioned by a tunnel that is being built from 2021 on and will connect the island with Denmark.

To conduct the investigation on climate adaptation preferences of stakeholders and reach conclusions, a specific methodological process had been designed by the SOCLIMPACT project partners **FCiências.ID (Fig.1).**

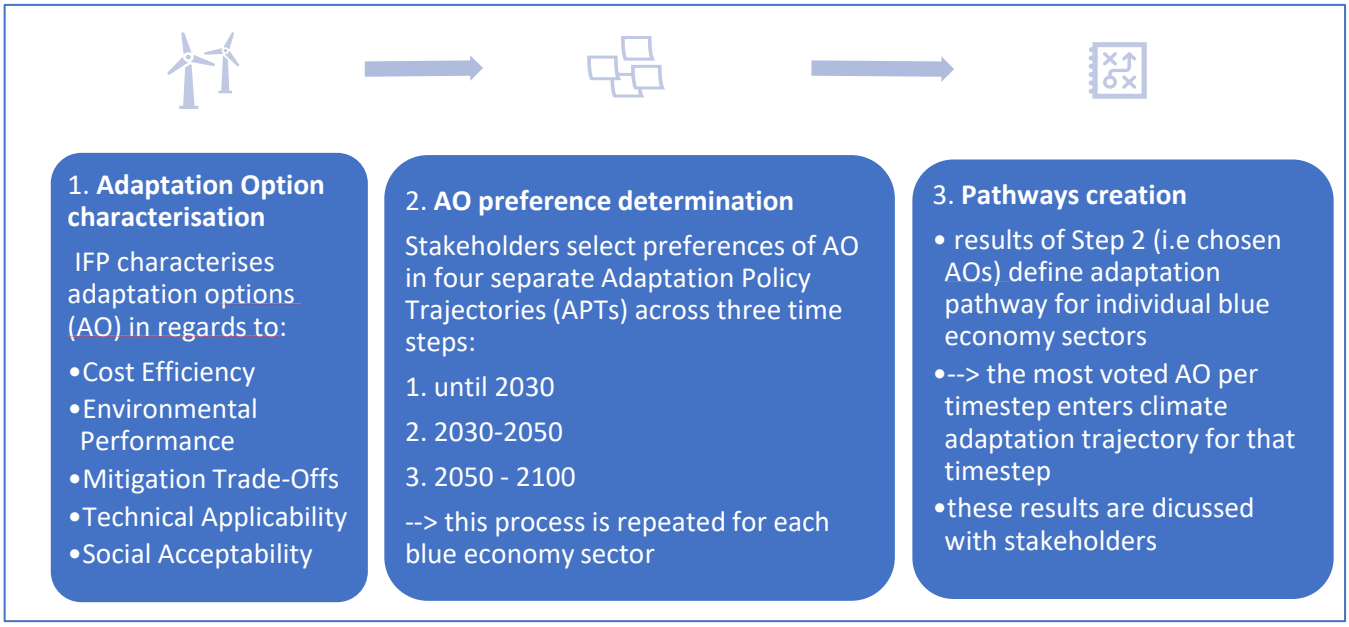

Figure 115: General methodology behind D7.3.

<u>Part 1</u> of the methodology was to be conducted by each Island Focal Point (IFP) individually.

We rated all five characteristics («Cost Efficiency», «Environmental Performance», «Mitigation Trade-Offs», «Technical Applicability», «Social Acceptability») of all 24 available adaptation options (AOs) based on specific island knowledge and expertise that we from BEF Germany had previously acquired through working on the island and with stakeholders. Our assessment was influenced by personal preferences and informed by what we knew about the island's and Germany's social and economic structure. We performed this part by going through all AOs in chronological order and talking through every choice selection until we reached a compromise on what value should be assigned for each category. The evaluation criteria that formed the basis for

our valuation can be found in Table 1. The specific values that were given to each AO in each category can be found in a supplementary table in Section 6 «Additional Material« at the end of this document.

Table 18: Description of the criteria used to evaluate the adaptation pathways performance.

Criteria	Description	
Cost Efficiency	Ability to efficiently address current or future climate hazards/risks in the most economical way	Higher score = higher cost-efficiency
Environmental protection	Ability to protect the environment, now and in the future	Higher score = higher environmental protection
Mitigation (GHG emissions) win-wins and trade-offs	Current ability to meet (win-win) or not (trade-off) the island/archipelago's mitigation objectives	Higher score = higher mitigation win-wins and lower trade-offs
Technical applicability	Current ability to technically implement the option/measure in the island/archipelago	Higher score = higher technical applicability
Social acceptability	Current social acceptability of the option/measure in the island/archipelago	Higher score = higher social acceptability

<u>Part</u> 2 of the methodology was performed during an island workshop on Fehmarn.

To identify stakeholder preferences for specific adaptation measures, a workshop was held on September 25th, 2020 on Fehmarn island at the local council. Ten stakeholders – amongst them the leader of the island's tourist organisation as well as leading representatives of Fehmarn municipality in climate change relevant sectors such as building, harbours, environment and coastal protection participated and were led through the workshop by the IFP coordinators Damian Arikas and Philipp Siegel. Besides, Prof. Bodo Ahrens from Goethe University Frankfurt/Main (GUF), who is also a collaborator on the SOCLIMPACT project, had been invited as a guest speaker to present the most recent modelling results for climate projections in the Baltic Sea Region and Fehmarn, as well as to give general background information on how climate modelling is conducted. The workshop started with a brief introduction to the SOCLIMPACT project and its purpose and aims. Afterwards, Prof. Ahrens gave a 1-hour-presentation on climate modelling which concluded in an overview of Fehmarn's potential climate future until the end of the 21st century. This was followed by a talk on the results of the SOCLIMPACT tourism survey and an overview on existing climate adaptation measures to display what can be done and has been done in other parts of the world to prepare for a changing climate and reduce the effects that have already started to worsen economic, social, and ecological life in places around the world. After these presentations, the stakeholder tool was presented to the participants of the workshops. The process was explained, and stakeholders made their AO preference choices. The workshop concluded with a discussion on adaptation measures and what aspects in the stakeholder tool were missing, redundant or did not apply as specific AOs for Fehmarn. The workshop concluded with a brief outlook on the further activities within the SOCLIMPACT project.

<u>Part 3</u> summarised the tool results of the stakeholder workshop.

This part of the methodology pooled the most selected AOs at each time step and presented them as a climate adaptation future that stakeholders would be in favour of implementing on Fehmarn until the end of the 21st century. These futures correspond to suggestions that could be followed if stakeholders were to

progress down a societal trajectory that is similar to the attitudes laid out in the four **Adaptation Policy Trajectories (APTs)** of the stakeholder tool. An AO was included in the pathway when it had been selected 50% or more in each time frame for a particular APT.

A follow-up webinar to report on the identified preferences and consult stakeholders about their views and further ideas on what to use this information for was held on November 30th, 2020. Once again, we had invited a guest speaker to give an outside perspective on adaptation measures and to present the stakeholders with pre-existing knowledge on island adaptation possibilities. For this, we had invited Thomas Vodde, marketing director and vice-mayor of the Northern German island Juist. After his talk, we presented the results of the stakeholder tool choice process from the September workshop and laid out choice preferences and trends that we as the IFP coordinators had identified as suitable starting points for discussion. Based on our discussion starters, stakeholders could give their opinions and let us know whether they agreed with our interpretation as well as what they thought about using these preferences as a future basis for choosing real-life adaptation measures.

2 Fehmarn specific adjustments to the methodology

In general, the process as envisaged by the project partners (Fig. 1) was adhered to: All AOs were evaluated by the IFP to characterise them. Then, stakeholders were asked on their discrete preferences for these adaptation options within four APTs in a first consultation part. A second consultation provided stakeholders with the results of the first workshop and had them elaborate on the identified trends. There were however differences in the implementation process in comparison to the envisaged schedule and methodology that shall be discussed further.

Methodological aspects that diverged from the original proposal

Most notably, our approach ensured that we had a personal face to face interaction with the participants. This was important as we had predicted little willingness to participate if the stakeholder engagement would be carried out only online, as some stakeholders might not have been as confident with video conferences and would lack a level of personal engagement. This allowed us to not present and explain the entire stakeholder tool virtually, as proposed in the original planning, after which stakeholders would have been given a further 10 days to evaluate their choice preferences. Instead, we could present the tool in person, answering questions and have the stakeholders choose their preferences on paper. Conducting part 2 of the methodology in person allowed us to speed up the process, make it more personal, and answer any questions about the process immediately on the spot.

Changing the format to a workshop also brought other notable changes. First of all, we could conduct a one-hour presentation about Fehmarn's climate future before the adaptation pathway selection. The original progress proposed that stakeholders would be provided with background material on possible climate futures via the stakeholder tool excel worksheet. This would have required a lot of active engagement and reading from stakeholders. Our approach, on the other hand, made sure that climate predictions were presented by an expert and remained fresh in the stakeholder's minds so that they could inform their decision-making with information that was laid out to them clearly and visually a few minutes before the stakeholder tool section of the workshop. Being there in person and talking the stakeholders through the process allowed us to continuously remind them that the choices they are making have to be made from the perspective of a decision-taker that decides on AOs from the perspective of someone with the willingness for change and willingness to invest that corresponded to the APT in focus.

We also aimed at not burdening the stakeholders with theoretical-methodological concepts. Rather than utilising the overly theoretical-sounding term "Adaptation Pathway Trajectory", we framed the 4 APTs as

"scenario worlds" in which the stakeholders would live as hypothetical decision-takers. We also did not mention **the fact that the AOs came from three main strategic vectors for climate resilience, as defined by Suckall et al., 2018. Instead, we presented choice options without mentioning their position in the greater methodological framework.** We also did not present the valuation of our AO characterisation conducted in Part 1, as we felt that it would unnecessarily complicate the understanding of what had to be done. We assumed that every stakeholder would implicitly conduct this characterisation for themselves while reading through the choices. Instead and **to make the process as accessible as possible for the stakeholders, we presented them with a simple choice between options « A » and « B », omitting surrounding methodological information such as the adaptation class that this choice constituted a part of. The** "Local Knowledge" AOs were not added for the stakeholders, as we did not want to pre-emptively decide on measures that should be chosen from. As an IFP that is not physically based on the island, we did not want to assume relevant AO choices with our outside perspective.

Since the stakeholder tool and the various APTs were presented in a PowerPoint presentation directly before the decision-making process for each APT started, we could display a summary slide with the most important attitudes of each APT onto a screen that was visible for the stakeholders during the choice-making (Fig. 2). This allowed them to come back to the APT attitude and imagine being a decision-taker in one of these world's whenever they looked up. During the presentation of APTs, different real-life examples of APT measures were presented to the stakeholders (provided by **FCiências.ID**) to give a better idea on what kind of actions could be expected to be implemented by a decision-taker in this scenario world.

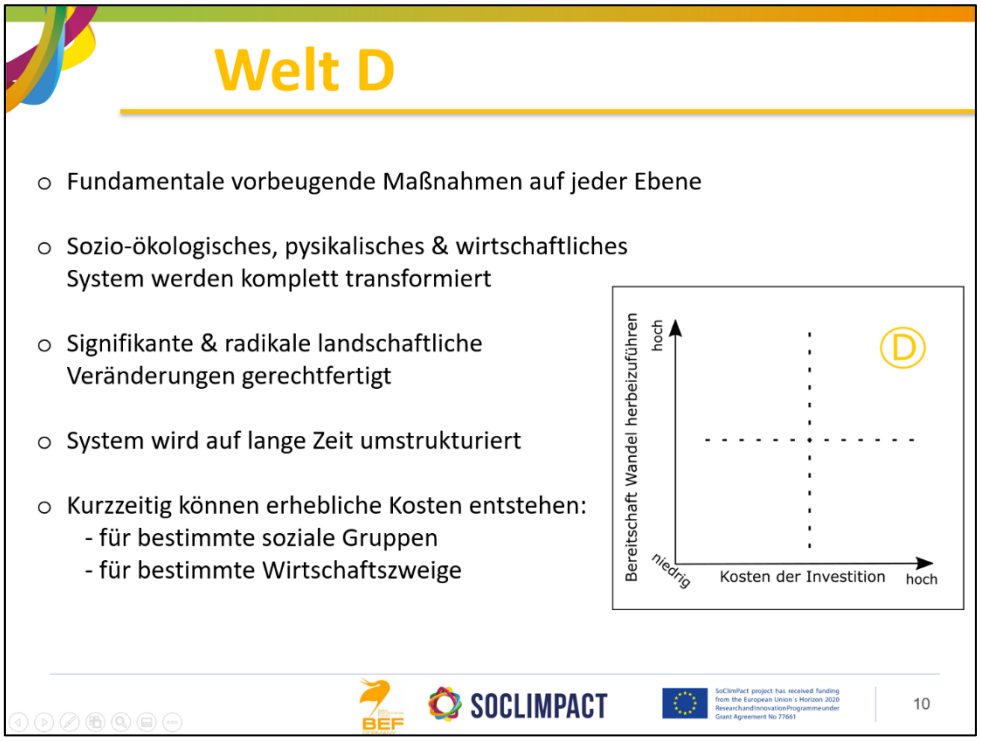

Figure 116: Example of an explanatory slide (in German) to describe scenario world D. This slide was projected onto the wall during the stakeholder choice-making process. The slide contains the main characteristics that define decision-making in this world, as well as a figure that displays where the scenario world is positioned in terms of «willingness to invest» and «willingness to create change».

We also changed the format in which the decisions were presented to the stakeholders. In the Excel online tool, the descriptor of the AO and the choices to be made were presented on different worksheets.
During the workshop we did not receive any questions from participants wanting a more detailed explanation of a specific AO, indicating that short descriptions were sufficient to make a choice.

Before engaging with the stakeholders during the workshop, we played through the choice process with colleagues at BEF Germany several times, always tweaking and changing sections that caused misunderstanding and simplifying as much as we could. We had realised that too much information for each AO disengaged the decision-taker and shifted the focus from making a discrete choice to trying to understand a particular AO.

We also made sure that all AO choices to be made within one scenario world were printed on one page so that the stakeholders could see their progress during the choice-making and were not overwhelmed by too many pages. Only for scenario world C (APT C), which required 8 choices to be made, did we have to use a second page. All material was translated into German to not create a language barrier between the process and the stakeholders.

For the second webinar, we realigned the process to the envisaged online format and presented the stakeholders with a translated German version of the results that had been supplied to us by the SOCLIMPACT partners **FCiências.ID**.

3 Background Material

The background material that we provided to the stakeholders came in the form of presentations.

Variable	Description
Climate in the area	Prof. Bod Ahrens gave an all-round view on anticipated climatic changes for the area, ranging from changes in precipitation, temperature, wind, and sea level to alterations in energy droughts, extreme events, and salinity of surface waters.
Tourism behaviour	The findings of the SOCLIMPACT tourism survey were used to inform the stakeholders about tourism attitudes and potential future tourism trends and willingness to invest in specific climate adaptation measures.

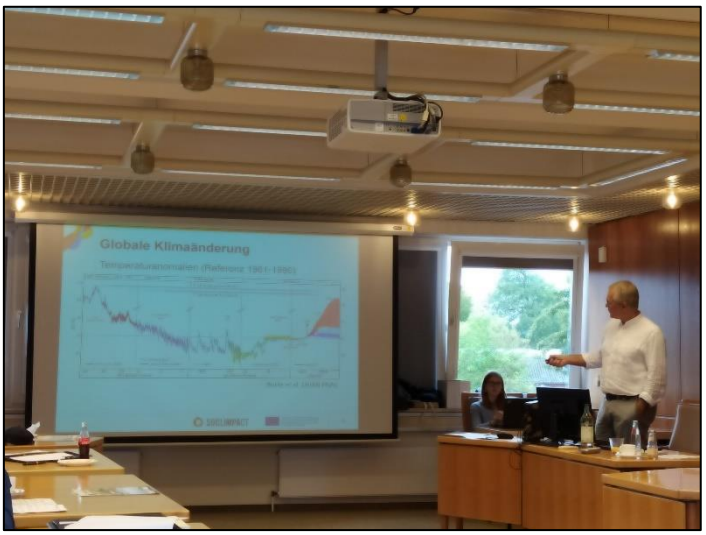

Figure 117: Prof. Bodo Ahrens from the University of Frankfurt delivering information on climate modelling and climate predictions for Fehmarn and the Baltic Sea Region during the stakeholder workshop on Fehmarn.

4 Results for the Blue Economy Sector "Tourism"

The results for the Tourism sector are presented in two different outputs:

(1) Final Adaptation Pathways

Tourism pathway choices were based on decisions made by 10 island stakeholders. This output aims to capture the acceptance of each AO by calculating how many times each AO was selected across all ATP scenario worlds within the maximum possible number of times they could be selected (Ratio – Selected/Maximum). This considers the number of times the option was selected by all stakeholders in all four APTs across all three timeframes.

(2) Sustainability Performance

This output aims to characterise each pathway through the evaluation of the options chosen in each APT. The options selected in each APT were evaluated considering a set of criteria: Cost Efficiency; Environmental protection; Mitigation (GHG emissions) win-wins and trade-offs; Technical applicability; Social acceptability.

4.1 Final Adaptation Pathways

The adaptation pathways aim to capture the policy preferences in time and their relevance in the context of investment and commitment (Suckall et al., 2018). Policy preferences in chronological order result in specific proposed adaptation trajectories. The Adaptation Pathways methodology applied in SOCPLIMPACT was based on the framework developed by Suckall et al. 2018 and considered the three main strategic vectors for climate resilience: **(1) Vulnerability Reduction -** actions to **reduce** socio-economic **vulnerability** (Five capitals of Sustainable Livelihoods Approach (SLA)); **(2) Disaster Risk Reduction** – actions that address **disaster risk reduction** (developed throughout Hyogo and Sendai Frameworks); **(3) Social-Ecological Resilience -** actions that affect **social-ecological resilience** (emerge from the Millennium Ecosystem Assessment (MEA) and Common International Classification of Ecosystem Services (CICES)). 12 adaptation classes were grouped around these three vectors. For **vulnerability reduction,** five classes were considered: (1) Human capital; (2) Financial capital; (3) Social capital; (4) Physical capital; and (5) Natural capital. For **Disaster Risk Reduction** four classes were considered: (6) Risk mitigation; (7) Hazard preparedness; (8) Disaster response; (9) Post-disaster recovery and rehabilitation. For **Social-Ecological Resilience** three classes were considered: (10) Provisioning services; (11) Regulating and Maintenance Services; (12) Cultural services (Fig. 2).

Each set of these 12 adaptation classes consisted of two AOs to choose from and a choice had to be made for the time frames "up to 2030", "2030 – 2050", and "2050 – 2100". Each stakeholder choice contributed to creating a policy pathway. If most (at least 50% in each time frame) of the stakeholders chose the same AO, then that measure was incorporated into the island's adaptation pathway for that specific class in each APT. The result of the series of choices in the three timeframes defined the pathway. If there was a tie between two options, then they were both be included and became part of the adaptation pathway in each time frame.

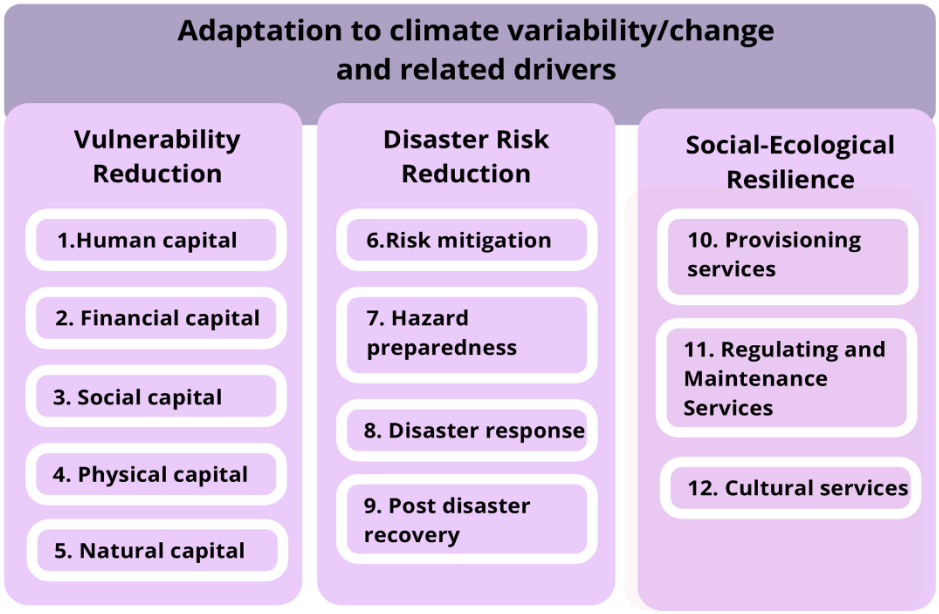

Figure 118 -The 12 classes of adaptation for which adaptation options were chosen. The classes are structured in three broader objectives (Vulnerability Reduction, Disaster Risk Reduction and Social-Ecological Resilience).

4.2 Selected Adaptation Pathways on Fehmarn

Choices made by the stakeholders at the workshop lead to the creation of adaptation pathways specific to Fehmarn. In the following paragraphs, clear preferences and trends that emerged from analysing the choices are described for each of the strategic vectors. The visual representation of the pathways is displayed in Figs. 5 & 6. Not all choices could be made in each scenario world and each world had a specific set of choices to be made.

Vulnerability Reduction

Measures that address the issue of climate change adaptation through a **vulnerability reduction** showed that for most of the choices the stakeholders had clear preferences on which option to choose over time. "Activity and product diversification" was the most selected AO across all scenario worlds, being chosen 75% of the time when the question was asked. It was the preferred measure to be implemented in all 4 APTs across all three-time frames. During the webinar it became clear that "activity and product diversification" was considered a very broad term, potentially explaining why it was so popular. By being unspecific, it could encompass a whole range of activities with different capacity of durability and climate adaptation capacity, so that stakeholders making this choice could choose it as a flexible option that does not require to have specific activities in mind. The opposing choice, "information campaigns" did never enter the adaptation trajectories and was not considered a viable option to combat and prepare for climate change. This finding is interesting as communities, including Fehmarn, seem too often support and promote information campaigns to educate the public. There seems to be a discrepancy between activities and perceived usefulness. Potentially stakeholders had no clear idea of the implications of information campaigns.

It could be observed that choosing different scenario worlds could lead to differential outcomes. In the case of the choice between "economic policy measures" and "financial incentives to retreat from high-risk areas", it seemed to matter whether a stakeholder imagined being on trajectory B or D, the two APTs in

which this choice was available. In APT B, policy measures were chosen across all time steps, whereas in APT D, the two options were on par in the first time step (up to 2030), after which the retreat incentives were chosen until the end of the century.

Contrary to this, for the choice between "water-saving and grey water recycling" and "local sustainable fisheries," it did not seem to make a difference whether the choice was made in APT C or D. in Both worlds "local fisheries" were preferred at the beginning and middle of the century, whereas the "water measures" were chosen more at the middle to end of the century. This particular choice in combination with the finding that "Desalination measures" were also preferred towards the end of the century might indicate that measures that appear to deal with heat and water scarcity seem to gain importance towards the end of the century. Possibly this is informed by the climate projections that predict summers to become hotter, as well as past experiences, e.g. the summer of 2018, during which Fehmarn municipality declared water shortages and asked citizens and tourists to cut down on their water consumption.

"Local circular economy" was a popular choice among stakeholders, being picked 73% of the time and entering the adaptation pathway across all three-time frames in APT C, the only scenario world in which the option was present. When asking the stakeholders how they imagined such a circular system to work, they focused on rather small-scale activities. One stakeholder suggested utilising seagrass that has been washed onto the shore as biomaterial to build housing insulations, fertilise agricultural land, and create products such as pillows. Another stakeholder mentioned that existing projects, like a local dish and cup deposit scheme could be expanded upon. Although the options were popular, the stakeholders did not have concrete ideas on how a truly circular economy would look like on Fehmarn.

Disaster Risk Reduction

For measures concerning **disaster risk reduction**, the trend continued that AOs concerning water scarcity alleviation were primarily chosen towards the end of the century continued. "Drought and water management plans" were never chosen in the first time frame but always at the end of the century. Three out of four times they were also chosen in the middle of the century. This was explained by one stakeholder during the webinar. The climate predictions for the end of the century look more dramatic than the current climate situation. Implemented measures need to be explained by politics and decision-makers. If there is no evident necessity at the moment or soon, then the financial investment is not justified as the cost to benefit calculations are not in the favour of the adaptation measure.

"Coastal protection structures" were chosen in the beginning and middle of the century. In APT A, it was chosen throughout all periods. The rationale behind these choices could be that stakeholders might consider it important to build up structures early to avoid consequences from sea level rise towards the end of the century. The webinar revealed that trust in the local protection structure surveillance is high. Indeed, the general opinion was that if high and extensive coastal protection structures are built now, then this will be one issue less to worry about towards the end of the century. It was also mentioned that the pattern of this choice could indicate a certain optimism in that protection structures are needed in the near future, but towards the end of the century, one could be hopeful that the rising sea level trends are stopped, lessening the need for building more protective structures.

The choice for "medical systems improvement" was made across all time frames in APT A, the only trajectory where it could be chosen. Surprisingly, it was on par with "Fire management plans" in the beginning and end of the century, but not in the middle of the century. As those two choices entered the trajectory to almost equal parts in all time frames, there does not seem to be a clear preference

on which AO is more important. This might indicate different perspectives, where some stakeholders might consider the medical service to be underdeveloped, whereas others consider the fire department, which also frequently aids in disaster management in Germany, to be not sufficiently developed. This might depend on stakeholder's personal experiences with past droughts and other disasters or illnesses.

"Pre-disaster management plans" vs "post-disaster financial funds" showed that stakeholders tended to pick the financial aid for the periods in the beginning and end of the century, whereas the pre-disaster preparation seemed more relevant at the end of the century, potentially indicating that stakeholders might consider disaster preparation from an organised or municipal entity important, as climate risk and severity are predicted to increase at the end of the century. Financial support might be considered adequate towards the beginning and middle of the century to overcome the impacts of climate change or severe weather events.

Social-Ecological Resilience

Selection choices for adaptation options that are aimed at fostering **social-ecological resilience** also yielded interesting trends for Fehmarn. "Adaptation of the groundwater management system" was the dominant choice in this category and entered the adaptation trajectories in all four APT scenarios and across all time frames, apart from the end of the century in APT D, where "Monitoring, modelling and forecasting systems" were chosen. Such a clear choice preference might have to do with the island's climate predicted to become hotter and drier in the summer. So far, the island's freshwater is supplied via a connection to the mainland. However, from the workshop, we identified the desire that stakeholders would like the island to become more independent and less reliant on the mainland supply, potentially leading to the desire to improve their groundwater management. Consultations during the second webinar yielded that is not so much the supply of the freshwater that is considered a potential issue in the future, but the quality of the groundwater on the island. Dry summers, as well as more industrialised activity and over-usage of soils, are considered a threat to the groundwater on Fehmarn.

"Monitoring, modelling and forecasting systems" entered the trajectories in APTs B, C, and D at the end of the century, although across all choices, they were only picked 37% of the time. This shows that stakeholders might be interested in knowing specific occurrences of events when climate hazards are more common rather than establishing these systems now and being in a continuously alerted state. During the webinar we could find that the climate hazards of the near future are still considered to be manageable, whereas towards the end of the century the predictions seemed more dramatic, warranting forecasting systems.

"Dune restoration and rehabilitation measures" got chosen across all time frames when the option was available. Dunes are playing an important role on the island, both as natural coastal protection measures, but also from a touristic perspective. It was, therefore, a clear choice to pick, as the other option was "River rehabilitation and restoration", an option that was not important as there are no large rivers on the island and only a few small canals to drain fields.

"Restoring and managing natural habitats adaptively" was chosen in the beginning and middle of the century, whereas "establishment of ocean pools" came into play at the end of the century. This is interesting, as Fehmarn is an island that has several larger beach lakes functioning effectively as ocean pools. With rising sea levels, stakeholders seem to consider it important to establish more of these to have more natural protection from stormwater surges and rising sea levels.

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ID	Name	Class number	Ratio	APT A			APT B			APT C			APT D		
				S	M	L	S	M	L	S	M	L	S	M	L
T1	Economic Policy Instruments (EPIs)	1	53%					B						D	
T2	Financial incentives to retreat from high-risk areas	1	47%					B						D	
T9	Activity and product diversification	2	75%		A			B			C			D	
T10	Public awareness programmes	2	25%		A			B			C			D	
T11	Local circular economy	3	73%								C				
T12	Tourist awareness campaigns	3	27%								C				
T14	Water restrictions, consumption cuts and grey-water recycling	4	53%								C			D	
T13	Local sustainable fishing	4	47%								C			D	
T15	Beach nourishment	5	60%					B							
T16	Desalination	5	40%					B							
T17	Coastal protection structures	6	56%		A			B			C			D	
T18	Drought and water conservation plans	6	44%		A			B			C			D	
T19	Mainstreaming Disaster Risk Management (DRM)	7	63%								C				
T20	Using water to cope with heat waves	7	37%								C				
T22	Health care delivery systems	8	53%		A										
T21	Fire management plans	8	47%		A										
T24	Pre-disaster early recovery planning	9	52%		A									D	
T23	Post-Disaster recovery funds	9	48%		A									D	
T3	Adaptation of groundwater management	10	63%		A			B			C			D	
T4	Monitoring, modelling and forecasting systems	10	37%		A			B			C			D	
T5	Dune restoration and rehabilitation	11	72%					B			C				
T6	River rehabilitation and restoration	11	28%					B			C				
T7	Adaptive management of natural habitats	12	50%								C				
T8	Ocean pools	12	50%								C				

Figure 119: Results of the stakeholder tool choices grouped as an option within the three strategic vectors **Vulnerability Reduction, Disaster Risk Reduction, Social-Ecological Resilience.** The ratio displays how many times an AO got chosen when it was available. The time frames S, M, and L correspond to the periods "up to 2030", "2030 – 2050", and "2050 – 2100". When an AO was chosen 50% or more it entered the pathway, which is depicted as a coloured square below the time step and scenario world. If the square is grey the AO was chosen less than 50% of the time or was not available in that particular scenario world.

SOCLIMPACT
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ID	Name	Class number	Ratio	APT A			APT B			APT C			APT D		
				S	M	L	S	M	L	S	M	L	S	M	L
T9	Activity and product diversification	2	75%		A			B			C			D	
T11	Local circular economy	3	73%								C				
T5	Dune restoration and rehabilitation	11	72%					B			C				
T3	Adaptation of groundwater management	10	63%		A			B			C			D	
T19	Mainstreaming Disaster Risk Management (DRM)	7	63%								C				
T15	Beach nourishment	5	60%					B							
T17	Coastal protection structures	6	56%		A			B			C			D	
T22	Health care delivery systems	8	53%		A										
T14	Water restrictions, consumption cuts and grey-water recycling	4	53%								C			D	
T1	Economic Policy Instruments (EPIs)	1	53%					B						D	
T24	Pre-disaster early recovery planning	9	52%		A									D	
T7	Adaptive management of natural habitats	12	50%								C				
T8	Ocean pools	12	50%								C				
T23	Post-Disaster recovery funds	9	48%		A									D	
T2	Financial incentives to retreat from high-risk areas	1	47%					B						D	
T13	Local sustainable fishing	4	47%								C			D	
T21	Fire management plans	8	47%		A										
T18	Drought and water conservation plans	6	44%		A			B			C			D	
T16	Desalination	5	40%					B							
T20	Using water to cope with heat waves	7	37%								C				
T4	Monitoring, modelling and forecasting systems	10	37%		A			B			C			D	
T6	River rehabilitation and restoration	11	28%					B			C				
T12	Tourist awareness campaigns	3	27%								C				
T10	Public awareness programmes	2	25%		A			B			C			D	

Figure 120: Results of the stakeholder tool choices ordered by choice popularity. The ratio displays how many times an AO got chosen when it was available. The time frames S, M, and L correspond to the periods "up to 2030", "2030 – 2050", and "2050 – 2100". When an AO was chosen 50% or more it entered the

pathway, which is depicted as a coloured square below the time step and scenario world. If the square is white, the AO was chosen less than 50% of the time. If the square is grey, the option was not available in that particular scenario world.

4.3 Sustainability Performance

The combined set of AOs that entered an adaptation pathway through the choices made by stakeholders will have a certain environmental impact. This impact could be predicted as all AOs were evaluated by the IFP coordinators from BEF Germany. The created pathways differ in their environmental impacts regarding the 5 aspects "Cost Efficiency", "Environmental protection", "Mitigation (GHG emissions) win-wins and trade-offs", "Technical applicability", and "Social acceptability". Values to assess the impacts were discrete and could be "Low", Medium", and "High". The visual representation of the results can be found in Fig. 5. Please refer to the underlying scores in Section 6 "Additional Material" if you would like to find out in more detail the specific sustainability performance of single AOs.

Overall, environmental protection reached low scores, indicating that measures to prepare against catastrophe to ensure survival and comfort are rated higher than implementing measures that are beneficial to the environment. Measures that allow mitigating effects of climate change while providing adaptation to not worsen the possible climate hazard situation were therefore not considered important. This goes hand in hand with the low scores that were reached for mitigation win-wins, indicating that the trade-offs with climate adaptation would be high. Few of the proposed AOs would take care of multiple problems at the same time and implementing one would come at the cost of another. In general, measures implemented in the APT scenario world C would cause the greatest environmental protection (although values would remain at a medium level), while in all other scenarios the environmental protection would be low.

Technical applicability was rated generally high, as Germany is a developed country and a lot of the proposed technologies are available if the question of cost is disregarded. The question then remains whether a solution would be feasible within its economic, social, and environmental contexts which have to be assessed first. Some of the proposed measures could certainly be improved in their technical development, but in general, are considered to be already at a high level and readily available if the funds are present and willing to implement is there.

Measures with the highest Social Acceptability are found in APT A scenario, reaching high values whereas all other scenario worlds have a medium score on the social acceptability of the implemented measures. This appears to be logical as decision-makers in scenario world A tend to choose cost-efficient AOs that do not do much to change the status quo. As changes are not dramatic, stakeholders should have no reason to oppose them. Unsurprisingly, social acceptability of measures is lowest for APT D, especially towards the end of the century. This possibly indicates that measures are getting more extreme, with social acceptability for them declining as time progresses. Measures that are vaster and more invasive (such as resettling whole communities), should go hand in hand with lower social acceptance.

The cost-efficiency of the chosen measures tended to be medium to high. Highest cost-efficiency occurred in APT A; the scenario world that aims to invest as little as possible in adaptation measures. Surprisingly, APT D had the second-highest cost-efficiency values for AOs chosen at the end of the century. This result could appear odd in the light that one would assume that more extreme measures would be implemented in this APT as the century progresses. However, stakeholders seem to have chosen measures that appear to be relatively cost-efficient even though they were deciding with the mindset of a decision-maker from scenario world D, who would have a high willingness to invest a lot of money in climate change adaptation measures.

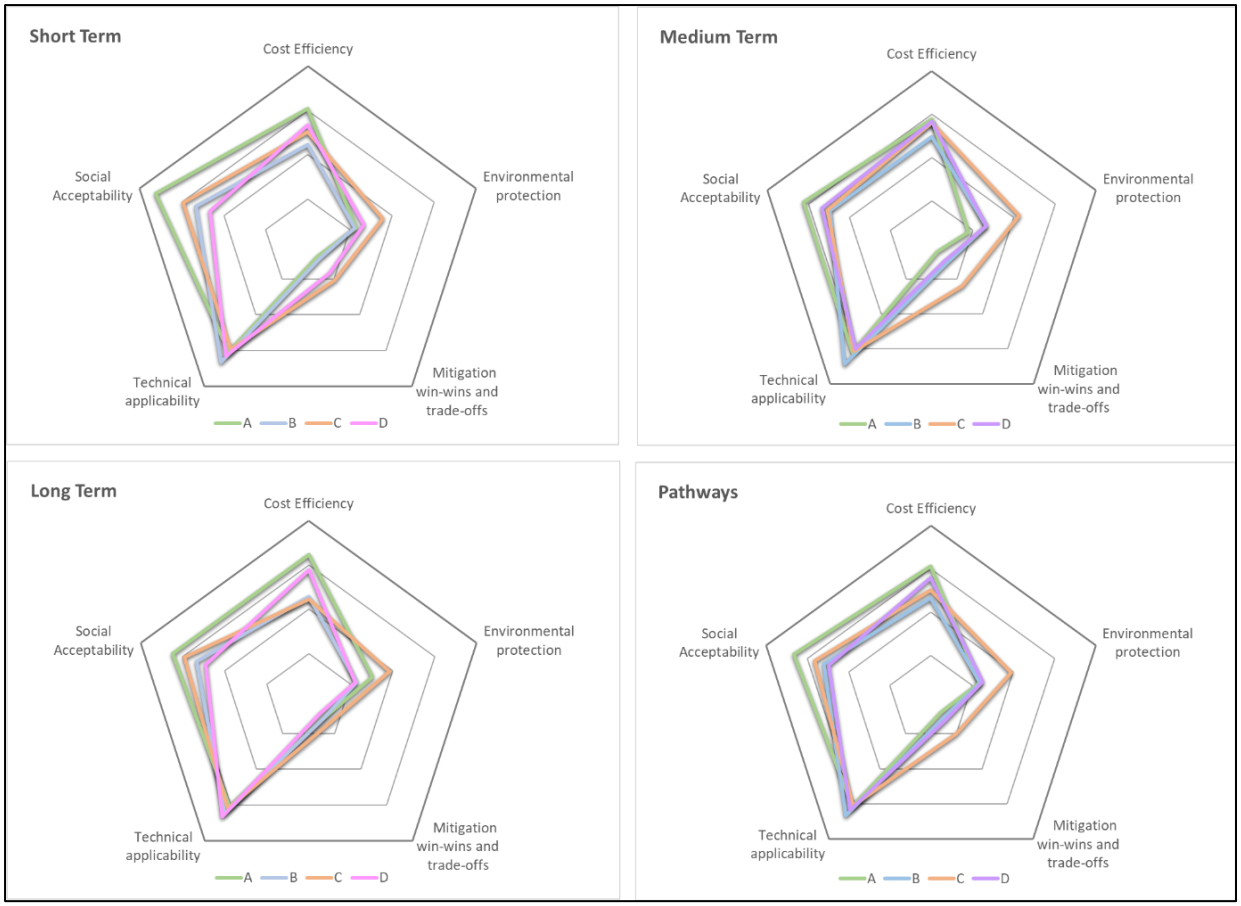

Figure 121: Pathway evaluation for the tourism sector considering: Cost Efficiency; Environmental protection; Mitigation (GHG emissions) win-wins and trade-offs; Technical applicability; and Social acceptability. The analysis was conducted for the four policy pathways scenarios: APT A - Minimum Intervention; APT B - Economic Capacity Expansion (ECE); APT C- Efficiency Enhancement (EE); APT D - System Restructuring (SR), for different timeframes: short, medium, and long term, as well as an average analysis across all timeframes. Evaluation based on the personal assessment of Fehmarn IFP Baltic Environmental Forum Germany.

4.4 Further comments

General discussion on the stakeholder engagement process and climate adaptation yielded further insights on stakeholder attitudes. It was acknowledged that climate change is coming and even mitigation measures will not do much to reduce the impacts. By implementing island-wide measures the climatic changes cannot be stopped in the eyes of some stakeholders. One person said that it is therefore important to always have a plan B in case the adaptation measures will not work. It was also acknowledged that there are limits to adaptation. Certain activities can only help so much before they cannot buffer the impacts of climate change. Even if all preventive and absorbing measures are implemented, it will depend on the severity of climate change to show how effective they are. There are certain events for which adaptive measures will not help, for instance, the increased occurrence of dangerous jellyfish. In those instances, inhabitants and tourists know that nothing can be done, and other solutions have to be found.

What was pointed out is that the island communities need to have an administrative structure that will enable them to adapt to climatic changes. If the municipality of Fehmarn does not have the means to coordinate and implement adequate measures, then creating adaptation plans is of no use. A negative

example for this is the planned construction of the "Fixed Fehmarn Belt" tunnel that will connect Fehmarn and Denmark. Although the community wants to become climate neutral by 2030, the tunnel and its connected infrastructure will cause lots of car traffic across the island. Fehmarn municipality and inhabitants are against the mega-project but cannot intervene as decisions are made on a federal level.

Playing through the stakeholder tool was considered a useful activity to start thinking about climate adaptation but working through four scenario worlds was considered a lot. One stakeholder remarked that it was quite challenging and confusing to focus on the mindset of a specific world and make choices based on the APT attitudes. She said that sometimes she just picked a random option to move on to the next choice. This was potentially the case for other stakeholders as well. It was stated that focussing on one scenario world in more detail could have potentially been more productive. Regardless of the tool's complexities, it was considered valuable to end up with a plan outlining the general adaptation trajectories and a combination of measures.

5 Main conclusions

The activities of D7.3 were conducted in cooperation with stakeholders from Fehmarn island to create Adaptation Policy Pathways that lay out a trajectory of adaptation options that could be utilised on Fehmarn to prepare for an uncertain climate future. Overall, the process was considered a valuable activity by the participating stakeholders. Stakeholders engaged with the process and gave feedback on the utilised tool as well as its usefulness. Discussions were insightful and laid open the limitations of such a process. As the proposed stakeholder tool was set within the framework of a complex methodology, the IFP coordinators BEF Germany simplified the process to make it more accessible for the participating stakeholders and to receive more directed results on climate adaptation measure preferences.

The resulting adaptation pathways for different scenario worlds form a useful basis for discussing adaptation measures and can be used to compare differences and similarities between stakeholder preferences among the participating SOCLIMPACT islands. Working through the stakeholder tool was considered a good exercise to engage with the topic of climate adaptation. However, it was just a game, and one stakeholder remarked that "reality begins where the stakeholder tool ends".

6 References

Suckall, N., Tompkins, E. L., Nicholls, R. J., Kebede, A. S., Lázár, A. N., Hutton, C., Vincent, K., Allan, A., Chapman, A., Rahman, R., Ghosh, T., & Mensah, A. (2018). A framework for identifying and selecting long term adaptation policy directions for deltas. *Science of the Total Environment*, *633*, 946–957. https://doi.org/10.1016/j.scitotenv.2018.03.234

7 Additional Material

7.1 Conducted Events

7.1.1 Workshop Agenda (translated to English)

10:30 – 10:40	**Welcome**	Introduction of all participants
10:40 – 11:15	**Climate predictions for Fehmarn**	Prof. Dr. Bodo Ahrens (Meteorologist, Goethe-Universität Frankfurt a.M.) will present the most recent climate models and explain what climatic changes Fehmarn is facing in the coming 80 years.
11:15 – 11:35	**Presentation of the Fehmarn tourism survey results**	In 2019, a tourism survey was conducted on Fehmarn to investigate the expectations and attitudes of tourists on the island. Damian Arikas (BEF) will present the results and bring them into a climatic context.
11:35 – 11:45	Coffee break	
11:45 – 13:00	**Scenarios for climate adaptation strategies on islands**	To create a basis for climate adaptation policies across European islands, your knowledge is required! We want to investigate what decisions are being taken by experts on Fehmarn when faced with a changing climate. This section is accompanied by Dr. Philipp Siegel (BEF).
13:00 – 13:30	**Discussion & Future Activities**	The topic of climate change adaptation provides a lot of material for discussion. Different perspectives of stakeholders from economics, science and politics are important for good solutions.

7.1.2 Workshop participants, 25.9.2020

Name	Organization	Sectors
Bodo Ahrens	Universität Frankfurt	Scientific institution
Damian Arikas	BEF Germany	NGO
Oliver Behncke	Leitung Tourismus-Service Fehmarn	Municipal administration
Beate Burow	Umweltrat Fehmarn	Municipal administration
Moira Deuker	BEF Germany	NGO
Peter Haltermann	Fehmarn Wege, Landwirt	NGO
Wolfgang Jensen	Landesbetrieb für Küstenschutz, Meeresschutz und Nationalpark Schleswig-Holstein	Federal administration
Lars Lausat	Stadt Fehmarn, Fachbereich Bauen und Häfen	Municipal administration

Philip Schinnagel	CORE Kiteboarding GmbH	Private sporting company
Cornelia Schönbrodt-Leßmann	Tourismus-Service Fehmarn	Municipal administration
Philipp Siegel	BEF Germany	NGO
Jürgen Zuch	Regional- und Projektmanagement Feste Fehmarnbelt- und Fehmarnsundquerung Fehmarn und Großenbrode	District administration
Rolf Reijnders	Umweltrat Fehmarn	Municipal administration
Dirk Lucht	Schleswig-Holstein Netz AG	Municipal energy company

The event was held in the largest meeting room of the municipality. The number of participants was relatively low although interest in the event was large. Unfortunately, not all those who were interested could participate due to restrictions that were put in place because of measures in response to Covid-19.

7.1.3 Webinar Agenda (translated to English)

10:30 – 10:35	**Welcome and Log In**	
10:35 – 11:00	**Insights from climate change adaptation strategies**	Thomas Vodde, marketing director and vice-mayor of the island Juist: Tourism and climate strategies, what problems do islands have and which adaptation strategies can be pursued?
11:00 – 11:05	**Presentation of stakeholder tool results**	During the Fehmarn-workshop in September 2020, stakeholders were asked to participate in an exercise about preferences concerning different climate adaptation strategies. Her ewe presents the results.
11:05 – 11:50	**Discussion of stakeholder tool results**	Now we would like to know what you think about the results, why you think certain decisions were taken, and what the insights could mean for Fehmarn.
11:50 – 12:00	**Future activities**	In the end, we will present to you the further steps in the SOCLIMPACT project and what other activities BEF Germany has planned in cooperation with the environmental council of Fehmarn.

7.1.4 Webinar participants, 30.11.2020

Name	Organization	Sectors
Jenny Schmigale	Scandlines Deutschland GmbH	Private transportation company
Markus Groth	Climate Service Center Germany	Scientific Institution
Cornelia Schönbrodt-Leßmann	Tourismus-Service Fehmarn	Municipal administration
Philip Schinnagel	CORE Kiteboarding GmbH	Private sporting company
Damian Arikas	BEF Germany	NGO
Moira Deuker	BEF Germany	NGO
Philipp Siegel	BEF Germany	NGO
Matthias Grätz	BEF Germany	NGO
Beate Burow	Umweltrat Fehmarn	Municipal administration
Rolf Reijnders	Umweltrat Fehmarn	Municipal administration
Thomas Vodde	Juist island	Municipal administration

Similar to the first event, interest was larger than it appears from the participant list. More people had signed up to the webinar, but due to technical problems, health issues and other reasons, not everyone joined the meeting.

7.2 Adaptation option characterisation

This characterisation formed the basis for assessing the sustainability performance of the four different APTs. Here we present the values that were assigned to the five criteria (cost efficiency, environmental

protection, mitigation win-wins and trade-offs, technical applicability, social acceptability) for each option. For further descriptions and a clearer resolution of the options please refer to the "Classes of Adaptation" section within the island stakeholder tool.

Options Characterization			Criteria				
ID	Name	Class of adaptation	Cost Efficiency	Environmental protection	Mitigation win-wins and trade-offs	Technical applicability	Social Acceptability
A1	Economic Policy Instruments (EPIs)	1. Financial capital	3	2	3	4	2
A2	Financial incentives to retreat from high-risk areas	1. Financial capital	3	1	1	4	2
A3	Adaptation of groundwater management	10. Provisioning services	3	2	1	2	4
A4	Monitoring, modelling and forecasting systems	10. Provisioning services	2	1	1	3	4
A5	Dune restoration and rehabilitation	11. Regulating and Maintenance Services	2	3	1	4	3
A6	River rehabilitation and restoration	11. Regulating and Maintenance Services	2	3	2	4	4
A7	Adaptive management of natural habitats	12. Cultural services	3	3	2	4	4
A8	Ocean pools	12. Cultural services	2	4	1	4	3
A9	Activity and product diversification	2. Human capital	3	1	1	4	3
A10	Public awareness programmes	2. Human capital	2	2	2	4	4
A11	Local circular economy	3. Social capital	3	4	4	2	4
A12	Tourist awareness campaigns	3. Social capital	1	2	1	4	3
A13	Local sustainable fishing	4. Natural capital	3	4	3	3	2
A14	Water restrictions, consumption cuts and grey-water recycling	4. Natural capital	3	3	2	3	2
A15	Beach nourishment	5. Physical capital	2	1	1	4	3
A16	Desalination	5. Physical capital	2	1	1	3	3
A17	Coastal protection structures	6. Managing long term risk	3	2	1	3	3
A18	Drought and water conservation plans	6. Managing long term risk	4	3	2	4	2
A19	Mainstreaming Disaster Risk Management (DRM)	7. Preparedness	4	1	2	4	2
A20	Using water to cope with heat waves	7. Preparedness	2	1	1	4	4
A21	Fire management plans	8. Response	4	4	3	4	4
A22	Health care delivery systems	8. Response	3	1	1	3	4
A23	Post-Disaster recovery funds	9. Post disaster recovery and rehabilitation	3	1	1	4	4
A24	Pre-disaster early recovery planning	9. Post disaster recovery and rehabilitation	4	2	1	3	4

This project has received funding from the European Union's Horizon 2020 research and innovation programme under Grant Agreement No776661

SOCLIMPACT

Downscaling climate impacts and decarbonisation pathways in EU islands, and enhancing socioeconomic and non-market evaluation of Climate Change for Europe, for 2050 and beyond

SOCLIMPACT

This project has received funding from the European Union's Horizon 2020 research and innovation programme under Grant Agreement No776661

Work Package 7:

This is a result of Tasks 7.3. This deliverable will include the agendas, the list of participants, and the workshops outputs including the decisions taken.

Deliverable 7.3.

Workshop report - Madeira

Island Focal Point coordinated by AREAM

Filipe Oliveira, Elizabeth Olival, Hugo Vasconcelos

1 Introduction

This document presents the results of the stakeholders' consultation process to design the **SOCLIMPACT Adaptation Pathways Workshops in the Autonomous Region of Madeira**. This process is included in SOCLIMPACT Task 7.3 - Engage islands' stakeholders in the design of alternative pathways. According to the project Description of Action, it is expected that the online consultation process uses as background the main results from previous WPs and the material prepared in Task 7.2 (D7.2).

In the consultation process, the following objectives are expected to be covered:

13. **Identify and present the characterized packages of adaptation and risk management options** available for each archipelago/island.
14. **Develop detailed archipelago/island integrated adaptation pathways**, in three timeframes: Short term (up to 2030), Mid-century (up to 2050) and End-century (up to 2100).
15. **Evaluate** and rank pathways for Blue Economy sectors.

In Madeira, the consultation process was split into two online webinars. The original plan was to hold physical workshops. However, public health concerns due to Covid-19 forced changes to the original plan and the consortium decided to develop two shorter online sessions mixed with a survey. The rationale was to make it as easier as possible for both **Island Focal Point (AREAM)** and **Local Working Group** (stakeholders) to carry out the proposed work, without seriously compromising the **scientific quality** of the projects' outcomes.

Madeira Local Working Group webinars were performed on the 29th of September 2020 and on the 11th of November 2020. The total number of surveys filled by the stakeholders was 103.

The workshop was performed taking into consideration the specific requirements of the region and the resources available. For Madeira archipelago significant gaps in data were and substantially complemented with external sources (mostly local information). Data gaps are related with the specific geographic context of the region and are explain in the correspondent deliverables. Oceanic islands face diverse development challenges, mainly due to their distance from the mainland and limited land space, and where standardized mainland-based strategies cannot be directly implemented, as the complexity of the local context needs to be accounted for (SOCLIMPACT - D4.5).

The 24 measures available per sector were characterized by the Island Focal Point using the five criteria defined. In addition, up to six additional adaptation measures per island and per sector could be added by the Island Focal Point and Local Working Group (class of adaptation "Local Knowledge"). The "Local Knowledge" options for Madeira were developed considering the climate change local program, assessment and the local experts' knowledge.

The report follows what was defined in the proposal by presenting the online workshop materials, namely: (1) decisions taken; (2) agendas and (3) list of participants.

The **Adaptation Pathways methodology applied in SOCPLIMPACT was based in the framework developed by Suckall et al.2018 and considered the three main strategic vectors for climate resilience: (1) vulnerability reduction** - Five capitals of Sustainable Livelihoods Approach (SLA); **(2) Disaster Risk Reduction** – developed throughout Hyogo and Sendai Frameworks; **(3) Social-Ecological Resilience** – that emerge from the Millennium Ecosystem Assessment (MEA) and Common International Classification of Ecosystem Services (CICES).

The **Adaptation Pathways** aim to capture the policy preferences in time and the relevancy of the context traduced in investment and commitment (Suckall et al., 2018). These Adaptation Pathways Trajectories

(APT) were delineated as a set of adaptation classes each one with two options/measures to choose from, for more detailed information about the Adaptation Pathway Trajectories please see the link. Each individual stakeholder choices contribute to create a policy pathway together with the other choices made by different stakeholders. If most of the stakeholders chose one option, then that measure was incorporated in the island adaptation pathway for that specific class in each APT, per sector. The result of the series of choices in the three timeframes defines the pathway. If there is a tie between two options, then they will both be included and become part of the adaptation pathway in each time frame. The options were included in the pathway when they were selected more than 50% in each time frame in each APT. Local Knowledge measures were included if they were chosen by at least 20% of all stakeholders for the aquaculture sector, 17% for the energy and tourism sectors, and 25% for the maritime transport, according with the number of local knowledge measures proposed.

Pathway options are grouped around three objectives: (1) actions to reduce socio-economic vulnerability; (2) actions that address disaster risk reduction; and (3) actions that affect social-ecological resilience. Adaptation policy under **vulnerability reduction**, **disaster risk reduction**, and **social-ecological resilience** were developed considering classes of adaptation under which the participants decide which are the most relevant options for the Madeira archipelago.

For **vulnerability reduction** five classes were considered: (1) Financial capital; (2) Human capital; (3) Social capital; (4) Physical capital; and (5) Natural capital. For **Disaster Risk Reduction** four classes were considered: (6) Risk mitigation; (7) Hazard preparedness; (8) Disaster response; (9) Post disaster recovery. For **Social-Ecological Resilience** three classes were considered: (10) Provisioning services (11) Regulation and maintenance services; and (12) Cultural services.

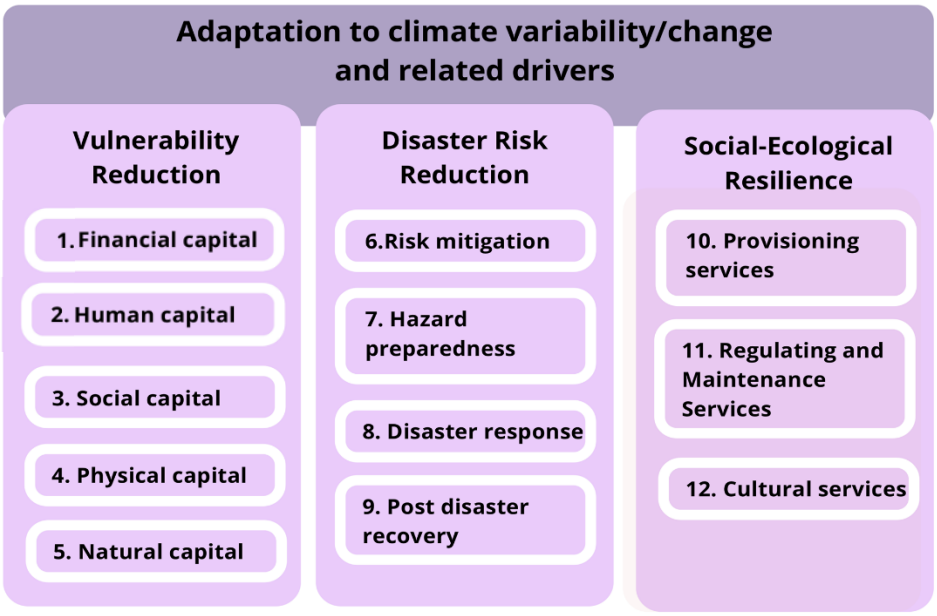

Figure 122 - The 12 classes of adaptation in the figure are structured in three broader objectives (Vulnerability reduction, Disaster Risk reduction and Ecosystem and social resilience).

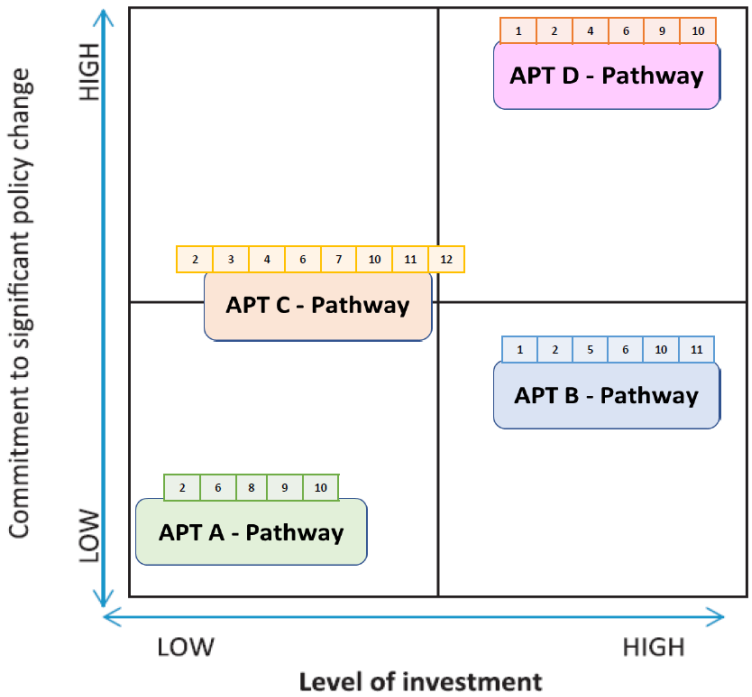

Figure 123 - The 12 classes of adaptation are distributed by the four Adaptation Pathway Scenarios. The classes can be present in one or more APTs, according with their characteristics.

The results of the Adaptation Pathways are presented in this report in two different outputs per sector: **(1) Selected Adaptation Pathways; and (2) Sustainability Performance.**

The (**1) Selected Adaptation Pathways** outputs aim to capture the acceptance of each adaptation option by calculating the options (number of times) selected within the maximum number of times they can be selected (Ratio – Selected/Maximum). This considers the number of times the option was selected by all stakeholders in all four APTs and three timeframes.

The **(2) Sustainability performance** outputs aim to characterize each pathway through the evaluation of the options chosen in each APT. The options selected in each APTs are evaluated considering a set of criteria: Cost Efficiency; Environmental protection; Mitigation; Technical applicability; Social acceptability (Table 3).

Table 19 – Description of the criteria used to evaluate the adaptation pathways performance.

Criteria	Description	
Cost Efficiency	Ability to efficiently address current or future climate hazards/risks in the most economical way	Higher score = higher cost efficiency
Environmental protection	Ability to protect the environment, now and in the future	Higher score = higher environmental protection
Mitigation	Current ability to meet (win-win) or not (trade-off) the island/archipelago's mitigation objectives *4 – The adaptation measure contributes for the reduction of CO2* *3 – The adaptation measure is neutral or contributes a little for the reduction of CO2* *2 – The adaptation measure emits CO2 but is more efficient, contributing a little for the for the emission of CO2. Example: Efficient air conditioning system* *1 – The adaptation measure contributes negatively for the mitigation. Example: Normal air conditioning or desalinization.*	Higher score = higher mitigation win-wins and lower trade-offs
Technical applicability	Current ability to technically implement the option/measure in the island/archipelago	Higher score = higher technical applicability
Social acceptability	Current social acceptability of the option/measure in the island/archipelago	Higher score = higher social acceptability

2 Summary of Background Material

2.1 Climate, socio-economic and adaptation information

To support the decisions within the Survey Tool and to define the Adaptation Pathways, relevant information related with climate, socio-economy and adaptation were presented to stakeholders. The deliverable 7.2 (Background Materials) were the preferential source information but additional information was used, namely the Autonomous Region of Madeira Climate Change Adaptation Strategy (Estratégia CLIMA-Madeira, September 2015).

2.1.1 Climate projections

The table below refers to the projected changes on hazard indicators until 2100 produced by the SOCLIMPACT and the projected changes on vulnerability indicators until 2099 produced in the scope of the *Estratégia Clima Madeira.*

Variable	Details
Fish species thermal stress	Produced by SOCLIMPACT More information
Extreme temperature Cooling degree days Wind energy productivity Photovoltaic productivity Energy droughts Standardized Precipitation- Evapotranspiration Index - SPEI	Produced by SOCLIMPACT More information
Mean sea level rise Waves extreme Winds extremity index	Produced by SOCLIMPACT More information
Annual mean significant wave height Extreme wave return time	Produced by SOCLIMPACT More information
Humidity index Beach reduction	Produced by SOCLIMPACT More information
Fire weather index	Produced by SOCLIMPACT More information
Precipitation Variation Temperature Variation Hydric resources Hydric Energy Heat waves Hydrogeomorphology risks Meteorological fire risk Air quality and vector borne diseases	Estratégia Clima Madeira More information

2.1.2 Economic Projections

Variable	Details
Keep ports operability	Produced by SOCLIMPACT More information
Seabream production	Produced by SOCLIMPACT More information
Cooling energy demand Desalination energy demand	Produced by SOCLIMPACT More information
Monthly energy consumption for climatization	Estratégia Clima Madeira More information

2.1.3 Non-Market Valuation

Variable	Details
How tourists react to climate change	Produced by SOCLIMPACT More information

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3 Sector Adaptation Pathways

3.1 Aquaculture

The identification and description of the adaptation measures for the aquaculture sector, including the local knowledge measures, are on the Annex AI.

Aquaculture pathways are based on choices made by 23 experts island stakeholders.

3.1.1 Selected Adaptation Pathways

ID	Name	Class number	Ratio	APT A			APT B			APT C			APT D		
				S	M	L	S	M	L	S	M	L	S	M	L
A1	Financial schemes, insurance and loans	1	55%					**B**						**D**	
A2	Tax benefits and subsidies	1	45%					**B**						**D**	
A10	Efficient feed management	2	54%		**A**			**B**			**C**			**D**	
A9	Awareness campaigns for behavioural change	2	46%		**A**			**B**			**C**			**D**	
A11	Addressing consumer and environmental concerns at the local	3	55%								**C**				
A12	Promote cooperation to local consumption	3	45%								**C**				
A13	Integrated multi-trophic aquaculture (IMTA)	4	54%								**C**			**D**	
A14	Short-cycle aquaculture	4	46%								**C**			**D**	
A16	Submersible cages	5	75%					**B**							
A15	Recirculation Aquaculture Systems (RAS)	5	25%					**B**							
A17	Climate proof aquaculture activities	6	53%		**A**			**B**			**C**			**D**	
A18	Risk-based zoning and site selection	6	47%		**A**			**B**			**C**			**D**	
A19	Disease prevention methods	7	70%								**C**				
A20	Environmental monitoring and Early Warning Systems (EWS)	7	30%								**C**				
A21	Mainstreaming Disaster Risk Management (DRM)	8	61%		**A**										
A22	Contingency for emergency management, early	8	39%		**A**										
A23	Recovery Post-Disaster plans	9	65%		**A**									**D**	
A24	Recovery Post-Disaster funds	9	35%		**A**									**D**	
A3	Feed production	10	55%		**A**			**B**			**C**			**D**	
A4	Species selection	10	45%		**A**			**B**			**C**			**D**	
A6	Best Management Practices	11	55%					**B**			**C**				
A5	Selective breeding	11	45%					**B**			**C**				
A7	Create educational visits	12	55%								**C**				
A8	Promote aquaculture cuisine	12	45%								**C**				
A29	(A29) Aquaculture as an alternative to fishing	Local	30%		**A**			**B**			**C**			**D**	
A27	(A27) Aquaculture and circular economy	Local	23%		**A**			**B**			**C**			**D**	
A28	(A28) Implement measures for increasing local industry self-	Local	22%		**A**			**B**			**C**			**D**	
A25	(A25) Long-term environmental data collection and management	Local	18%		**A**			**B**			**C**			**D**	
A26	(A26) Implementation of local sanitary programs at regional scale	Local	7%		**A**			**B**			**C**			**D**	

Figure 124 - Adaptation options for the aquaculture sector. Options are identified with an ID number, full name, class of adaptation number and ratio. Adaptation objectives are identified in each option by colour: ***Addressing Drivers of Vulnerability (red), Disaster Risk Reduction (blue), Social-Ecological Resilience (green)*** *and* ***Local Knowledge adaptation options (grey)****. Each APT (APT A; APT B; APT C; APT D) is represented in three timeframes: S - Short term (up to 2030), M- Medium term (between 2030 and 2050), L - Long term (between 2050 and 2100). Bold letters in each ATP indicate the option was available to be selected. Highlighted options indicate the measure was selected in each ATP and timeframe: ATP A (light blue); ATP B (light green); ATP C (Light orange) and ATP D (light purple). Space with colour: option was selected for the timeframe: Short term, Medium term, or Long term. Bold letter: option is available in the APT.*

The measures selected for each Adaptation Pathway for the aquaculture sector can be consulted in the Annex BI. It is also possible to verify the percentage of stakeholders that selected each measure by Adaptation Pathway Trajectory and time frame.

The **human capital** (class 2) measure considered a priority to address **Vulnerability Reduction** for the APT B (capacity expansion) was "Awareness campaign and behavioural change" for all time frames, which indicates the necessity of this measure on a scenario of low political commitment. Under APT D (system restructuring) the considered priority was "Efficient feed management" for all time frames, which is coherent with a scenario of high political commitment.

Under the APT B and D, both with high level of investment, the **financial capital** measures (class 1) considered a priority for the short and long terms are the same. It indicates that regardless the level of commitment, at short term the region is more focused on "Financial schemes, insurances and loans", and on the long term the focus is "Tax benefits and subsidies".

In the scope of **social capital** (class 3) and under the APT C (efficient enhancement), "Promote cooperation to local consumption" was consider a priority for the short term. For medium and long term, the priority considered was "Addressing consumer and environmental concerns at the local level".

The measure "Short-cycle aquaculture", **physical capital** (class 4), was considered a priority for all time frames for the APT C and on short for the APT D. Currently, "Integrated multi-trophic aquaculture (IMTA)" is not implemented in Madeira island. This measure was selected for the medium and long time frame for APT D, being the priority consistent with a system restructuring scenario.

In opposition to "Recirculation Aquaculture Systems (RAS)", the measure "Submersible cages", **natural capital** (class 5), was a clear priority in all time frames of the scenario where the measure was available, i.e. scenario of capacity expansion. The measure enables to submerge the cages according with temperature gradient and to protect them from sea storms, being considered a good adaptation measure. Furthermore, it decreases the cages visual impact, which, currently, is one of the main regional social constraints to the development of this blue economy sector.

For **Disaster Risk Reduction**, in opposition to "Environmental monitoring and Early Warning Systems (EWS)", the measure "Disease prevention methods", **hazard preparedness** (class 7) was consider a priority in all time frames of the scenario where the measure was available, scenario of efficiency enhancement.

The measure considered a priority to address **risk mitigation** (class 6) for the APT's B, C and D was "Climate proof aquaculture activities" in the majority of the time frames, in opposition to the measure "Risk-based zoning and site selection", which was the priority for the scenario of minimum intervention for all time frames and for the short term for the APT C and D.

In the scope of **disaster response** (class 8) the priority for the short term was the measure "Mainstreaming Disaster Risk Management (DRM)" and for the medium and long term the regional priority considered was "Contingency for emergency management, early harvest and/or relocation", for minimum intervention scenario.

Under the **post disaster recovery** (class 9), the region gave priority to the measure "Recovery Post-Disaster plans" for all time frames in the APT A and in the short term for the APT D, in opposition with the measure "Recovery-disaster funds", that was a priority for the medium and long terms for the APT D (high investment/ high commitment).

In **Social-Ecological Resilience** adaption objective, concerning **provisioning services class** (class 10), the region considered a priority the measure "Feed production" for all time frames in the scenarios minimum intervention (APT A) and capacity expansion (APT B), both scenarios with low commitment. This measure was a priority in the APT C and APT D at short term, being the measure "Species selection" the priority measure at medium and long term for these APTs.

The measure to address the class **regulating and maintenance services** (class 11) considered a priority by the stakeholders was "Best management practices" for the medium and long term for the APT C, in opposition with the measure "Selective breeding", which was a regional priority in all time frames for the capacity expansion (APT B) intervention, and at short and medium terms for the scenario efficiency enhancement.

Under **cultural services** (class 12) the regional priority is to promote "Aquaculture cuisine" at the short term for the APT C, in order to increase the local consumption, and "Create educational visits" at medium and long terms to increase awareness on aquaculture advantages.

Local knowledge priorities where focus on "Aquaculture as an alternative to fishing" on all time frames of the lower commitment scenarios, APT A and APT B, and at short term in the efficiency enhancement scenario, APT C. It highlights the role of aquaculture in the preservation the natural resources. The following priorities are related with circular economy and self-sufficiency in aquaculture, which is important to the regional food security and decrease the region dependence from the exterior. They are strategic objectives to increase the archipelago resilience to climate change.

The measure "Long-term environmental data collection and management" at regional level was also considered a priority in the APT A, C and D, which is important to ensure the reduction of the aquaculture impacts and increase its social acceptability.

3.1.2 Sustainability Performance

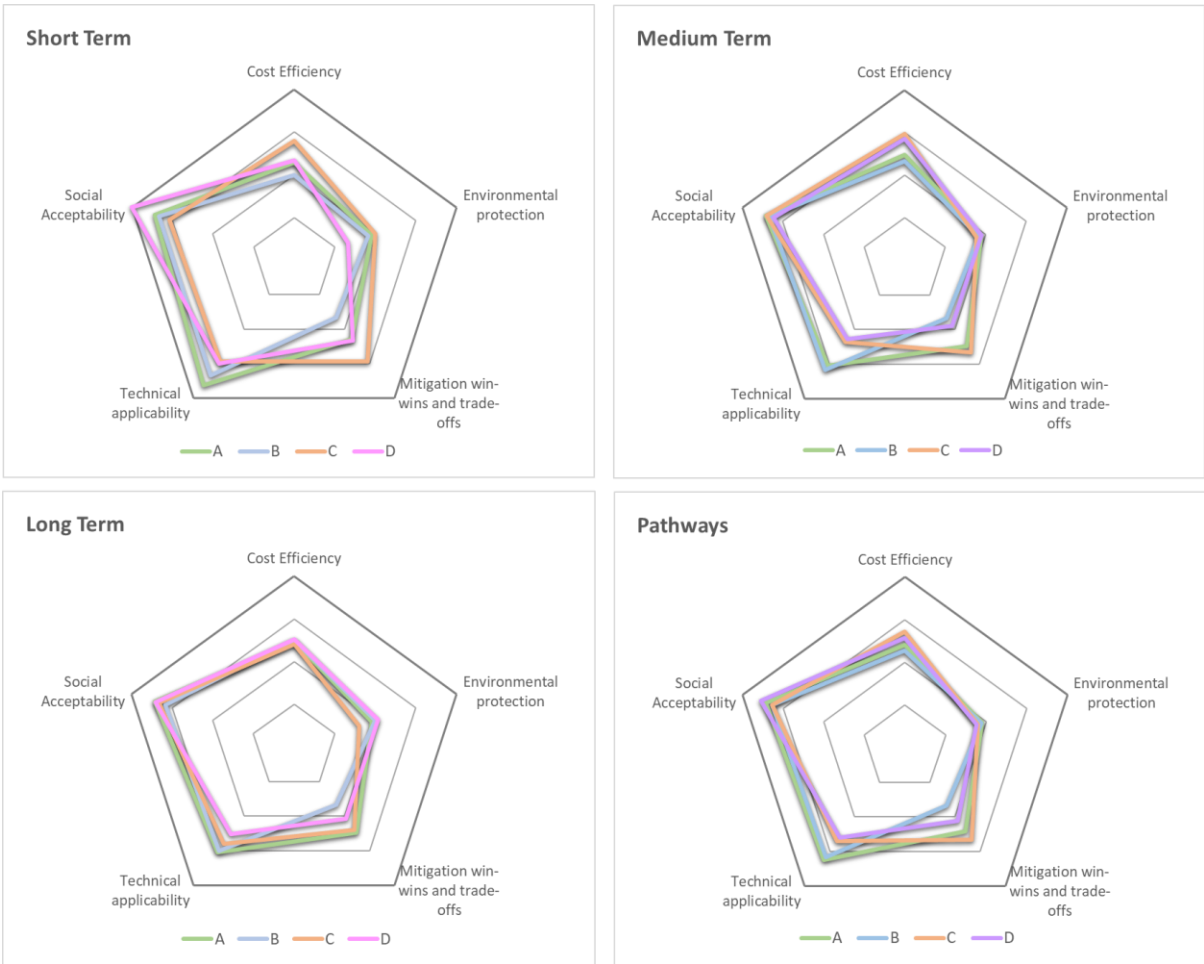

Figure 125 - Pathways evaluation for aquaculture sector considering: Cost Efficiency; Environmental protection; Mitigation (GHG emissions); Technical applicability; Social acceptability. The policy pathways scenarios: APT A - Minimum Intervention; APT B - Economic Capacity Expansion; APT C- Efficiency Enhancement; APT D - System Restructuring, for different timeframes: short, medium, and long term.

On the short term, the measures selected for the APT A have better technical applicability performance, the measures selected for the APT D have better social acceptability performance and the measures selected for the APT C have better cost efficiency, environmental protection and mitigation performances.

On the medium term, the measures selected for the APT B have better technical applicability performance, and the measures selected for the APT C have better the cost efficiency, social acceptability, and mitigation performances.

On the long term, all APT's have similar performance in all criteria. However, the measures selected for the APT B have lower mitigation performance, the measures selected for the APT C have lower environmental protection performance and the measures selected for the APT D have lower technical performance.

In the long term, for all APTs, the technical applicability is lower, but the measures were classified for 2020 for this criterion and should be expected more maturity for this adaptation solutions after 2050.

Overall, the APT C is the one with better contribution for the regional mitigation objectives of reduce at least 40% of GHG emissions for 2030 and achieve climate resilience and carbon neutrality (85% GHG emissions reduction) by 2050, according the Sustainable Energy and Climate Action Plan under development, and have highest cost efficiency performance. The APT D is the scenario with better social acceptance performance.

3.2 Energy

The identification and description of the adaptation measures for the energy sector, including the local knowledge measures, are on the Annex AII.

Energy pathways are based on choices made by 25 expert island stakeholders

3.2.1 Selected Adaptation Pathways

ID	Name	Class number	Ratio	APT A			APT B			APT C			APT D		
				S	M	L	S	M	L	S	M	L	S	M	L
E2	Financial support for smart control of energy in houses and	1	55%					B						D	
E1	Financial support for buildings with low energy needs	1	45%					B						D	
E9	Green jobs and businesses	2	63%		A			B			C			D	
E10	Public information service on climate action	2	37%		A			B			C			D	
E11	Small scale production and consumption (prosumers)	3	63%								C				
E12	Risk reporting platform	3	37%								C				
E13	Energy storage systems	4	68%								C			D	
E14	Collection and storage of forest fuel loads	4	32%								C			D	
E16	Demand Side Mangement (DSM) of Energy	5	59%					B							
E15	SeaWater Air Conditioning (SWAC).	5	41%					B							
E17	Review building codes of the energy infrastructure	6	53%		A			B			C			D	
E18	Upgrade evaporative cooling systems	6	47%		A			B			C			D	
E20	Grid reliability	7	55%								C				
E19	Early Warning Systems (EWS)	7	45%								C				
E22	Energy-independent facilities (generators)	8	52%		A										
E21	Study and develop energy grid connections	8	48%		A										
E23	Energy recovery microgrids	9	57%		A									D	
E24	Local recovery energy outage capacity	9	43%		A									D	
E3	Energy efficiency in urban water management	10	68%		A			B			C			D	
E4	Underground tubes and piping in urban planning	10	32%		A			B			C			D	
E6	Urban green corridors	11	52%					B			C				
E5	Biomass power from household waste	11	48%					B			C				
E7	Educational garden plots	12	69%								C				
E8	Heated pools with waste heat from power plants	12	31%								C				
E25	(E25) Minimize islands energy dependence from imported fossil	Local	31%		A			B			C			D	
E26	(E26) Diversification on energy supply and electricity generation	Local	22%		A			B			C			D	
E29	(E29) Promote electric mobility integrated in smart grids with	Local	17%		A			B			C			D	
E27	(E27) Implement electricity prices for renewable energy	Local	14%		A			B			C			D	
E30	(E30) Electrification of energy demand	Local	10%		A			B			C			D	
E28	(E28) Modelling and forecasting of supply and demand	Local	6%		A			B			C			D	

Figure 126 - Adaptation options for the energy sector. Options are identified with an ID number, full name, class of adaptation number and ratio. Adaptation objectives are identified in each option by colour: ***Addressing Drivers of Vulnerability (red), Disaster Risk Reduction***

(blue), Social-Ecological Resilience (green) *and* ***Local Knowledge adaptation options (grey)****. Each APT (APT A; APT B; APT C; APT D) is represented in three timeframes: S - Short term (up to 2030), M- Medium term (between 2030 and 2050), L - Long term (between 2050 and 2100). Bold letters in each ATP indicate the option was available to be selected. Highlighted options indicate the measure was selected in each ATP and timeframe: ATP A (light blue); ATP B (light green); ATP C (Light orange) and ATP D (light purple). Space with colour: option was selected for the timeframe: Short term, Medium term, or Long term. Bold letter: option is available in the APT.*

The measures selected for each Adaptation Pathway for the energy sector can be consulted in the Annex BII. It is also possible to verify the percentage of stakeholders that selected each measure by Adaptation Pathway Trajectory and time frame.

The **financial capital** (class 1) measure considered a priority to address **Vulnerability Reduction** for the APT B (capacity expansion) and APT D (system restructuring) was "Financial support for buildings with low energy needs" for the short term. At medium and long term, the regional priority was "Financial support for smart control of energy in houses and buildings", which reflects an expected maturity of these solutions.

Under the **human capital** measures (class 2) the regional priority for the APT B and D was "Green jobs and businesses" for all time frames. For the APT A (minimum intervention) and APT C (efficiency enhancement), the regional priority was "Public information service on climate action" at short term and "Green jobs and businesses" at medium term.

In the scope of **social capital** (class 3) and under the APT C, the regional priority was "Small scale production and consumption (prosumers)" for all time frames.

The measure "Energy storage systems", **physical capital** (class 4), was considered a priority for all time frames of the APT C and on short for the APT D. This measure will allow Madeira to decrease its dependence from fossil fuels, and thus increasing its resilience to climate change.

In opposition to "Sea Water Air Conditioning (SWAC)", the measure "Demand Side Management (DSM) of Energy", **natural capital** (class 5), was consider a priority in all time frames of the APT B (capacity expansion), where the measure was available. This choice is compatible with sea water average temperature and the island orography that difficult the sea access.

For **Disaster Risk Reduction** the measure considered a priority to address **risk mitigation** (class 6) for the APT's A, B, C and D was "Review building codes of the energy infrastructure" in the majority of the time frames, in opposition to the measure "Upgrade evaporative cooling systems", which was the priority, at the long term, for the scenarios of capacity expansion (APT B), efficiency enhancement (APT C) and system restructuring (APT D).

Under the class **hazard preparedness** (class 7), the priority at short term was "Early Warning Systems (EWS)" and for the medium and long terms the priority was "Grid reliability" for the efficiency enhancement scenario, where the measures were available.

In the scope of **disaster response** (class 8), the priority at short term was the measure "Study and develop energy grid connections" and for the medium and long term the regional priority was "Energy-independent facilities (generators)", for minimum intervention scenario.

Under the post **disaster recovery** (class 9), the measure "Energy recovery microgrids" was considered a priority for all time frames in the APT D and for the short and medium terms in the APT A, in opposition to the measure "Local recovery energy outage capacity" that was consider a priority at long term for the APT A.

In **Social-Ecological** Resilience adaption objective concerning **provisioning services class** (class 10), the region gave clear priority to "Energy efficiency in urban water management" for all time frame in the APT A (minimum intervention), APT B (capacity expansion), APT C (efficiency enhancement) and APT D (system restructuring).

The measure considered a priority to address the class **regulating and maintenance services** (class 11) was "Urban green corridors" for all time frames for the APT B and for the medium term for the APT C, in opposition of the measure "Biomass power from household waste" that was consider a priority for the short and long terms for the APT C. The local stakeholders recognize the importance of reducing the air temperatures in the cities without increase the consumption of energy for cooling, increasing the quality of life in open spaces.

Under **cultural services** (class 12), there is a clear priority to promote "Educational garden plots" for all time frames for the APT C, which highlights the importance to reduce the food carbon footprint and food security in islands.

Local knowledge priorities focused on minimizing islands energy dependence from imported fossil fuels to increase its climate change resilience, in all time frames of the 4 scenarios. It highlights the importance to decrease imported fossil fuels as a climate change adaptation measure. The following priority is related with the diversification of energy supply and electricity generation (E26), which contributes the measure "Promote electric mobility integrated in smart grids with smart-charging and vehicle-to-grid infrastructure" and "Implement electricity prices for renewable energy generation on islands based on actual local costs to stimulate the RES generation".

During the results discussion, the stakeholders underlined the importance of the diversification on energy supply and electricity generation for energy independence of islands, as the extreme weather events, namely storms, can destroy wind farms, being important to invest in photovoltaic energy and the foreseen precipitation reduction will affect hydropower production. Hydro energy will be affected by water scarcity and by priority uses, human consumption and irrigation in Madeira island.

It was also underlined that downscaling the climate models for Madeira and Porto Santo islands is important to better forecast the renewable resources and deal with the foreseen reduction of precipitation. Currently, the available climate data and models for these Atlantic islands do not have the necessary accuracy do support the decision-making process on RES and energy storage investments.

3.2.2 Sustainable performance

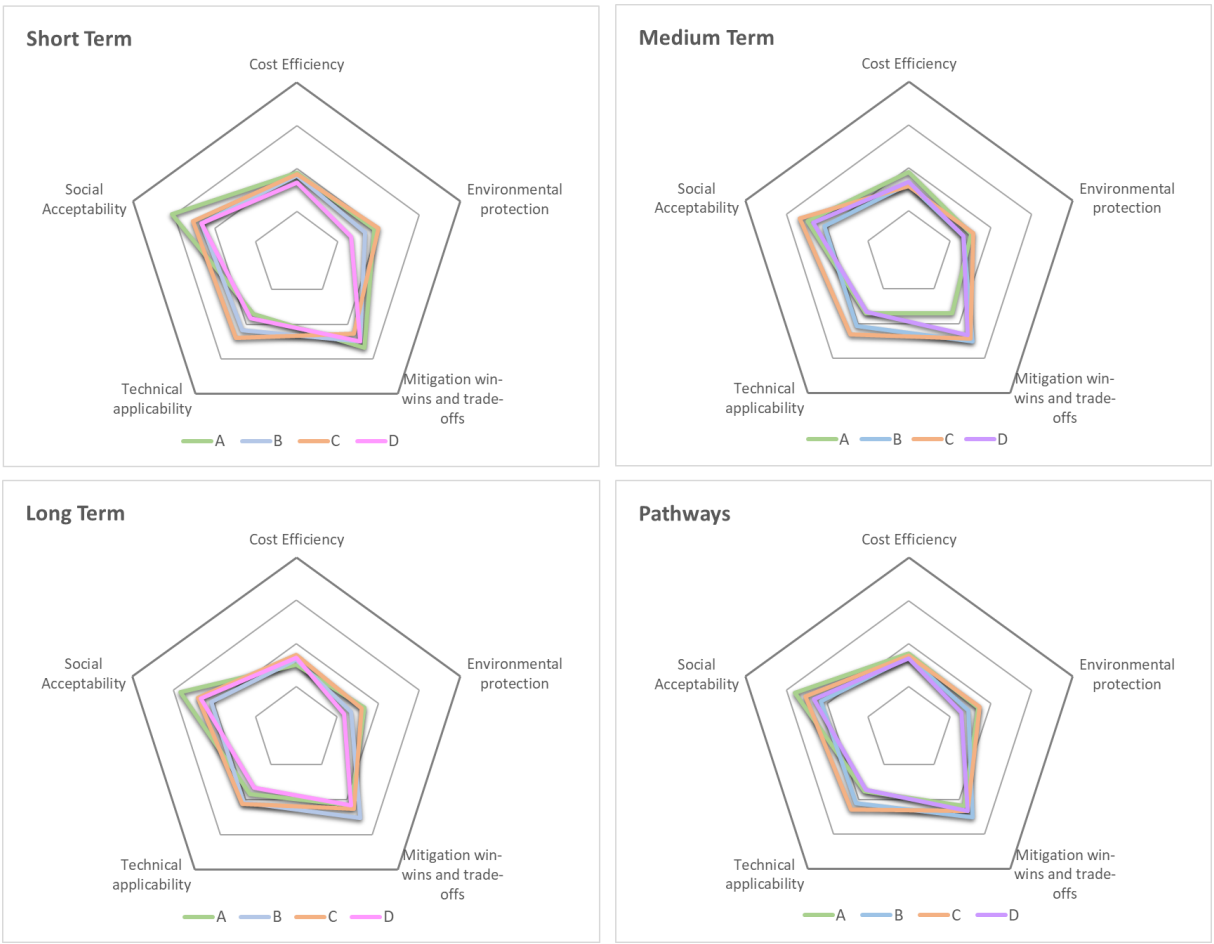

Figure 127 - Pathways evaluation energy sector considering: Cost Efficiency; Environmental protection; Mitigation (GHG emissions); Technical applicability; Social acceptability. The policy pathways scenarios: APT A - Minimum Intervention; APT B - Economic Capacity Expansion; APT C- Efficiency Enhancement; APT D - System Restructuring, for different timeframes: short, medium, and long term.

On the short term, the measures selected for the APT A have better social acceptability, cost efficiency and mitigation performances, and the measures selected for the APT C have better technical applicability and environmental protection performances.

On the medium term, the measures selected for the APT A have better cost efficiency performance, the measures selected for the APT B have better mitigation performance, and the measures selected for the APT C have better technical applicability, social acceptability and environmental protection performances.

On the long term the measures selected for the APT A have better social acceptability and environmental protection, the measures selected for the APT B have better mitigation performance, and the measures selected for the APT C have better technical applicability performance.

At long term, for all APTs, the technical applicability is lower, but the measures were classified for 2020 for these criteria and should be expected more maturity for this adaptation solutions after 2050.

Overall, the APT B is the one with higher contribution for the regional mitigation objectives of reduce at least 40% of GHG emissions for 2030 and achieve climate resilience and carbon neutrality (85% GHG emissions reduction) by 2050, according the Sustainable Energy and Climate Action Plan under development. The APT A is the scenario with better social acceptability and cost efficiency performances, the APT C is the scenario with better technical applicability and environmental protection performances,

and the APT D is the scenario with lower technical applicability and environmental protection performances.

3.3 Maritime Transport

The identification and description of the adaptation measures for the maritime transport sector, including the local knowledge measures, are on the Annex AII.

Maritime transport pathways are based on choices made by 24 expert island stakeholders

3.3.1 Selected Adaptation Pathways

ID	Name	Class number	Ratio	APT A			APT B			APT C			APT D		
				S	M	L	S	M	L	S	M	L	S	M	L
MT2	Financial incentives to retreat from high-risk areas	1	57%					**B**						**D**	
MT1	Insurance mechanisms for ports	1	43%					**B**						**D**	
MT10	Social dialogue for training in the port sector	2	51%		**A**			**B**			**C**			**D**	
MT9	Awareness campaigns for behavioural change	2	49%		**A**			**B**			**C**			**D**	
MT12	Climate resilient economy and jobs	3	61%								**C**				
MT11	Diversification of trade using climate resilient commodities	3	39%								**C**				
MT14	Restrict development and settlement in low-lying areas	4	61%								**C**			**D**	
MT13	Refrigeration, cooling and ventilation systems	4	39%								**C**			**D**	
MT16	Increase operational speed and flexibility in ports	5	58%					**B**							
MT15	Sturdiness improvement of vessels	5	42%					**B**							
MT17	Climate proof ports and port activities	6	53%		**A**			**B**			**C**			**D**	
MT18	Consider expansion/retreat of ports in urban planning	6	47%		**A**			**B**			**C**			**D**	
MT20	Early Warning Systems (EWS) and climate change monitoring	7	56%								**C**				
MT19	Reinforcement of inspection, repair and maintenance of	7	44%								**C**				
MT21	Inteligent Transport Systems (ITS)	8	57%		**A**										
MT22	Prepare for service delays or cancellations	8	43%		**A**										
MT23	Backup routes and infrastructures during extreme weather	9	68%		**A**									**D**	
MT24	Post-Disaster recovery funds	9	32%		**A**									**D**	
MT4	Combined protection and wave energy infrastructures	10	55%		**A**			**B**			**C**			**D**	
MT3	Marine life friendly coastal protection structures	10	45%		**A**			**B**			**C**			**D**	
MT6	Coastal protection structures	11	53%					**B**			**C**				
MT5	Hybrid and full electric ship propulsion	11	47%					**B**			**C**				
MT7	Integrate ports in urban tissue	12	63%								**C**				
MT8	Ocean pools	12	38%								**C**				
MT27	(MT27) Increase knowledge and modelling tools on climate	Local	27%		**A**			**B**			**C**			**D**	
MT28	(MT28) City ports as coastal protection infrastructures against	Local	27%		**A**			**B**			**C**			**D**	
MT25	(MT25) Specific requirements to increase climate change	Local	23%		**A**			**B**			**C**			**D**	
MT26	(MT26) Prepare islands ports to supply alternative fuels and	Local	23%		**A**			**B**			**C**			**D**	

Figure 128 - Adaptation options for the maritime transport sector. Options are identified with an ID number, full name, class of adaptation number and ratio. Adaptation objectives are identified in each option by colour: ***Addressing Drivers of Vulnerability (red), Disaster Risk Reduction (blue), Social-Ecological Resilience (green)*** *and* ***Local Knowledge adaptation options (grey)****. Each APT (APT A; APT B; APT C; APT D) is represented in three timeframes: S - Short term (up to 2030), M- Medium term (between 2030 and 2050), L - Long term (between 2050 and 2100). Bold letters in each ATP indicate the option was available to be selected. Highlighted options indicate the measure was selected in each ATP and timeframe: ATP A (light blue); ATP B (light green); ATP C (Light orange) and ATP D (light purple). Space with colour: option was selected for the timeframe: Short term, Medium term, or Long term. Bold letter: option is available in the APT.*

The measures selected for each Adaptation Pathway for the maritime transport sector can be consulted in the Annex BIII. It is also possible to verify the percentage of stakeholders that selected each measure by Adaptation Pathway Trajectory and time frame.

The **financial capital** (class 1) measure considered a priority to address **Vulnerability Reduction** for the scenario capacity expansion (APT B) was "Insurance mechanisms for ports" for all time frames which is coherent with the low commitment to significant policy change. For the scenario system restructuring (APT D) the priority measure considered was "Financial incentives to retreat from high-risk areas" for all time frames, which is coherent with a scenario of high level of investment and high commitment to significant policy change.

Under the **human capital** measures (class 2) the regional priority for the APT A, B, C and D was "Awareness campaigns for behavioural change" for the short term. For the medium and long terms, in all

scenarios, the regional priority was "Social dialogue for training in the port sector", underling the concerns with the foreseen sea level rise in these time frames.

In the scope of **social capital** (class 3) and under the APT C, the regional priority was "Climate resilient economy and jobs" for all time frames, which underlines the importance to reduce imported goods from the exterior.

Under the APT C and D, in all time frames, the measure "Restrict development and settlement in low-lying areas" **physical capital** (class 4), was considered a clear priority.

Under the class **natural capital** (class 5), the measure "Sturdiness improvement of vessels" was selected by 50% of the stakeholders at the short term for the APT B. The measure "Increase operational speed and flexibility in ports" was considered the priority for the medium and long term.

For **Disaster Risk Reduction,** the measure to address **risk mitigation** (class 6) "Climate proof ports and port activities" was considered a priority for the APT A for all time frames, for the APT B for the medium and long term, for the APT C for the medium term and for the APT D for the short and medium term, this underlines the island dependence from the exterior and the importance of preventing the disruption of port activities due extreme weather events.

Under the class **hazard preparedness** (class 7), the measure "Early Warning Systems (EWS) and climate change monitoring" was consider a clear priority for the medium and long terms in opposition of "Reinforcement of inspection, repair and maintenance of infrastructures". Both measures were selected to be included in adaptation pathway for the short term.

For the minimum intervention scenario, in the scope of **disaster response** (class 8) the priority at short term, was the measure "Prepare for service delays or cancellations". For the medium and long term, "Intelligent Transport Systems (ITS)" was considered a regional priority, which is coherent with the development of this technology until the end of the century.

Under the post **disaster recovery** (class 9), the measure "Backup routes and infrastructures during extreme weather" was considered a clear priority for all time frames for the APT A and APT D in opposition of "Post-Disaster recovery funds". For the long term for the scenario system restructuring, both measures were selected to be included in adaptation pathway.

In **Social-Ecological Resilience** adaption objective concerning **provisioning services class** (class 10), the measure "Marine life friendly coastal protection structures" was selected for the short term for the APTs A, B, C and D. This recognizes the potential role of coastal protection infrastructures for biodiversity preservation. For the medium and long term, the selected measure "Combined protection and wave energy infrastructures" was selected for the APTs B, C and D, which indicates the potential contribution of wave energy for islands energy independence.

The measure selected by the stakeholders to address the class **regulating and maintenance services** (class 11) was "Coastal protection structures" for all time frames for the APT B and for the short term for the APT C, in opposition of the measure "Hybrid and full electric ship propulsion", that was considered a priority for the medium and long term for the scenario efficiency enhancement.

Under **cultural services** (class 12), there is a priority to "Integrate ports in urban tissue" for short and long term for the APT C. For the medium term, the measure "Ocean pools" was consider the regional priority.

The Local Knowledge measure "Increase knowledge and modelling tools on climate change for islands" was considered a priority for the short term for all scenarios, which highlights the importance of this measure for the decision making process. All measures were considered a priority for, at least, 3 different scenarios, which highlights the importance of all Local Knowledge measures.

During the results discussion, the stakeholders underlined the concerns related with the sea level rise that will require high investments in all ports and coastal protection infrastructures. Prepare island ports to

supply alternative fuels was identified as an important contribute to reduce the island energy dependence and the emissions associated with maritime transport.

It was also underlined the importance of making available climate change projections on maximum hight waves that combined with the sea level rise will have severe impacts in ports, marines and other coastal infrastructures.

Given the high dependence from maritime transport, it was highlighted by the stakeholders the importance of backup routes and infrastructures to overcome the islands isolation during extreme weather events which require high investment, justified by the principle of territorial continuity.

The maritime transport is very important for the transportation of goods and persons in archipelagos, being highlighted by the stakeholders that the next concession for maritime public transport services between islands should have requirements concerning alternative fuels and improved vessels sturdiness to increase climate change resilience.

The regional stakeholders mention the importance to increase the regional dry docks areas in marines and shipyards to protect recreational and maritime touristic activities boats in extreme weather events.

3.3.2 Sustainable performance

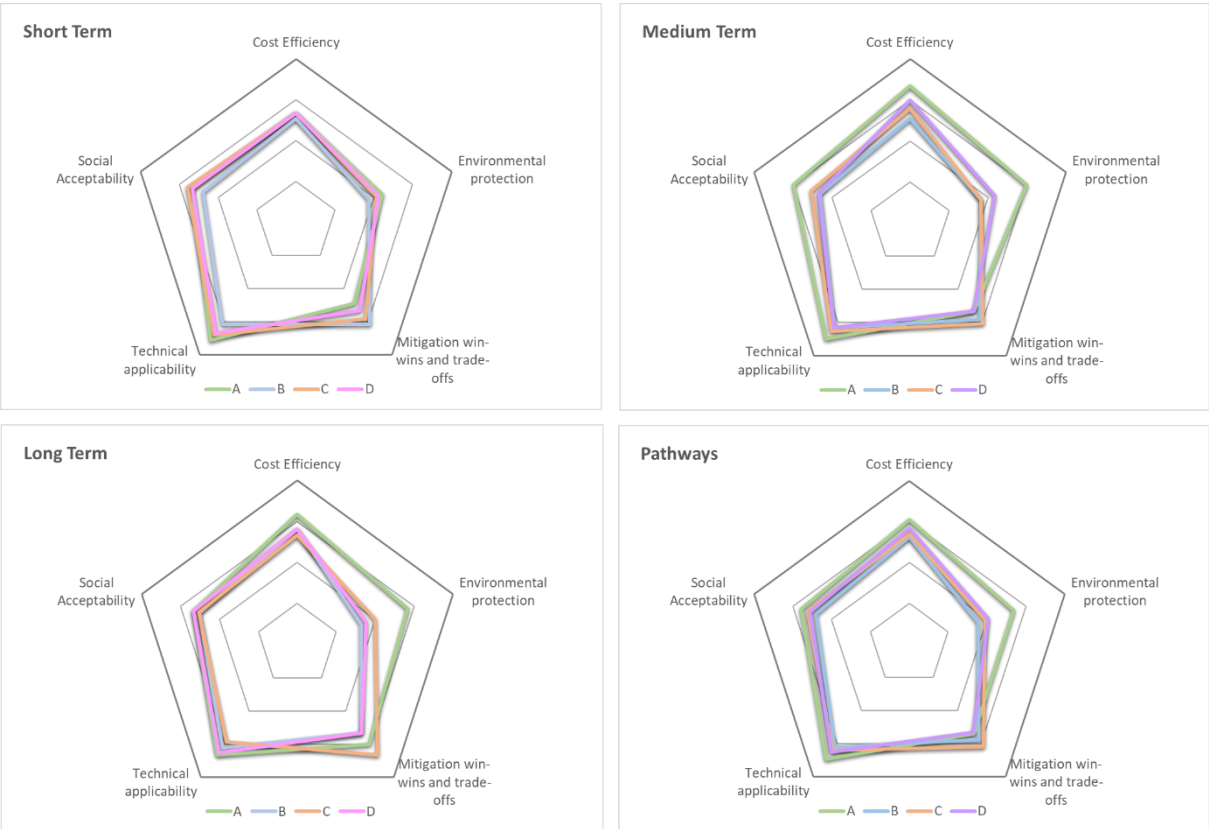

Figure 129 - Pathways evaluation maritime transport sector considering: Cost Efficiency; Environmental protection; Mitigation (GHG emissions); Technical applicability; Social acceptability. The policy pathways scenarios: APT A - Minimum Intervention; APT B - Economic Capacity Expansion; APT C- Efficiency Enhancement; APT D - System Restructuring, for different timeframes: short, medium, and long term.

On the short term, the measures selected for the APT A have better technical applicability and environmental protection performances, the measures selected for the APT B have better mitigation performances, the measures selected for the APT C have better social acceptance performance, and the APT D have better cost efficiency performance.

On the medium term, the measures selected for the APT A have better technical applicability, social acceptability, cost efficiency and environmental protection performances, and the measures selected for the APT C have better mitigation performance.

On the long term the measures selected for the APT A have better cost efficiency, environmental protection and technical applicability performances, and the measures selected for the APT C have better mitigation performance, and the measures selected for the APT D have better social acceptability performance.

At long term, for all APTs, the technical applicability is lower, but the measures were classified for 2020 for these criteria and should be expected more maturity for this adaptation solutions after 2050.

Overall, the APT C is the one with higher contribution for the regional mitigation objectives of reduce at least 40% of GHG emissions for 2030 and achieve climate resilience and carbon neutrality (85% GHG emissions reduction) by 2050, according the Sustainable Energy and Climate Action Plan under development. The APT A is the scenario with better technical applicability, environmental protection, social acceptability and cost efficiency performances.

3.4 Tourism

The identification and description of the adaptation measures for the tourism sector, including the local knowledge measures, are on the Annex AIV.

Tourism pathways are based on choices made by 31 expert island stakeholders.

3.4.1 Selected Adaptation Pathways

ID	Name	Class number	Ratio	APT A			APT B			APT C			APT D		
				S	M	L	S	M	L	S	M	L	S	M	L
T2	Financial incentives to retreat from high-risk areas	1	54%					**B**						**D**	
T1	Economic Policy Instruments (EPIs)	1	46%					**B**						**D**	
T9	Activity and product diversification	2	58%		**A**			**B**			**C**			**D**	
T10	Public awareness programmes	2	42%		**A**			**B**			**C**			**D**	
T11	Local circular economy	3	68%								**C**				
T12	Tourist awareness campaigns	3	32%								**C**				
T14	Water restrictions, consumption cuts and grey-water recycling	4	63%								**C**			**D**	
T13	Local sustainable fishing	4	37%								**C**			**D**	
T16	Desalination	5	58%					**B**							
T15	Beach nourishment	5	42%					**B**							
T17	Coastal protection structures	6	52%		**A**			**B**			**C**			**D**	
T18	Drought and water conservation plans	6	48%		**A**			**B**			**C**			**D**	
T19	Mainstreaming Disaster Risk Management (DRM)	7	75%								**C**				
T20	Using water to cope with heat waves	7	25%								**C**				
T21	Fire management plans	8	57%		**A**										
T22	Health care delivery systems	8	43%		**A**										
T24	Pre-disaster early recovery planning	9	57%		**A**									**D**	
T23	Post-Disaster recovery funds	9	43%		**A**									**D**	
T4	Monitoring, modelling and forecasting systems	10	54%		**A**			**B**			**C**			**D**	
T3	Adaptation of groundwater management	10	46%		**A**			**B**			**C**			**D**	
T6	River rehabilitation and restoration	11	56%					**B**			**C**				
T5	Dune restoration and rehabilitation	11	44%					**B**			**C**				
T7	Adaptive management of natural habitats	12	72%								**C**				
T8	Ocean pools	12	28%								**C**				
T25	(T25) Rehabilitation and conservation of islands natural habitats	Local	24%		**A**			**B**			**C**			**D**	
T26	(T26) Diversification of economic activities to reduce the	Local	23%		**A**			**B**			**C**			**D**	
T28	(T28) Increase knowledge and modelling tools on climate	Local	17%		**A**			**B**			**C**			**D**	
T30	(T30) Implement waste reduction and management procedures	Local	17%		**A**			**B**			**C**			**D**	
T29	(T29) Control measures for terrestrial and maritime tourist	Local	11%		**A**			**B**			**C**			**D**	
T27	(T27) Promote islands as telework tourism destinations	Local	8%		**A**			**B**			**C**			**D**	

Figure 130 - Adaptation options for the tourism sector. Options are identified with an ID number, full name, class of adaptation number and ratio. Adaptation objectives are identified in each option by colour: ***Addressing Drivers of Vulnerability (red), Disaster Risk Reduction (blue), Social-Ecological Resilience (green)*** *and* ***Local Knowledge adaptation options (grey)****. Each APT (APT A; APT B; APT C; APT D) is represented in three timeframes: S - Short term (up to 2030), M- Medium term (between 2030 and 2050), L - Long term (between 2050 and 2100). Bold letters in each ATP indicate the option was available to be selected. Highlighted options indicate the measure was selected in each ATP and timeframe: ATP A (light blue); ATP B (light green); ATP C (Light orange) and ATP D (light purple). Space with colour: option was selected for the timeframe: Short term, Medium term, or Long term. Bold letter: option is available in the APT.*

The measures selected for each Adaptation Pathway for the tourism sector can be consulted in the Annex BIV. It is also possible to verify the percentage of stakeholders that selected each measure by Adaptation Pathway Trajectory and time frame.

The **financial capital** (class 1), the regional priority to address **Vulnerability reduction** was "Financial incentives to retreat from high-risk areas" for the APT B (capacity expansion) for the medium term and for the APT D (system restructuring) for all time frames, in opposition to the measure Economic Policy Instruments (EPIs) that was considered a priority for the APT B for the short and long terms.

Under the **human capital** measures (class 2), the regional priority for the APT A for all time frames (minimum intervention) was "Public awareness programmes". For the APT B and APT C (efficiency enhancement) for the medium and long term, and for the APT D for all time frames the measure "Activity and product diversification" was consider the regional priority. This result reveals the stakeholder's perception that it is necessary to invest more money and more political commitment to diversify the tourism economy instead of promoting awareness campaigns.

In the scope of **social capital** (class 3) and under the APT C, the regional priority was "Local circular economy" for all time frames. This measure will allow Madeira to decrease its waste and offers a framework to reduce CO2 emissions from imports and exports.

In opposition to "Local fishing", the measure "Water restrictions, consumption cuts and grey-water recycling", **physical capital** (class 4), was considered a clear priority for all time frames of the APT C and for the APT D. This measure will allow Madeira to use hydric resource more efficiency and decrease water waste.

For the short term, the measure "Beach nourishment", **natural capital** (class 5), was consider the regional priority. For the medium and long term, the measure "Desalination" was considered the regional priority. This choice underlines the stakeholders concerns regarding the projections on precipitation decrease and subsequent water scarcity.

For **Disaster Risk Reduction** the measure considered a priority to address **risk mitigation** (class 6) for the APT's A, B, and D was "Coastal protection structures" in the majority of the time frames, in opposition to the measure "Drought and water conservation plans", which was the priority for the short and medium term, for the scenario of efficiency enhancement.

Under the class **hazard preparedness** (class7), the clear regional priority for all time frames was "Mainstreaming Disaster Risk Management (DRM)" for the efficiency enhancement scenario, where the measures were available.

In the scope of **disaster response** (class 8), the priority at short and medium terms was the measure "Fire management plans", in coherence with the foreseen fire weather index that will stay in the same fire danger class (which is high). For the long term the regional priority was "Health care delivery systems", for minimum intervention scenario, in coherence with the foreseen significant increase of heat waves.

Under the post **disaster recovery** (class 9), the measure "Pre-disaster early recovery planning" was selected for short and long terms in the APT A and for the short and medium terms in the APT D, in opposition to the measure "Post-Disaster recovery funds" that was consider a priority at medium term for the APT A, and for the long term for the APT D.

In **Social-Ecological** Resilience adaption objective concerning **provisioning services class** (class 10), the region gave priority to "Monitoring, modelling and forecasting systems" for all scenarios for the short term, which is coherent with the necessity to improve knowledge in these matters.

The measure considered a priority by the stakeholders to address the class **regulating and maintenance services** (class 11) was "River rehabilitation and restoration" for all time frames for the APT B and APT C, in opposition of the measure "Dune restoration and rehabilitation". This underlines the high risk of flash

floods and its historic occurrence in Madeira island, and presence of dunes only in the small island of Porto Santo.

Under **cultural services** (class 12), for all time frames for the APT C, there is a clear priority for "Adaptive management of natural habitats", a key asset for the archipelago's touristic activities.

Local knowledge priorities where focused on habitats rehabilitation, conservation and monitoring actions, including control of non-indigenes species, that are important to increase ecosystems resilience to climate change, in order to preserve habitats, biodiversity and landscape, key assets for tourism, agriculture, fisheries and food security.

The diversification of economic activities was also considered a regional priority to reduce the dependence from tourism activities that can be disrupted by extreme weather events. Stakeholders recognise the importance of diversify the island economy, namely by promoting the development of primary sector activities to increase food security and reduce food carbon footprint and promote digital innovative products and services. Also, fair trade, quality, certification and differentiation can increase competitiveness of islands cash crops.

3.4.2 Sustainable performance

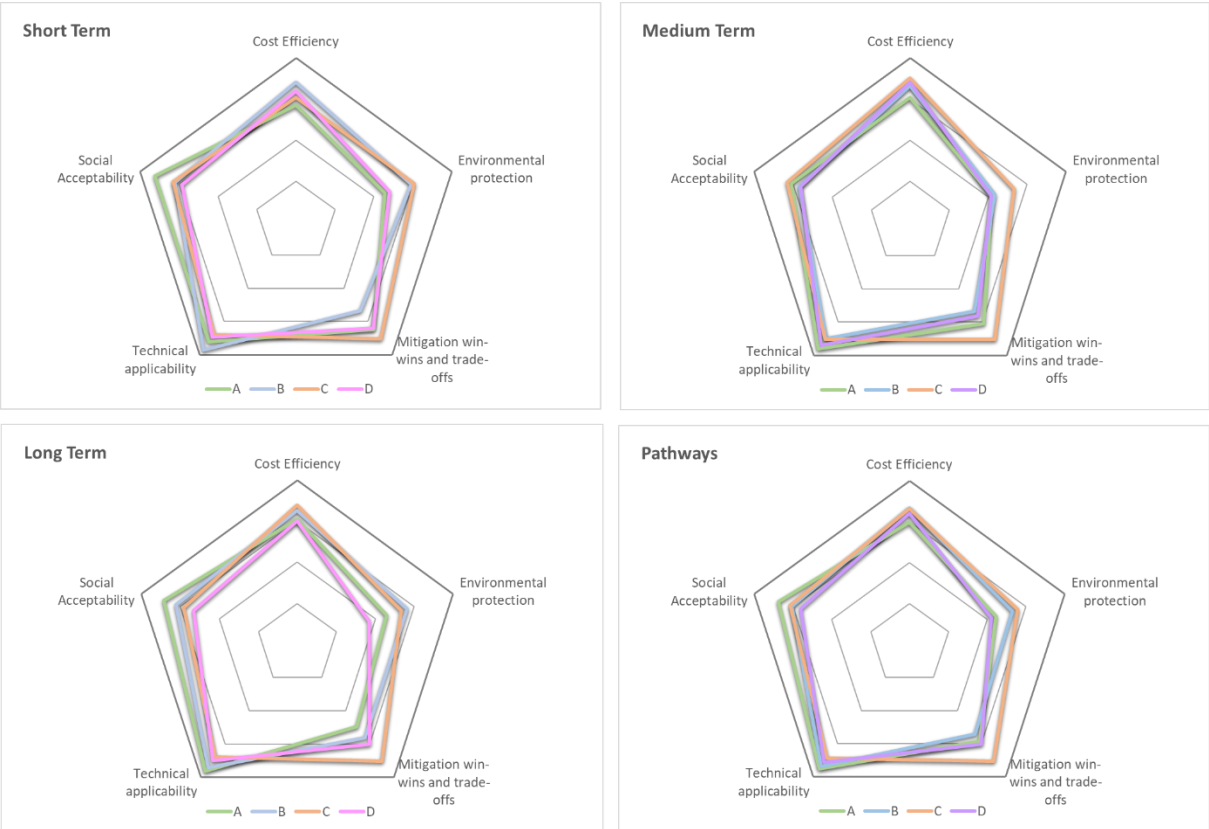

Figure 131 - Pathways evaluation tourism sector considering: Cost Efficiency; Environmental protection; Mitigation (GHG emissions); Technical applicability; Social acceptability. The policy pathways scenarios: APT A - Minimum Intervention; APT B - Economic Capacity Expansion; APT C- Efficiency Enhancement; APT D - System Restructuring, for different timeframes: short, medium, and long term.

On the short term, the measures selected for the APT A have better social acceptability performance, the measures selected for the APT B have better technical applicability and cost efficiency performances, and the measures selected for the APT C have better mitigation and environmental protection performance.

On the medium term, the measures selected for the APT A have better technical applicability performance, and the measures selected for the APT C have better mitigation, social acceptability, cost efficiency and environmental protection performances.

On the long term the measures selected for the APT A have better technical applicability and social acceptability performances, the measures selected for the APT B have better environmental protection performance, and the measures selected for the APT C have better mitigation and cost efficiency performance

The technical applicability for all APTs keeps almost the same for all time frames due the fact that these measures are not as technical as the ones from the aquaculture, energy and maritime transport sectors.

Overall, the APT C is the one with better cost efficiency and environmental protection performance, and higher contribution for the regional mitigation objectives of reduce at least 40% of GHG emissions for 2030 and achieve climate resilience and carbon neutrality (85% GHG emissions reduction) by 2050, according the Sustainable Energy and Climate Action Plan under development. The APT A is the scenario with better technical applicability and social acceptability performances.

4 Lessons learnt from COVID-19 pandemic

During the results discussion the regional stakeholders identified several lessons from the COVID-19 pandemic that can be applied in the scope of climate change mitigation and adaptation strategies for the Autonomous Region of Madeira.

The telework and digital services were boosted during the first stage of the pandemic decreasing the mobility needs, reducing energy consumption and emissions. This experience can be explorer in the scope of climate change adaptation in order to decrease the energy dependence from the exterior.

The pandemic COVID-19 accelerated the adoption of video conferencing, cloud collaboration and teleworking, opening new possibilities for remote working lifestyles. Telework tourism opens new perspectives for individuals, couples, families, and groups, who are interested to combine a possibility of a new format of remote office work, and leisure in a foreign country which can contribute to decrease tourism seasonality in island with advantages for climate change adaptation.

The allocation of financial resources to support the public health services, families and companies affected by the COVID-19 brought, at short and medium term, investment constraints for adaptation and mitigation policies. For example, the disruption of cruise ships activities due the pandemic affected severely the income of the Ports administration authority, decreasing funds availability for adaptation measures that require high investments.

Tourism sector disruption due the COVID-19 pandemic illustrates the socio-economic effects of a possible tourism disruption caused by extreme weather events, affecting ports and airports that are essential to isolated insular territories. This highlights the importance of the economy diversification to reduce dependence from tourism activities.

The pandemic also showed the necessity and advantages to rely on scientific evidence to base the decision-making process in a global situation that requires international cooperation and local action, as the adaptation and mitigation policies to climate change. This situation also highlighted the importance to elaborate and implement contingency plans to face climate change, namely for extreme weather events or water scarcity.

In the scope of COVID-19 economic crisis, savings associated with energy efficiency and renewable energy measures are important for companies' recovery and competitiveness, and also to tackle and prevent energy poverty among families, improving their quality of life and balance their budgets, contributing to reduce energy dependence and therefore for climate change adaptation and mitigation.

Dependence of food imports was highlighted due to the overdemand in the beginning of the pandemic, stressing the importance to invest on local food production, to ensure food security which is an important adaptation measure to reduce dependence from the exterior and minimize the impacts of transports disruption due extreme weather events. Promote activities of the primary sector, including the promotion of the aquaculture sector, is also important to diversify regional economy, highly dependent from tourism activities which can also be disrupted by extreme weather events.

The tourism disruption severely decreased the demand for local food products, oblige to a reorganization of the distribution channels to increase the availability of these products in the local commerce and delivery services, which raised awareness among residents for the importance to consume local products that contributes for food security and for mitigation and adaptation regional policies.

There is an opportunity to recover the economy with sustainable and self-sufficient practices, with advantages for climate change adaptation and mitigation. For example, measures to promote resilience of natural ecosystems, organic farming and circular economy could help the economy recovery in the post-Covid-19 context.

The COVID-19 pandemic response strengthened the multi-level governance intervention, the collaboration among public and private institutions and the involvement of all citizens for a common cause, that can be replicated for other global causes as climate change adaptation and mitigation policies, namely to address drivers of vulnerability, disaster risk reduction and social-ecological resilience for extreme weather events.

5 Discussion

The SOCLIMPACT project provided the opportunity to create a multisectoral working group, with the participation of around 65 local and regional policy makers, public and private companies, research institutions, associations, and local experts, that had the possibility to increase their knowledge on climate change and adaptation. It is important to acknowledge the adaptation challenges in the daily decision-making process and in the sectorial and holistic planning exercises, and to update the regional adaptation strategy, foreseen for 2021.

Despite the joint discussion limitations due to the pandemic constraints, the adaptation pathways provided insight into the concerns and priorities of regional stakeholders regarding climate change and adaptation measures required.

Reliable climate change projections are fundamental for the decision-making process on fund allocation for climate change adaptation. Until now, the decision-making process on climate change adaptation is highly linked with the occurrence of extreme weather events that have severe socioeconomic and environmental impacts. For example, the flash floods that occurred in Madeira Island on February 2010 obliged to large investments on post-disaster intervention and launched several initiatives on weather forecast, early warning systems and other adaptation measures that contributed to disaster risk reduction. However, the allocation of high investments on post disaster recovery, in sequence of extreme weather events, reduces the capacity of investment on adaptation measures to increase resilience and decrease climate change vulnerability. This fact highlights the importance of reliable downscaling climate models for the Atlantic.

The EU outermost regions, particularly Atlantic Ocean archipelagos, have small and fragmented territories located on the margins of EU climate models, making it difficult to have reliable climate change projections. The participation in the project also highlighted the lack of systematic data collection that is important to enable downscaling of climate models and assess climate change impacts on natural ecosystems and infrastructures, and socio-economic activities.

Systematic data collection of diverse nature is crucial to regionalize the climate models and increase the accuracy of climate change projections and climate change impact assessment for the Autonomous Region of Madeira. Examples: series of data on seawater temperature and wave height at various coastal points, data on effects of heat waves on public health, record of number of visitors per age group, etc.

Adaptation policies based on scientific and technical knowledge instead of reaction to extreme weather events, allow to reduce socio-economic and environmental impacts of extreme weather events and other climate change impacts like water scarcity and heat waves by efficiently allocating available resources to increase resilience, decrease vulnerability and disaster risk, especially for risk mitigation, hazard preparedness and disaster response. This scientific based approach is particularly important to support adaptation policies to face climate change hazards never experienced before.

Particular attention of the EU to these specific territories is needed in order to have high-resolution climate models that provide reliable projections to support the planning and decision-making process on climate change adaptation. To overcome the lack of historic data series, EU regulations, guidelines and funds for data collection to be reported to a centralized EU database, could provide the necessary incitement for regional and local policy makers to allocate human and financial resources for data collection procedures.

Even considering a scenario with increased resolution on climate change modelling and climate change impact assessment, small and fragmented island territories such as the Archipelago of Madeira, face greater uncertainty and error in weather forecasts and projections due to less coverage of weather observation networks (there are no fixed weather stations on the ocean, some data is collected by merchant vessels at sea). Even with a radar, that was installed after the flash floods of 2010, weather forecast is dependent on the presence of water or dust in the atmosphere. This disadvantage of small island territories, in relation to continental regions, should be considered by the Member States and by the EU, as the allocation of

resources for climate change adaptation in these territories need to deal with a greater redundancy to tackle uncertainty.

Awareness raising and training of technicians and decision-makers on the issue of climate change and adaptation is important to foster cooperation between sectors with synergies, and to facilitate the integration of climate change variables namely data collection and processing, planning exercises, technical specifications of projects, prioritization of measures and allocation of funds.

Another conclusion of this exercise for Madeira archipelago was the evidence of the need for a specific adaptation approach to each island, as they have specificities that will determine different vulnerabilities to climate change. For example, Porto Santo Island, that joined the UNESCO world network of biosphere reserves in 2020, is highly dependent on seasonal tourist activities relying on its natural heritage, a 9 km sandy beach that, according to the project climate projections, 90% of its area will disappear by the end of the century. This underlines the importance of dune restauration and rehabilitation and beach nourishment as priority adaptation measures for Porto Santo Island, which is not a priority for Madeira Island, that has pebble beaches along the majority of its coastline. In Madeira, the increase in average temperature, heat waves episodes and reduction of precipitation will raise forest fire vulnerability of natural ecosystems, such as the Laurissilva forest classified as UNESCO natural world heritage, an important asset for the island's tourism nature-based activities. Precipitation reduction will also affect, in Madeira Island, the water canal system that provides water for human consumption, irrigation and energy production and storage, and supports tourism nature-based activities in the water canal trails. This is a unique reality of Madeira Island that requires a specific adaptation approach.

6 Conclusion

This exercise highlighted the necessity to develop reliable downscaled climate models for the Atlantic islands, to efficiently allocate resources on adaptation policies, avoiding high investments on disaster response and post disaster recovery in sequence of extreme weather events. The use of available funds for disaster response and post disaster recovery reduces the capacity of investment on adaptation measures for risk mitigation and hazard preparedness, and to increase socio ecological resilience and decrease climate change vulnerability.

To overcome the lack of historic data series fundamental to regionalise the climate models, EU regulations, guidelines, and funds for data collection and the report to a centralized EU database, could be the necessary incitement for regional and local policy makers in order to allocate human and financial resources for data collection procedures.

The COVID-19 response and the socio-economic crisis are absorbing a significant amount of regional funds, restricting the short- and medium-term investments in other priorities as climate change policies. Nevertheless, the current pandemic situation showed opportunities for climate change adaptation, namely the importance to rely on scientific evidence to base the decision-making process, the advantages of digital transition, the increase of self-sufficiency in islands and efficiency in the use of resources, the economy diversification, as well as the importance of contingency plans, multi-level governance cooperation and citizens role to face a global challenge.

7 Webinars

7.1 Webinar #1 – 29th September 2020

7.1.1 Objectives

1) Project's presentation and context
2) Activity description – Adaptation Pathways
3) Background material
   - Climate projections
   - Adaptation Policy Trajectory (APT) narratives
   - Adaptation options up to 2030, 2050 and until the end of the century
   - Additional Adaptation Measures – Local Knowledge
4) How to fill in and submit the Survey Tool to Design adaptation pathways, developed by *Faculdade de Ciências da Universidade de Lisboa* due to the Covid-19 restriction

7.1.2 Agenda

ON-LINE MEETING (Microsoft Teams)

Local Working Group– Madeira

Climate Change Adaptation Options for the Autonomous Region of Madeira

Tuesday 29th September, 2020		
Time	Activity	
15h00 – 15h10	Local Working Group Presentation	All
15h10 – 15h15	SOCLIMPACT Project Presentation	AREAM
15h15h – 16h00	Climate Data Presentation	AREAM
16h00 – 16h10	Break	
16h10 – 16h45	Excel Tool Presentation	AREAM
16h45 – 17h00	Questions and Answers Session	All

7.2 Webinar #2 – 11th November 2020

7.2.1 Objectives

1) Initial remarks
2) Presentation and analysis of the final Adaptation *Pathways* for Madeira per sector
3) Presentation and analysis for the mitigation contribution of the final Adaptation *Pathways* for Madeira
4) Synergies between the different sectorial Adaptation *Pathways*
5) COVID19 implications on the adaptation measures

7.2.2 Agenda

ON-LINE Working Session (Microsoft Teams)

Local Working Group of Ram

Presentation and Analysis of the Results:

Climate Change Adaptation Pathways for the Autonomous Region of Madeira

Wednesday 11th November 2020

15h00 – 15h05	Opening and Participants Presentation
15h05 – 15h25	**Aquaculture** - Adaptation measures more selected - Final adaptation pathway for each scenario - Joint Analysis
15h25 – 15h45	**Energy** - Adaptation measures more selected - Final adaptation pathway for each scenario - Joint Analysis
15h45– 15h50	Break
15h50 – 16h10	**Maritime Transport** - Adaptation measures more selected - Final adaptation pathway for each scenario - Joint Analysis
16h10 – 16h30	**Tourism** - Adaptation measures more selected - Final adaptation pathway for each scenario - Joint Analysis
16h30 – 16h40	**Presentation and Analysis of the adaptation pathways for mitigation**
16h40 – 17h00	**Participants opinion regarding the constrains and opportunities of the Covid-19 context** - Impacts of the pandemic on the choices made. - The adaptation strategy should contemplate the pandemic effects. - Which were the biggest impacts of the pandemic in your sector? Which implication will have the pandemic on the climate change adaptation?

7.3 List of participants

The following table identifies the Local Working Group involved.

Name	Organization	Sectors
Aires Henriques	Madeira Electricity Company	Energy
Alexandra Gaspar and Filipa Rodrigues	Madeira Water and Waste Management Company	Energy, Tourism
Ana Caldeira	Municipality of Calheta	Aquaculture, Energy, Maritime Transport, Tourism
Ana Pinheiro and Luís Sousa	Civil Protection	Energy, Maritime Transport, Tourism
António Olim and Lisandra Camacho	Regional Laboratory for Civil Engineering	Maritime Transport, Tourism
Assis Correia	Chamber of Commerce and Industry	Tourism
Carlos Andrade	Calheta Mariculture Centre	Aquaculture
Cátia Carvalho Esteves	Transinsular - Maritime Transport Company	Aquaculture, Maritime Transport, Tourism
Cláudia Henriques	Regional Agency for Energy and Environment of the Autonomous Regions of Madeira	Aquaculture, Energy, Maritime Transport, Tourism
Claúdio Coutinho	Researcher	Aquaculture
Claúdio Ramos	Municipality of Câmara de Lobos	Tourism
Cristina Gomes	Regional Authority for the land use planning	Aquaculture, Energy, Maritime Transport, Tourism
Diego Castejó	Researcher	Aquaculture
Dinarte Spínola	Municipality of Ribeira Brava	Energy, Tourism
Duarte Barreto	Institute of Forests and Nature Conservation	Energy, Tourism
Duarte Costa	Regional Authority for the land use planning	Aquaculture, Energy, Maritime Transport, Tourism
Elisabete Alves	Regional Authority for Tourism	Tourism
Elizabeth Olival	Regional Agency for Energy and Environment of the Autonomous Regions of Madeira	Aquaculture, Energy, Maritime Transport, Tourism
Fábio Pereira	Regional Agency for Energy and Environment of the Autonomous Regions of Madeira	Aquaculture, Energy, Maritime Transport, Tourism
Fernando Silva	Regional Authority for Energy and road transport	Energy
Filipe Oliveira	Regional Agency for Energy and Environment of the Autonomous Regions of Madeira	Aquaculture, Energy, Maritime Transport, Tourism
Helena Pereira	Municipality of Santana	Energy, Tourism

Hugo Vasconcelos	Regional Agency for Energy and Environment of the Autonomous Regions of Madeira	Aquaculture, Energy, Maritime Transport, Tourism
João Silva	Municipality of Porto Moniz	Aquaculture, Energy, Maritime Transport, Tourism
José Fernandes and Paula Menezes	Regional Ports Administration	Maritime Transport
José Sousa and Maria Aveiro	Regional Authority for Fisheries	Maritime Transport
Luís Freitas	Researcher - Whale Museum	Tourism
Madalena Gonçalves	Regional Authority for land use planning	Energy, Tourism
Monica Silva	Regional Authority for Energy and road transport	Maritime Transport, Tourism
Nancy Policarpo	Regional Authority for the land use planning	Aquaculture, Energy, Maritime Transport, Tourism
Natasha Nogueira and Maria Isabel Lopes	Regional Authority for the Sea	Aquaculture
Nuno Jesus	Vice Presidency	Maritime Transport
Olga Camacho and Elizabeth Correia	Municipality of Funchal	Maritime Transport, Tourism
Paola Parretti	Marine and Environmental Science Centre	Aquaculture, Maritime Transport
Paula Ferreira	Tecnovia - Construction Company - Shipyard administration	Maritime Transport, Tourism
Pedro Diniz and Leena Nunes	Marismar	Aquaculture
Pedro Frazão, João Dionisio Sousa and David Pedra Costa	Sousa Enterprises	Energy, Maritime Transport, Tourism
Pedro Sepúlveda, João Daniel and Henrique Rodrigues	Regional Authority for the Environment and Climate Change	Aquaculture, Energy, Tourism
Primeiro Tenente Quintal Pereira	Maritime Authority	Energy, Maritime Transport
Ricardo José	Calheta Mariculture Centre	Aquaculture
Ricardo Luís	Calheta Mariculture Centre	Aquaculture
Rúben Figueira	Regional Agency for Energy and Environment of the Autonomous Regions of Madeira	Aquaculture, Energy, Maritime Transport, Tourism
Rubina Brito	Municipality of Porto Santo	Energy, Maritime Transport, Tourism

Rui Gonçalves, Mirandolina Freitas and César Gomes	Ilha Peixe	Aquaculture
Sandro Santos and Nélia Vera Cruz	Roads Regional Authority	Energy
Sérgio Lopes	Regional Authority for Social Equipment and Conservation	Tourism
Susana Fontinha	Regional Authority for the Environment and Climate Change	Tourism
Susana Gonçalves	IASaude - Public Health Emergency	Tourism
Tiago Abreu	Regional Agency for Energy and Environment of the Autonomous Regions of Madeira	Aquaculture, Energy, Maritime Transport, Tourism
Víctor Prior	Portuguese Institute for Sea and Atmosphere	Weather forecast

SOCLIMPACT
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7 Annexes - Madeira

7.1 Annex A – ADAPTATION MEASURES

7.1.1 Annex AI - Adaptation measures for the Aquaculture sector

Options Characterization				Criteria					Sources
ID	Name	Description	Class of adaptation	Cost Efficiency	Environmental protection	Mitigation (win-wins and trade-offs)	Technical applicability	Social Acceptability	
A1	**Financial schemes, insurance and loans**	Financial schemes, insurance and loans are public or private risk-sharing mechanisms that aim to support farmers to respond to loss of production and infrastructures damages due to extreme weather, such as strong winds, heavy rains, floods or tidal surges. Additionally, it can provide capital to farm relocation, infrastructure and equipment upgrade, repair or replacement required.	1. Financial capital	2	1	3	3	4	Barange, M. et al (2018). **Impacts of climate change on fisheries and aquaculture: synthesis of current knowledge, adaptation and mitigation options**. FAO Fisheries and Aquaculture Technical Paper No. 627. Rome, FAO. 628 pp
A2	**Tax benefits and subsidies**	Tax benefits and subsidies consists in financial public policy instruments to promote or benefit economic or aquaculture sustainable practices and operator's overall resilience to climate change.	1. Financial capital	3	2	3	2	3	Barange, M. et al (2018). **Impacts of climate change on fisheries and aquaculture: synthesis of current knowledge, adaptation and mitigation options**. FAO Fisheries and Aquaculture Technical Paper No. 627. Rome, FAO. 628 pp
A3	**Feed production**	An important indirect impact to aquaculture is the change in fisheries production due to climate change. Aquaculture of finfish is highly dependent on fisheries for feed ingredients. This already a current problem with many fisheries overexploited and will only intensify in the future. Therefore, alternative feed ingredients are being developed such as insect meal and algae.	10. Provisioning services	4	4	4	4	4	Rosa, R., Marques, A., & Nunes, M. L. (2012). **Impact of climate change in Mediterranean aquaculture**. Reviews in Aquaculture, 4(3), 163-177.

A4	**Species selection**	Species selection consists of selecting species that are less sensitive to changes in the environment, less prone to diseases and less dependent on fish meal and oil. For example, choosing non-carnivorous species reduces food dependence and stocking larger hatchery fingerlings reduces the culture cycle and exposure to diseases.	10. Provisioning services	**3**	**1**	**3**	**4**	**3**	Ahmed, N., Thompson, S. & Glaser, M. **Global Aquaculture Productivity, Environmental Sustainability, and Climate Change Adaptability**. Environmental Management 63, 159–172 (2019).	
A5	**Selective breeding**	Selective breeding consists of genetic selection of species or strains with a focus on developing strains with a higher tolerance to changes in temperature, that grow faster, and which are more resilient to diseases. This is done by selecting and mating only the fish with desirable traits as broodfish. For example, choosing species with a wider temperature tolerance range may reduce the risk of future mortality.	11. Regulating and Maintenance Services	**2**	**1**	**3**	**3**	**3**	Pedro B. Bueno, 2017 - **ADAPTATION STRATEGIES OF THE AQUACULTURE SECTOR** TO THE IMPACTS OF CLIMATE CHANGE	
A6	**Best Management Practices**	Implementing Best Management Practices at farms which focus on food safety, fish health, environmental impact (including climate change) and social responsibility. These practices improve the farms capacity to participate in value chains with the aim of improving the overall resilience of the farm. For example, increasing hygiene will improve resilience of species to diseases.	11. Regulating and Maintenance Services	**4**	**3**	**3**	**2**	**3**	Harvey, B. et al. 2017. **Planning for aquaculture diversification**: the importance of climate change and other drivers. FAO. Technical Workshop, 23–25 June 2016, FAO Rome. FAO Fisheries and Aquaculture Proceedings No. 47. Rome, FAO. 166 pp.	Barange, M. et al (2018). **Impacts of climate change on fisheries and aquaculture**: synthesis of current knowledge, adaptation and mitigation options. FAO Technical Paper No. 627. Rome, FAO. 628 pp
A7	**Create educational visits**	Students, schools, institutes and organisations can organise visits to the fish farms to learn about aquaculture and the interactions between aquaculture and the environment. These visits can also increase knowledge on different impacts on aquaculture including man-made and climate impacts. Biosecurity should be strictly observed.	12. Cultural services	**2**	**2**	**3**	**4**	**4**		

A8	**Promote aquaculture cuisine**	This measure promotes aquaculture via online information and uses local restaurants. Aquaculture itself can be seen as an adaptation measure to climate change as an alternative to wild fisheries, which production and yield will reduce due to climate change. Therefore, promoting aquaculture species in restaurants or setting up specific 'aquaculture' restaurants will provide both a cultural experience and promote farmed products. The online tool highlights the initiative, provides recipes and aggregates information.	12. Cultural services	**3**	**3**	**3**	**4**	**2**	
A9	**Awareness campaigns for behavioural change**	Awareness campaigns aim to increase the knowledge of individuals and organisations, it could also be relevant in a region affected by a particular climate threat, groups of stakeholders, and the general public.	2. Human capital	**1**	**2**	**4**	**4**	**3**	**Climate-Adapt** - metadata adaptation options
A10	**Efficient feed management**	Efficient feed management practices that reduce the Food Conversion Ratio by using technology or practices to feed more efficient helps to reduce the cost of production and increase environmental standards.	2. Human capital	**3**	**2**	**4**	**2**	**4**	Pedro B. Bueno, 2017 - **ADAPTATION STRATEGIES OF THE AQUACULTURE SECTOR TO THE IMPACTS OF CLIMATE CHANGE.** FAO
A11	**Addressing consumer and environmental concerns at the local level**	This option aims to promote economy and jobs to address the future challenges of climate change. The major challenges need to be underlined and linked to the key concerns and impacts on the aquaculture sector.	3. Social capital	**3**	**4**	**3**	**2**	**3**	Integrating aquaculture within local communities
A12	**Promote cooperation to local consumption**	Cooperation to promote local consumption of aquaculture produced fish specially in tourist sector will reduce the cost of distribution and will improve the creation of add value in local products or by-products in innovative industries.	3. Social capital	**2**	**3**	**3**	**3**	**2**	BASE on Integrating aquaculture within local communities
A13	**Integrated multi-trophic aquaculture (IMTA)**	Integrated multi-trophic aquaculture (IMTA) is an ecosystem-based approach to culture species from different trophic levels (fish, shellfish, seaweeds) in an integrated farm to create balanced systems for environmental sustainability. IMTA can increase resilience due to its tolerance to wider ranges of climatic factors such as temperature and salinity.	4. Natural capital	**3**	**4**	**4**	**2**	**3**	Ahmed, N., et al(2019). **Global Aquaculture Productivity, Environmental Sustainability, and Climate Change Adaptability**. Environmental Management 63, 159–172.

A14	**Short-cycle aquaculture**	Short-cycle aquaculture shortens the farming period and the time in marine cages by stocking larger fingerlings in the nursery stage (land-based) or selecting species with a shorter culture cycle.	4. Natural capital	**3**	**1**	**4**	**3**	**4**	Pedro B. Bueno, 2017 - **ADAPTATION STRATEGIES OF THE AQUACULTURE SECTOR TO THE IMPACTS OF CLIMATE CHANGE.** FAO	
A15	**Recirculation Aquaculture Systems (RAS)**	Recirculation Aquaculture Systems (RAS) are land-based indoor fish farms with closed containment rearing systems where filtration is applied to purify and regulate water parameters and remove toxic metabolic wastes of fish. Since RAS is land-based and indoor it limits the risk of infrastructure destruction due to extreme events in the ocean.	5. Physical capital	**2**	**1**	**1**	**2**	**4**	Pedro B. Bueno, 2017 - ADAPTATION STRATEGIES OF THE AQUACULTURE SECTOR TO THE IMPACTS OF CLIMATE CHANGE	Barange, M. et al (2018). **Impacts of climate change on fisheries and aquaculture**: synthesis of current knowledge, adaptation and mitigation options. FAO Technical Paper No. 627. Rome, FAO. 628 pp
A16	**Submersible cages**	Submersible cages are oceanic depth-adjustable and can be moved up and down in the sea to escape the worst effects of storms, parasite outbreaks, surface algal blooms and to keep species at an optimal temperature.	5. Physical capital	**3**	**1**	**2**	**3**	**4**	Ahmed, N., et al(2019). **Global Aquaculture Productivity**, Environmental Sustainability, and Climate Change Adaptability. Environmental Management 63, 159–172.	Barange, M. et al (2018). **Impacts of climate change on fisheries and aquaculture**: synthesis of current knowledge, adaptation and mitigation options. FAO Technical Paper No. 627. Rome, FAO. 628 pp
A17	**Climate proof aquaculture activities**	Climate-proof activities refer to investments that consider climate change projections to manage future risks to infrastructures and improve operational safety conditions. E.g. strengthening mooring systems, cage structures and nets.	6. Managing long term risk	**4**	**3**	**3**	**3**	**4**	Decision-making and economics of adaptation to climate change in the fisheries and aquaculture sector	

A18	**Risk-based zoning and site selection**	Risk-based zoning and site selection consists of taking into consideration climate change scenarios when planning and selecting a site for a farm. For example, marine cage operations should not select a site that is (or is expected to be) exposed to high waves or strong currents, and pond farming operations should select sites with low risk of flooding. Zone management can facilitate effective sharing of space and resources with other users, taking into account the carrying capacity of the site.	6. Managing long term risk	**4**	**1**	**3**	**3**	**4**	Pedro B. Bueno, 2017 - **ADAPTATION STRATEGIES OF THE AQUACULTURE SECTOR TO THE IMPACTS OF CLIMATE CHANGE.** FAO
A19	**Disease prevention methods**	Disease prevention methods are preventive health measures such as vaccines, stronger fingerlings, probiotics, ensuring optimal water quality and implementing stricter hygiene procedures with the aim of reducing the risk of diseases now and in the future.	7. Preparedness	**4**	**1**	**3**	**3**	**4**	Pedro B. Bueno, 2017 - **ADAPTATION STRATEGIES OF THE AQUACULTURE SECTOR TO THE IMPACTS OF CLIMATE CHANGE.** FAO
A20	**Environmental monitoring and Early Warning Systems (EWS)**	Environmental monitoring and Early Warning Systems (EWS) systematically collects and provides information to fish farmers with the aim of supporting climate risk management decision-making. Monitoring and early warning can facilitate adaptation actions, such as early harvesting or relocation of fish net pens from sites of intense harmful algae blooms. Dynamic vulnerability maps, remote sensing and GIS are typically applied in the development of this type of measures.	7. Preparedness	**4**	**2**	**3**	**4**	**4**	Barange, M. et al (2018). **Impacts of climate change on fisheries and aquaculture: synthesis of current knowledge, adaptation and mitigation options**. FAO Fisheries and Aquaculture Technical Paper No. 627. Rome, FAO. 628 pp
A21	**Mainstreaming Disaster Risk Management (DRM)**	This measure aims to plan and organize DRM considering climate change along five stages including prevention, protection, preparedness, and response, recovery and review in the aquaculture decision making and management frameworks. Examples include interventions to limit farm development in natural hazard areas; review safety engineering standards for farms; study the interactions of climate change in local ecosystems and appropriately develop strategies, arrangements, and procedures to address crises; and post-emergency recovery activities.	8. Response	**4**	**2**	**3**	**3**	**4**	EU-funded project: EnviGuard

A22	**Contingency for emergency management, early harvest and/or relocation**	These plans consist in moving produce or activities to sites with more suitable characteristics to protect them against climate hazards such as storms, high waves, temperature changes or water quality degradation. Relocation can mean moving activities within the same environment (ocean-ocean; land-land) or between environments (ocean to land). It also includes protocols emergency harvesting to reduce the stock loss.	8. Response	**3**	**2**	**3**	**2**	**3**	Pedro B. Bueno, 2017 - **ADAPTATION STRATEGIES OF THE AQUACULTURE SECTOR TO THE IMPACTS OF CLIMATE CHANGE.** FAO	
A23	**Recovery Post-Disaster plans**	Establish early recovery good practices and objectives. This option will allow to reduce socio-economic and environmental consequences of the disaster. Examples of good practices are: Identify goods and services (support facilities like boats and docks as well as farm infrastructure) that require restoration.	9. Post disaster recovery and rehabilitation	**2**	**1**	**3**	**4**	**4**	Adapted from: **METHODOLOGICAL GUIDE FOR POST-DISASTER RECOVERY PLANNING PROCESSES**	
A24	**Recovery Post-Disaster funds**	Create recovery funds and plans for Post-Disaster in Aquaculture with Initiatives to get the economy running quickly, e.g. rebuild damaged critical infrastructures such boats, docks, and farm infrastructure. This option minimizes the economic and social impacts that can occur in a post-disaster context.	9. Post disaster recovery and rehabilitation	**3**	**1**	**3**	**4**	**4**	International Monetary Fund (IMF)	PreventionWeb (UNDRR)
A25	**Long-term environmental data collection and management at regional**	Long-term consistent environment data collection and management, and planning - establishment of long-term standard monitoring systems for the different regions, integrating climate, oceanography and environmental data...and Marine Strategy Framework Directive descriptors;	Local knowledge	**1**	**3**	**3**	**4**	**4**	Local Experts	
A26	**Implementation of local sanitary programs at regional scale**	Long-term stock health surveys, disease control and eradication;	Local knowledge	**1**	**3**	**3**	**4**	**4**	Local Experts	
A27	**Aquaculture and circular economy**	Integrate aquaculture in circular economy to take advantage of potential local wastes regarding energy, fish industry discards and wastes, distribution and marketing systems, etc. in order to strengthen, diversify and increase resilience of the local economies. Diminishing the ecological footprint of aquaculture;	Local knowledge	**3**	**4**	**4**	**2**	**3**	Local Experts	

A28	**Implement measures for increasing local industry self-sufficiency**	Providing higher autonomy and selfcare of the industry with production of local "seed" (lower risk of introduction of new species; lower number of pathogens) with strains of higher adaptability to local climate changes. Cooperative links between companies to increase purchase scale and lower costs, for better the stock management as well as decrease the costs of production, to improve response to market demand and improve first sale price.	Local knowledge	**3**	**3**	**3**	**3**	**4**	Local Experts
A29	**Aquaculture as an alternative to fishing**	Jobs offer and training programmes for fishermen who left decommissioned fishing boats; adaptation of fishing boats into aquaculture service boats.	Local knowledge	**3**	**4**	**4**	**4**	**2**	Local Experts

7.1.2 Annex AII - Adaptation measures for the energy sector

Options Characterization	Criteria	Sources

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ID	Name	Description	Class of adaptation	Cost Efficiency	Environmental protection	Mitigation (win-wins and trade-offs)	Technical feasibility	Social Acceptability		
E1	**Financial support for buildings with low energy needs**	Financial schemes in the form of loans, subsidies or tax reliefs are ways to support the reduction of energy needs of new or existing buildings, making them address climate change in a more efficient manner. For example, architecture and construction materials that rely on passive thermal comfort reduce the use of energy for human comfort, so less air-conditioning is necessary in the cooling season.	1. Financial capital	2	1	4	3	3	**European Energy Performance of Buildings Directive** (EPBD, COM(2016) 765 final)	**How low should be the energy required by a nearly Zero-Energy Building?** The load/generation energy balance of Mediterranean housing
E2	**Financial support for smart control of energy in houses and buildings**	The support of smart control of energy in houses and buildings allows for an efficient and automated use of energy that enables savings and creates synergies with utilities. For example, such a system could coordinate the automated opening vents with the air conditioning operation, avoiding energy consumption when possible. This will allow for the adaptation of buildings at a controlled cost, while complying with mitigation goals.	1. Financial capital	2	1	4	2	2	**European Energy Performance of Buildings Directive** (EPBD, COM(2016) 765 final)	de Bruin, K. et al. (2009). **Adapting to climate change in The Netherlands: an inventory of climate adaptation options and ranking of alternatives**. Climatic change, 95(1-2), 23-45.
E3	**Energy efficiency in urban water management**	Energy efficiency in urban water management is the adaptation of urban design and construction for water conservation that avoids energy use under scarcity scenarios. For instance, Water Sensitive Urban Design (WSUD) aims to plan water conservation and storm water storage with integration with elements of urban design. This both to minimises hydrological impacts on the environment and the associated energy use of water supply.	10. Provisioning services	2	3	4	2	3	Adaptation of urban planning: water and energy (2015)	Water Sensitive Urban and building Design (WSUD) (2016)

E4	**Underground tubes and piping in urban planning**	Underground tubes and piping are used for space heating/cooling across the globe and are more resilient to climate change. These systems can be Earth Air Heat Exchanger (EAHE) and Ground Source Heat Pump (GSHP) types. Both systems use tubes or pipes that usually need to be buried beyond the footprint of the building or house. The measure considers this need, and both allows and encourages the use of such space in urban planning.	10. Provisioning services	**3**	**2**	**4**	**2**	**3**	**Hybrid ground coupled heat exchanger systems** for space heating/cooling applications: A review, Soni et.al, 2016	
E5	**Biomass power from household waste**	Biomass power plants burn household waste, waste from parks and public gardens and sludge generated by sewage treatment plants. Towns and cities can also realise urban production and recreational woods, which can be used for producing biomass for co-generation (Combine Heat and Power) as well as tri-generation (Combined Cold Heat and Power) plants.	11. Regulating and Maintenance Services	**3**	**3**	**4**	**3**	**2**	**urbangreenbluegrids**	
E6	**Urban green corridors**	Urban green areas decrease the air temperature in a city and thus decrease energy needs. Warm air tends to transport pollution and particulate matter to higher layers of atmosphere, causing a cloud of smog. Creating green corridors also promotes biodiversity, increases the touristic value and decreases water run-off during storms.	11. Regulating and Maintenance Services	**3**	**4**	**4**	**4**	**4**	urbanbluegrids/heat and smogformation	urbangreenbluegrids/reduced pave surfaced
E7	**Educational garden plots**	Educational garden plots are sites where people, especially children, can garden with volunteers one afternoon a week after school. The harvest can be taken home. This creates well-being while having local fresh produce reduces the energy consumption and pollution. These garden plots can be further exploring to educate people about other climate action measures, directly and indirectly related with energy such as waste to energy, composting, water retention and green corridors.	12. Cultural services	**2**	**1**	**4**	**4**	**4**	urbangreenbluegrids	
E8	**Heated pools with waste heat from power plants**	Power plants need cooling and their waste heat can be used in swimming pools for public use and tourism. This creates an attractive leisure activity in off-peak winter times which diversifies the touristic offer and promote community well-being. This type of heat recovery design is called Combined Heat and Power (CHP). Pools provide a heat sink for the	12. Cultural services	**1**	**2**	**4**	**2**	**3**	Lund, J. W., & Chiasson, A. (2007). **Examples of combined heat and power plants using geothermal**	Papamarcou, M., Kalogirou, S., 2001b) Lund, J.W., Chiasson, A., 2007

		power plants which increases efficiency and is useful during heat waves.							**energy**. In Proceedings of the european geothermal congress (Vol. 30).	
E9	**Green jobs and businesses**	The promotion of green jobs and businesses consists in training people and supporting green businesses to implement energy solutions across the economy, both in mitigation and adaptation. One example can be the support of research projects to help businesses deal with new technologies relevant to climate action.	2. Human capital	**3**	**3**	**4**	**3**	**2**	Lehr, U. et al., 2012	European Commision
E10	**Public information service on climate action**	Public information service on climate action aims to provide the general public with information about adaptation and mitigation options available for their activities and businesses. This includes information dissemination and counselling about available solutions and the public support. This type of information is relevant, for example, to support dwellings, hotels or commerce to adapt to climate change.	2. Human capital	**3**	**3**	**4**	**4**	**3**	Climate Adapt	Climate Adapt
E11	**Small scale production and consumption (prosumers)**	Small scale production and consumption (prosumers) aims to promote cooperation by creating economies of scale both in the production and consumption of energy. This allows for a greater use of local renewable resources and waste energy recovery which allow for a better resilience when dealing with climate change events such as heat waves.	3. Social capital	**2**	**3**	**4**	**3**	**2**	Prosumers as New Energy Actors, Leal-Arcas et al., 2018	Electricity Prosumers, European Parliamentary Research Service, 2016
E12	**Risk reporting platform**	Risk reporting platform intends to promote the communication between the general public and the administration bodies concerning the risks related with climate change. It is a platform were the general public reports directly the risks as they become aware of. These can be for example related with cliff instability, trees falling over energy lines, uncleared bushes that can be ignited by power lines or unstable structures that may fall due to strong winds.	3. Social capital	**3**	**1**	**3**	**3**	**2**	City of Seatle (USA)	

E13	**Energy storage systems**	The development of energy storage systems can provide an alternative when the main power sources fail and need time to recover. This allows for a more resilient energy grid while enabling decarbonization and peak levelling at a controlled cost. This includes not only electric batteries (like those in cars and buses), but also other forms of energy storage such as thermal tanks (heat), ice banks (cold) or water height (reversed pumping).	4. Natural capital	**2**	**2**	**4**	**2**	**3**	Gallo et.al, 2016	Fernando J.de Sisternes, Jesse D.Jenkins, AudunBotterud, 2016
E14	**Collection and storage of forest fuel loads**	Collection and storage of forest fuel loads intend to promote and regulate the collection and storage of wood and combustible material to reduce wildfire hazard. Actions may include: clearing of small trees out of dense areas, reduce the amount of fuel on the ground and increasing the spacing between trees. Materials collected can be used in energy to waste applications such as pellets, biogas or other energy solutions.	4. Natural capital	**3**	**3**	**4**	**4**	**4**	Climate, Forests and Woodlands eXtension Community of Practice (CoP)	
E15	**Sea Water Air Conditioning (SWAC).**	The Seawater Air Conditioning (SWAC) measure is an alternate-energy system design that uses cold water from the deep ocean to provide more efficient, decarbonized and reliable cooling. The sweater is piped to heat exchangers for process cooling or to provide condensation water in air conditioning systems. It replaces air cooling units or fresh water evaporative cooling towers which performances degrades in heat waves. Other subsequent or parallel seawater uses can be combined, like for swimming pools or desalinisation.	5. Physical capital	**2**	**2**	**4**	**2**	**3**	Seawater Air Conditioning: A Basic Understanding (technical comercial brochure	Adoption of sea water air conditioning (SWAC) in the Caribbean: Individual vs regional effects
E16	**Demand Side Management (DSM) of Energy**	Demand Side Management (DSM) of energy is an operational strategy that better coordinates producers and consumers of energy. More renewable energy use is possible while ensuring the energy service reliability and controlled costs. DMS balances off-peak and peak demand using peek shaving, which is important, for example, during heat waves.	5. Physical capital	**2**	**1**	**4**	**2**	**1**	GoFLEX H2020	RESPOND H2020

E17	**Review building codes of the energy infrastructure**	Review energy infrastructure building codes aims to climate-proof the energy system by reviewing regulatory codes and infrastructures considering the spatial distribution of climate risks. This should include establishment of new procedures, maintenance practices, operational changes, retrofitting and the use of climate and mapping services such as those produced by the Copernicus Emergency Management Service (EMS).	6. Managing long term risk	**3**	**2**	**3**	**2**	**3**	K. de Bruin, 2007 - Adapting to climate change in The Netherlands: an inventory of climate adaptation options and ranking of alternatives	
E18	**Upgrade evaporative cooling systems**	Upgrade of evaporative cooling systems that rely on a given range of air temperature and water availability is necessary given that this type of cooling systems are a technology that can be affected by climate change and become compromised due to heat waves and water scarcity.	6. Managing long term risk	**3**	**1**	**3**	**2**	**3**	Cuce, P. M., & Riffat, S. (2016). A state of the art review of evaporative cooling systems for building applications. Renewable and Sustainable Energy Reviews, 54, 1240-1249.	Ayoub, A., Gjorgiev, B., & Sansavini, G. (2018). Cooling towers performance in a changing climate: Techno-economic modeling and design optimization. Energy, 160, 1133-1143.
E19	**Early Warning Systems (EWS)**	Early Warning Systems (EWS) is an information system that assesses climate risks and provides real time information to decision makers, companies, utilities and the general public. Climate data used to control and monitor the energy infrastructure can be relayed to the EWS. Using this data to monitor the evolution of climate related impacts in the energy sector increases the knowledge necessary to make long term climate adaptation decisions.	7. Preparedness	**3**	**4**	**3**	**3**	**4**	a) Climate Adapt b) Operational early warning systems for water-related hazards in Europe	
E20	**Grid reliability**	Grid reliability improvement aims to find and upgrade critical components and to enhance the energy system resilience to climate risks. This may include redundant circuitry or components that provide alternative dispatch of energy, equipment upgrades (e.g. better cooling to cope with heat waves) or power downrating (e.g. decrease power output of energy transformers so that they do not overheat during heat waves).	7. Preparedness	**2**	**2**	**3**	**2**	**4**	de Groot RJW, 2015	W. Stahlhut et al., 2008

E21	**Study and develop energy grid connections**	Energy grid connections aims to develop interconnections between islands and/or with the mainland allowing for the creation of economies of scale, energy system reliability improvements and more Renewable Energy Sources (RES) penetration.	8. Response	**3**	**2**	**4**	**2**	**4**	G.N.Prodromidis, F.A.Coutelieris, 2010	
E22	**Energy-independent facilities (generators)**	Energy-independent facilities (generators) make it possible for buildings to temporarily create their own energy supply. In case of an energy supply failure (power outage), essential amenities remain functional and can be optimized with Combined Heat and Power (CHP) designs and other decentralised energy generation solutions.	8. Response	**3**	**2**	**3**	**2**	**3**	urbangreenbluegrids	
E23	**Energy recovery microgrids**	Energy recovery microgrids are operational elements of the energy grids that rely on distributed generation to restore systems from power outages and to stabilize the grid. This allows for a flexible and swifter recovery from power outages caused by knock-out events (e.g. tree falls on energy lines), excess demand (e.g. during heat waves) or other causes.	9. Post disaster recovery and rehabilitation	**2**	**1**	**3**	**2**	**3**	Erol-Kantarci et al., 2011	Chen et.al, 2015
E24	**Local recovery energy outage capacity**	Local recovery energy outage capacity consists in increasing and improving the ability of the islands to recover from energy outages caused by or worsen by climate extreme events, like severe sea or windstorms that can lead to island isolation and exacerbate logistical hurdles. To facilitate a swift recovery, it's useful to have more mobile backup power, power line replacements and other grid components, logistics, supplies and personnel.	9. Post disaster recovery and rehabilitation	**1**	**1**	**4**	**2**	**3**	M.M. Adibi, 1994	
E25	**Minimize islands energy dependence from imported fossil fuels to increase resilience to climate change**	Energy efficiency and renewable resources potential are key assets in islands to increase resilience to climate change and to reduce dependence from fossil fuels, integrated with storage technologies, namely hydrogen, batteries and water storage. In islands territories, savings associated to sustainable energy measures are important for companies' recovery and competitiveness and to tackle and prevent energy poverty	Local knowledge	**3**	**3**	**4**	**2**	**3**	Local Experts	

		among families, particularly in tourism dependent islands, highly affected by the COVID-19 pandemic.							
E26	**Diversification on energy supply and electricity generation**	To reduce the vulnerability of energy supply and electricity generation is important to have a balanced diversification of energy sources, namely renewable energy sources that may be affected by climate change events (wind, solar, hydro, biomass, etc.) and fossil fuels needed to ensure the security of supply, promoting the transition to cleaner fuels like natural gas in the electricity generation and vessels supply.	Local knowledge	**1**	**1**	**4**	**3**	**3**	Local Experts
E27	**Implement electricity prices for renewable energy generation on islands based on actual local costs to stimulate the RES generation**	Taking into consideration European Commission specific derogations on the electricity market directives, Member States should Implement differentiated electricity tariffs for renewable energy production on islands with non-interconnected energy systems that take into consideration the additional costs of investments in islands territories, the lack of competitiveness in these isolated markets and the marginal costs of local thermal electricity generation.	Local knowledge	**1**	**3**	**4**	**2**	**4**	Local Experts
E28	**Modelling and forecasting of supply and demand**	The safety of supply of energy can be reinforced through more detailed modelling of the complexity of the insular energy systems combined with a forecasting of the demand and supply based on weather aspects.The guarantee of supply using the climate as an energy source, needs reliable and predictable data sources. The use of WRF (Weather Research and Forecasting), which allows to resolve the climate on a lower scale and re-analyse the climate of the past, using data provided by ECMWF or GFS, can build confidence in this regard. In addition, the WRF could allow	Local knowledge	**1**	**1**	**3**	**1**	**2**	Local Experts

		to predict the future climate at lower scale, based on large-scale forecasts (Regional downscaling Climate models limitations).							
E29	**Promote electric mobility integrated in smart grids with smart-charging and vehicle-to-grid infrastructure**	The transition from Internal Combustion Engine (ICE) to electric powertrains followed with a capable charging infrastructure with smart-charging, and V2G (Vehicle-to-Grid) functionalities not only speeds up the transition, as softens the impact of electric vehicles on electric grid. This measure with the increase of RES power contributes to the decarbonization of the insular energy systems.	Local knowledge	**1**	**1**	**4**	**3**	**2**	Local Experts
E30	**Electrification of energy demand**	Electrification of residential and services consumptions regarding heating, cooling and cooking, contributes to the decarbonization of the territory and removes the dependence on fossil fuels transport and distribution and also increase of RES contribution.	Local knowledge	**1**	**1**	**4**	**2**	**3**	Local Experts

7.1.3 Annex AIII - Adaptation measure for maritime transport sector

Options Characterization	Criteria	Sources

ID	Name	Description	Class of adaptation	Cost Efficiency	Environmental protection	Mitigation (win-wins and trade-offs)	Technical [illegible]	Social Acceptability	
MT1	**Insurance mechanisms for ports**	Insurance mechanisms for ports include risk-sharing schemes that aim to assist port operators in responding to the climate risks they are enabled to reduce. Insurance outsources the risks to a third party in exchange for a regular financial compensation.	1. Financial capital	2	1	3	4	4	Scott, H., McEvoy, D., Chhetri, P., Basic, F., & Mullett, J. (2013). **Climate change adaptation guidelines for ports. Enhancing the resilience of seaports to a changing climate report series**, National Climate Change Adaptation Research Facility, Gold Coast, 26.
MT2	**Financial incentives to retreat from high-risk areas**	Financial incentives to retreat from high-risk areas refers to the creation of financial incentives to retreat or relocate settlements, infrastructure and productive activities from the original location due to their high exposure to risks such as flood, sea-level rise and storm surges.	1. Financial capital	3	1	3	3	3	Climate-Adapt **metadata-adaptation options- Retreat from high-risk areas (2015)**
MT3	**Marine life friendly coastal protection structures**	Marine life friendly coastal protection structures are coastal protection structures constructed with materials that maximize the fixation of marine organisms. This option reduces climate change impacts on local ecosystems, provides water waste depuration (made by marine organisms) and water quality bio-indicators inside the ports.	10. Provisioning services	3	4	4	3	3	S. Natanzi, Atteyeh & Mcnally, Ciaran. (2018). **Ecostructure: Concrete design for improved marine biodiversity**.
MT4	**Combined protection and wave energy infrastructures**	Combined protection and wave energy infrastructures is an energy measure that combines sea protection structures with wave energy production. This can create economies of scale, increase coastal protection and further decrease wave propagation inside the port during normal operations.	10. Provisioning services	3	3	4	2	2	Iglesias G., Abanades J. (2017) **Wave Power**: Climate Change Mitigation and Adaptation.

MT5	**Hybrid and full electric ship propulsion**	Hybrid and full electric ship propulsion is environmentally friendly for marine life, decreases carbon emissions and can increase ship manoeuvrability which is useful in small ports and under difficult weather conditions. Low speed manoeuvring with conventional engines creates air and water pollution, noise and fuel consumption. Electrically driven propulsion can address these issues while increasing manoeuvrability using for instance azimuth thrusters.	11. Regulating and Maintenance Services	**2**	**1**	**4**	**3**	**3**	a :J. M. Apsley et al. (2009). **Propulsion Drive Models for Full Electric Marine Propulsion Systems** b :Prousalidis, J. et al. (2005).**Studying ship electric energy systems with shaft generator**. IEEE Electric Ship Technologies Symposium.
MT6	**Coastal protection structures**	Coastal protection structures such as groynes, breakwaters, artificial reefs and seawalls are different types of artificial structures, built in the shoreline (or rivers), which are designed to protect the coast from SLR or storms. Those structures can be used to, for example, drift and trap sediments, protect from erosion, absorb wave energy, or allow navigation.	11. Regulating and Maintenance Services	**4**	**2**	**1**	**4**	**2**	Climate-Adapt **metadata adaptation options-groynes-breakwaters-and-artificial-reefs**
MT7	**Integrate ports in urban tissue**	Integrate ports into the urban tissue opening port areas to other activities, namely cultural, while gaining room in the urban landscape. This allows some port activities to be pooled from low-laying areas while leisure and cultural activities can access more waterfront space.	12. Cultural services	**2**	**1**	**3**	**3**	**4**	a :**Discussing the port-city relationship**. What can we expect from the future?, blog article by Pages Sanches, 2019 b :Pages Sanchez, Jose. (2015). **Port-City Relation: Integration -Conflict -Coexistence Analysis of Good Practices**.
MT8	**Ocean pools**	Ocean pools are situated by the sea where waves can wash into the pool. The width, length and depth of ocean pools varies and often depends on their location on the coastline. These recreational structures are a response to SLR, protect the coast and create alternatives to beach leisure areas.	12. Cultural services	**4**	**2**	**1**	**4**	**3**	a :**World's best tidal and oceanside pools of the feasibility of an ocean pool** at Hallett Cove, South Australia b :Coastal engineering assessment, Water Research Laboratory (WRL) to the city of Marion (Australia), 2019
MT9	**Awareness campaigns for behavioural change**	Awareness campaigns for behavioural change aim to increase individuals and organisations' knowledge about climate change and the risk faced by the maritime transport sector. These campaigns can be targeted to regions affected	2. Human capital	**2**	**3**	**4**	**4**	**3**	Climate-Adapt **metadata aptation options-awareness campaigns for behavioural change**

		by a particular climate threat, specific groups of infrastructures or the general transport sector as a whole.							
MT10	**Social dialogue for training in the port sector**	Social dialogue for training in the port sector refers to social and educational issues related with the gender equality and attracting the young to the sector, while tackling climate change. It relies on social dialogue between workers and employees to define common guidelines for training. It considers key challenges that ports are facing and how the industry is adapting to change and preparing for the future.	2. Human capital	**3**	**3**	**4**	**4**	**3**	**Maritime Transport Strategy**, European Commission web site (retreived at 2020)
MT11	**Diversification of trade using climate resilient commodities**	Diversification of trade using climate resilient commodities aims to reduce dependency on trade of perishable goods and critical services, create larger stocks of goods that are climate resilient and consider were changing trading systems to endure changes in climate is economically feasible, strategically justifiable and equitable.	3. Social capital	**4**	**2**	**4**	**4**	**2**	a :Small States' **Resilience to Natural Disasters and Climate Change** - Role for the IMF, IMF Policy paper, 2016 b :Kaján E., Saarinen J., 2013, Tourism, climate change and adaptation: a review
MT12	**Climate resilient economy and jobs**	Climate resilient economy and jobs aims to shift the economy and jobs towards a more climate resilient society. Perishable goods and some critical services rely heavily on the marine transport which can be affected by unpredictable extreme weather events. To address this the economy needs to adapt by shifting to products and services that depend less on Just In Time (JIT) operations, using for instance larger stocks.	3. Social capital	**4**	**3**	**4**	**3**	**3**	Assessing the I**mplications of Climate Change Adaptation on Employment** in the EU, European Commission, 2014
MT13	**Refrigeration, cooling and ventilation systems**	Improve the efficiency of refrigeration, cooling and ventilation systems in order to reduce costs in warmer weather and maintain operations during heat waves. Human thermal comfort provided by efficient ventilation and cooling is relevant to ensure the health and safety of passengers and port workers. Refrigeration is relevant for managing goods that need low temperatures.	4. Natural capital	**3**	**1**	**2**	**4**	**4**	a :Scott, H, et al.(2013). Climate change adaptation guidelines for ports, **Enhancing the resilience of seaports** to a changing climate report series, National Climate Change Adaptation Research Facility b :Velegrakis, A. F. (2013). Climate change impacts and adaptation for international

									transport networks : Expert Group Report (223 p.). UN (UNCTAD)
MT14	**Restrict development and settlement in low-lying areas**	Restrict development and settlement in low-lying areas means to assure that ports are not further developed in low-laying areas exposed to SLR. Planning must consider the long-term potential risks.	4. Natural capital	**3**	**1**	**4**	**4**	**2**	UNCTAD based on literature review - **Multi-Year Expert Meeting on Transport and Trade Facilitation** : Maritime Transport and the Climate Change Challenge, 16-18 February 2009, Geneva : summary of proceedings (p. 47 p. :). (2009). UN (UNCTAD)
MT15	**Sturdiness improvement of vessels**	Improve the strength of vessels to sea storms while decreasing the noise and increasing efficiency. Wave-induced loads on the ship structures are a major concern in hull design process. Ship owners should prefer designs that allow for more demanding wave regimes (for instance including the survivability to rouge waves).	5. Physical capital	**3**	**1**	**3**	**2**	**3**	Bitner-Gregersen E.M., et al., **Climate change and safe design of ship structures**, 2018
MT16	**Increase operational speed and flexibility in ports**	Increase operational speed and flexibility in ports aims to increase the attractiveness of ship transport in order to capture more freight and passenger movement. This can promote a modal shift towards shipping and create new opportunities including those related with exports and tourism. Faster operations also reduce the effects of heat waves on goods and people as well as decarbonise the economy.	5. Physical capital	**4**	**1**	**4**	**3**	**2**	Taneja, P. et al., 2012, **Flexibility in Port Planning and Design**. European Journal of Transport and Infrastructure Research
MT17	**Climate proof ports and port activities**	Climate-proof ports and port activities refers to investments that consider specific climate change projections to manage future risks in port infrastructures and improve operational safety conditions. These can include retrofitting or reconfiguring breakwaters and other port structures to avoid overtops and flooding due to storm surges, heavy precipitation, extreme heat, strong winds events and	6. Managing long term risk	**3**	**2**	**2**	**4**	**3**	a :Chhetri, P. et al., 2015, **Seaport resilience to climate change**: mapping vulnerability to sea-level rise b :Copernicus Emergency Management Service (EMS)

		extreme swell conditions. The Copernicus Emergency Management Services (EMS) services can provide regarding climate change and disaster risk reduction.							
MT18	**Consider expansion/retreat of ports in urban planning**	Consider expansion/retreat of ports in urban planning means to consider the expansion or reallocation of areas for future maritime transport infrastructures due to climate change risks. The urban planning and expansion should consider the potential requirements for port expansion/retreat options.	6. Managing long term risk	**2**	**2**	**3**	**3**	**2**	a :Minutes of the Local Working Group – Azores, 1st Meeting, 28th September 2018, Ponta Delgada b :SOCLIMPACT, Azores 1st Meeting Results and SSS (WP7)
MT19	**Reinforcement of inspection, repair and maintenance of infrastructures**	A continuous reinforcement of inspection, repair and maintenance of infrastructures aims to adapt monitoring to a new climate context. Changes in the frequency and/or intensity of storms, SLR or temperature, for example, may have impacts in infrastructure, increasing degradation of the materials and requiring new maintenance plans.	7. Preparedness	**3**	**3**	**2**	**4**	**4**	a :Yi Zhang et al., 2017, Optimal sustainable life cycle maintenance strategies for port infrastructures b :The Guidelines on Strategic Maintenance for Port Structures, ASEAN-Japan Transport Partnership Program, 2011
MT20	**Early Warning Systems (EWS) and climate change monitoring**	Early Warning Systems (EWS) is an information system with several components that assesses climate risks and relays that information to decision makers, companies utilities and the general public in real time. Transport operators should integrate this tool in procedures in order to protect the safety of people and goods. The collected data can also be used to study the evolution of climate impacts as time progresses, for instance the impact of heat waves and storms in operations.	7. Preparedness	**4**	**3**	**3**	**4**	**4**	a :Establishment of early warning systems (2019) b :Alfieri, L. et al., 2012, Operational early warning systems for water-related hazards in Europe

MT21	**Intelligent Transport Systems (ITS)**	Intelligent Transport Systems (ITS) are technologies that relay automated and tailored data and safety-related messages to ships, regarding climate hazards and other relevant information. ITS use communication and information standards that are uniform and widely accepted by other ports that the island is linked to.	8. Response	**4**	**3**	**4**	**4**	**4**	a :Crainic, T.G. et al.(2009) **Intelligent freight-transportation systems**: Assessment and the contribution of operations research b :An EU that delivers investments in **smart sustainable and safe mobility** for jobs and growth, 2018, European Comission
MT22	**Prepare for service delays or cancellations**	Prepare for service delays or cancellations aims to promote the creation of new procedures, alternative options and channels to sell goods and transport passengers, as well as better communication to deal with delays or cancellations. Dealing with more frequency and/or intensity of storms (which will happen in some regions) improves port reputation and customer preferences.	8. Response	**2**	**1**	**3**	**3**	**2**	a :Multi-Year Expert Meeting on Transport and **Trade Facilitation** : Maritime Transport and the Climate Change Challenge, 16-18 February 2009, Geneva : summary of proceedings (p. 47). (2009). UN (UNCTAD) b :Scott, H, et al., 2013, Climate change adaptation guidelines for ports, Enhancing the resilience of seaports to a changing climate report series, National Climate Change Adaptation Research Facility
MT23	**Backup routes and infrastructures during extreme weather**	Backup routes and infrastructures during extreme weather aims to creates a post disaster response that ensures available alternatives when the main ports are damaged or inaccessible due to extreme weather events. It considers alternative ports and access roads. Alternative ports can be smaller in size, simpler and be used for other purposes, but should have a different location and orientation from the main ones.	9. Post disaster recovery and rehabilitation	**4**	**3**	**1**	**4**	**3**	
MT24	**Post-Disaster recovery funds**	Post-Disaster recovery funds is the creation of recovery funds for the maritime transport sector to recover after disasters, through initiatives that get the economy up and running quickly while building-back-better (e.g. rebuild damaged critical infrastructures such as ports and roads). The aim is to minimize the economic and social impacts that can occur in a post-disaster context.	9. Post disaster recovery and rehabilitation	**2**	**1**	**3**	**4**	**4**	a :Hammett, L.M., Mixter, M., 2017, **Adaptive Finance to Support Post-Disaster Recovery** b :**Sendai Framework for Disaster Risk Reduction** 2015 - 2030, 2015, United Nations Office for Disaster Risk Reduction

MT25	**Specific requirements to increase climate change resilience of maritime transports services in islands**	It must be underlined, that small and fragmented territories are disadvantages of islands and archipelagos regarding climate change assessment that must be considered, as adaptation measures and allocated resources, namely for maritime transports, should deal with higher uncertainty. The maritime transport of passengers and goods is crucial for archipelagos, especially for smaller islands that are depend on main islands, aggravating their vulnerability to climate change. Additionally, to the consideration of backup routes and infrastructures, it is important to define specific requirements for this service, in order to ensure the operation of vessels with characteristics to deal with higher climate change uncertainty, and promote the use of natural gas, biogas, hydrogen and electricity, in order to decrease dependence from fossil fuels and increase manoeuvrability of vessels.	Local knowledge	**3**	**4**	**4**	**3**	**2**	Local Experts
MT26	**Prepare islands ports to supply alternative fuels and electricity**	Islands ports must be prepared to supply natural gas, biogas, hydrogen and electricity, in order to be prepared to alternative propulsion technologies and supply docked vessels with electricity from renewable sources, reducing the dependence from fossil fuels, and thus increasing the resilience of the islands energy systems to climate change, measures with high synergies with mitigation objectives.	Local knowledge	**2**	**3**	**4**	**3**	**3**	Local Experts
MT27	**Increase knowledge and modelling tools on climate change for islands**	Outermost regions, namely Atlantic islands, are located in existing climate models boundaries. Support downscaling climate modelling and ensure reliable systematic climate data collection is important to face islands additional constraints and support decision making processes and resources allocation for climate change adaptation.It must be underlined, that small and fragmented territories are disadvantages of islands and archipelagos regarding climate change assessment that must be considered by Member states and by EU, as adaptation measures and allocated resources should deal with higher uncertainty.Specific characterization, monitorization, inspection data collection and processing in the scope of public health and, marine	Local knowledge	**4**	**3**	**3**	**4**	**4**	Local Experts

		and terrestrial ecosystems (natural and artificial reefs, natural inland ecosystems, forest ecosystems, agricultural ecosystems, fluvial ecosystems) and potentially threaten infrastructures (coastal infrastructures, roads, tunnels, bridges, airports, dams, water streams, water channels, hydraulic drainage systems, desalination plants, energy infrastructures, health care infrastructures, communication infrastructures, etc.) should be implemented taking into consideration innovative approaches (including satellite information, geographic information systems and real-time data collection systems) to overcome knowledge gaps on climate change vulnerability and impacts on islands (sea level rise, storms, floods, flush floods, forest fires) and to better deal with climate change projections uncertainty.Given the high dependence from air transports, specific climate forecast models and climate data collection systems to ensure islands airports real-time operation must be specially promoted in other to decrease islands vulnerability to climate change.							
MT28	**City ports as coastal protection infrastructures against extreme climate events (sea level rise combined with sea storm)**	Future interventions in ports, specially urban and city ports, should take into consideration their potential to protect turban coastal areas from sea storms combined with sea level rise. The intervention in marinas and boatyards should also guarantee the security of the infrastructures in case of extreme weather events and consider the need of increase the dry dock areas, to ensure the boats security.	Local knowledge	**4**	**4**	**2**	**3**	**4**	Local Experts

7.1.4 Annex IV - Adaptation measures for the tourism sector

Options Characterization				Criteria					Source
ID	Name	Description	Class of adaptation	Cost Efficiency	Environmental protection	Mitigation (win-wins and trade-offs)	Technical applicability	Social Acceptability	
T1	**Economic Policy Instruments (EPIs)**	Economic Policy Instruments (EPIs) are incentives designed and implemented with the purpose of adapting individual decisions to collectively agreed goals. Diferent type of instruments can be aplied, like: pricing (e.g. water tariffs), environmental taxes and charges, subsidies; trading (e.g. tradable permit for pollution or water abstraction, compensation mechanisms, payments for environmental services); and voluntary agreements and risk management schemes such as insurances.	1. Financial capital	4	4	3	4	4	Climate-Adapt/behavioural change
T2	**Financial incentives to retreat from high-risk areas**	Financial incentives to retreat from high-risk areas refers to the creation of financial incentives to retreat or relocate settlements, infrastructure and productive activities from the original location due to their high exposure to risks such as flood, sea-level rise and storm surges.	1. Financial capital	2	1	3	3	2	Climate-Adapt/retreat

T3	**Adaptation of groundwater management**	Adaptation of groundwater management can be used to (1) conserve groundwater reservoirs, limiting water use and optimizing water reuse, and (2) restore or increase natural infiltration capacity. Both contribute to adaptation in circumstances of reduced precipitation and sea saltwater intrusion aggravated with groundwater over-exploitation. Different packages of interventions usually inlcude: freshwater injection, modifying pumping practice, delayed inflow, artificial recharge or efficient use of freshwater.	10. Provisioning services	**4**	**4**	**4**	**3**	**4**	Climate-Adapt/groundwater
T4	**Monitoring, modelling and forecasting systems**	Monitoring, modelling and forecasting systems are information system that provide timely and reliable climate information, as well as up-to-date data on the occurrence and severity of extreme events, possible impacts and their duration. Different systems can be implemented to respond to different climate hazards, such as drought-related, water quality monitoring, water resources management and predicting and managing flood risks.	10. Provisioning services	**3**	**4**	**3**	**4**	**4**	Climate-Adapt/monitoring
T5	**Dune restoration and rehabilitation**	Dune restoration and rehabilitation refers to the strengthening of the flood safety and sand reservoir functions of dunes. Dune erosion happens as a result of wind action, marine erosion, human activities and Sea Level Rise (SLR). Possible technics examples include: grass planting, thatching and fencing.	11. Regulating and Maintenance Services	**3**	**3**	**4**	**3**	**4**	Climate-Adapt/dunes
T6	**River rehabilitation and restoration**	River rehabilitation and restoration are measures that emphasise the natural functions of rivers and create vegetated buffer zones alongside watercourses. This contributes to the improvement of micro-climatic conditions, reduces run-off and erosion, and increases groundwater recharge. For Tourism, this option also increases available leisure areas, increases thermal comfort areas and the availability of water.	11. Regulating and Maintenance Services	**4**	**4**	**4**	**4**	**4**	Climate-Adapt/rivers
T7	**Adaptive management of natural habitats**	Adaptive management of natural habitats refers to the preservation of ecosystem services which are essential for human well-being. Human activities induce pressure and impacts on biodiversity and ecosystems that tend to be aggravated by climate change. Adaptive management measures include: understanding species response; make space for the development of rivers and coasts; aid gene flow; species translocation; targets and conservation mechanisms/plans.	12. Cultural services	**3**	**2**	**4**	**4**	**4**	Climate-Adapt

T8	**Ocean pools**	Ocean pools are seawater pools located by the sea where waves can wash into the pool. The width, length and depth of ocean pools varies and often depends on their location on the coastline. These recreational structures are useful on SLR context, doubling as an additional protection of the coast and creating alternatives to beach leisure areas.	12. Cultural services	**4**	**1**	**1**	**4**	**2**	CNN	By Water Research Laboratory (WRL) to the city of Marion (Australia)
T9	**Activity and product diversificatio n**	Activity and product diversification include actions to diversify the tourism activities and products and aim to reduce seasonality and overload in infrastructures and ecosystems. Shifting the dependency from 'sun, sea and sand' products to alternative leisure activities can reduce the impacts of heat waves, coastal erosion or ecosystem degradation, and thus help to maintain destination attractiveness.	2. Human capital	**4**	**2**	**4**	**4**	**3**	**Small States' Resilience to Natural Disasters and Climate Change** - Role for the IMF, IMF Policy paper, 2016	Kaján E., Saarinen J., 2013, Tourism, climate change and adaptation: a review
T10	**Public awareness programmes**	Public awareness programmes establish targeted programmes that raise awareness about climate change (specific values and protection needs) among guides, site managers and local communities.	2. Human capital	**2**	**4**	**4**	**4**	**3**	Belle, N. and Bramwell, B., 2005	
T11	**Local circular economy**	Local circular economy is an economic system aimed at eliminating waste and the continual use of resources that offers a valuable framework for reduced carbon emissions from materials (decarbonization) and increased resilience to climate change and its impacts.	3. Social capital	**3**	**2**	**4**	**3**	**2**	a: https://gca.org/solutions/why-is-the-path-to-a-resilient-economy-circular b: https://gca.org/home	
T12	**Tourist awareness campaigns**	Tourist awareness campaigns target behavioural change of visitors and aim to increase tourists (individuals and organisations) knowledge about climate change and the risk faced by tourism destinations. These campaigns can be targeted to regions affected by a particular climate threat, specific groups of visitors or the general tourism sector as a whole.	3. Social capital	**2**	**3**	**4**	**4**	**4**	https://climate-adapt.eea.europa.eu/metadata/adaptation-options/awareness-campaigns-for-behavioural-change	

T13	**Local sustainable fishing**	Local sustainable fishing refers to the promotion of fishing zones/rights for local small-scale fishers maintaining stocks and using sustainable methods. This option aims to add value to local resources and products, protect ecosystems services and decrease external dependency.	4. Natural capital	**2**	**3**	**4**	**4**	**2**	https://climate-adapt.eea.europa.eu/metadata/projects/mediterranean-network-of-sustainable-small-scale-fishing-communities	http://www.fao.org/3/a-i3569e.pdf
T14	**Water restrictions, consumption cuts and grey-water recycling**	Restrictions can be applied to allow water administration services to cope with water crises. Restriction (or rationing) of certain uses of water such as irrigation of lawns, car washing, filling swimming pools or hosing down pavement areas may be necessary during these times. Grey-water recycling (or reclamation) is the reuse of non-drinkable water (usually treated waste water) to cover water use needs that don't demand such a high-quality standard.	4. Natural capital	**4**	**3**	**4**	**4**	**2**	https://climate-adapt.eea.europa.eu/metadata/adaptation-options/water-restrictions-and-consumption-cuts	https://ec.europa.eu/clima/sites/clima/files/docs/0053/climate_adapt_en.pdf
T15	**Beach nourishment**	Beach nourishment (or replenishment) is the artificial placement of sand to compensate for erosion. Beach nourishment also often aims at maintaining beach width (for tourism and recreational purposes). Several beach nourishment techniques can be used including beach, backshore and shoreface nourishment, and large scale coastal nourishment (e.g. using sand motors).	5. Physical capital	**4**	**2**	**1**	**4**	**2**	https://climate-adapt.eea.europa.eu/metadata/adaptation-options/beach-and-shoreface-nourishment	
T16	**Desalination**	Desalination is the process of removing salt from sea or brackish water to make it useable for a range of purposes including drinking, and can contribute to adaptation in circumstances of current or future water scarcity problems. Technological examples include electrically driven technologies, like reverse osmosis, and thermally driven technologies, based mainly on vapor distillation processes.	5. Physical capital	**3**	**2**	**1**	**4**	**3**	https://climate-adapt.eea.europa.eu/metadata/adaptation-options/desalinisation	
T17	**Coastal protection structures**	Coastal protection structures such as groynes, breakwaters, artificial reefs and seawalls are different types of artificial structures, built in the shoreline (or rivers), which are designed to protect the coast from SLR or storms.	6. Managing long term risk	**3**	**1**	**1**	**4**	**3**	https://climate-adapt.eea.europa.eu/metadata/adaptation-options/groynes-	

		Those structures can be used to, for example, drift and trap sediments, protect from erosion, absorb wave energy, or allow navigation.							breakwaters-and-artificial-reefs
T18	**Drought and water conservation plans**	Drought and water conservation plans refer to tourism-lead adaptation and/or involvement in drought management plans with the aim to reduce the economic, social, and environmental consequences of drought and water scarcity, and to reduce the loss of water and improve efficiency in the sector.	6. Managing long term risk	**3**	**2**	**3**	**3**	**4**	https://climate-adapt.eea.europa.eu/metadata/adaptation-options/adaptation-of-drought-and-water-conservation-plans
T19	**Mainstreaming Disaster Risk Management (DRM)**	Mainstreaming Disaster Risk Management (DRM) aims to plan and organize DRM along five stages including prevention, protection, preparedness, and response, recovery and review. Examples include interventions to limit urban development in flood prone areas; identify natural hazard prone areas; develop strategies, arrangements, and procedures to address crises; and post-emergency recovery activities.	7. Preparedness	**4**	**4**	**3**	**3**	**4**	https://climate-adapt.eea.europa.eu/metadata/adaptation-options/crises-and-disaster-management-systems-and-plans
T20	**Using water to cope with heat waves**	Water use to cope with heat waves in cities are a set of investments in water supply services and infrastructures that aim to increase urban resilience regarding heat waves. Different packages of grey interventions are usually applied, as for example: creating and/or repairing fountains for drinking water and cooling; water spray fountains; and wetting streets.	7. Preparedness	**4**	**2**	**4**	**4**	**4**	https://climate-adapt.eea.europa.eu/metadata/adaptation-options/water-uses-to-cope-with-heat-waves-in-cities
T21	**Fire management plans**	Fire management plans are management actions have wide range of application such as early warning detection, with escape routes and advice to local citizens and tourists, mobilization and suppression of unwanted and damaging fires, or use of fire to manage fuel. Additionally, these plans help to increase the understanding of the interactions of climate change with vegetation cover and fire regimes.	8. Response	**3**	**2**	**3**	**4**	**4**	https://climate-adapt.eea.europa.eu/metadata/adaptation-options/adaptation-of-fire-management-plans
T22	**Health care delivery systems**	Health care delivery systems are pre-emptive actions and adjustments that need to be made to health care systems, namely reinforcing less prepared aspects of its operation and/or logistics, in order to guarantee effectiveness and efficiency during, for example, high temperature and heat-wave situations.	8. Response	**3**	**1**	**2**	**4**	**4**	a: https://climate-adapt.eea.europa.eu/metadata/adaptation-options/heat-health-action-plans b: https://climate-adapt.eea.europa.eu/metadata/guidances/heat-health-action-plans-2014-guidance

T23	**Post-Disaster recovery funds**	Post-Disaster recovery funds is the creation of recovery funds for the Tourism sector to recover after disasters, through initiatives that get the economy up and running quickly while building-back-better (e.g. rebuild damaged critical infrastructures such as ports and roads or recover the landscape from fires). The aim is to minimize the economic and social impacts (which may include future loss of the touristic destination attractiveness) that can occur in a post-disaster context.	9. Post disaster recovery and rehabilitation	**3**	**1**	**3**	**4**	**4**	a: https://www.preventionweb.net/publications/view/32306 b: https://www.imf.org/external/np/pp/eng/2016/110416.pdf
T24	**Pre-disaster early recovery planning**	Pre-disaster early recovery planning processes include the development of knowledge, good practices and objectives that aim to improve the living conditions of the affected communities, while facilitating the adjustments necessary to reduce the risk of future disasters. Examples of good practices are may include identifying critical ecosystems (goods and services) that require immediate restoration after a disaster or particularly vulnerable communities.	9. Post disaster recovery and rehabilitation	**4**	**2**	**3**	**4**	**4**	a: https://www.preventionweb.net/publications/view/32306 b: https://www.imf.org/external/np/pp/eng/2016/110416.pdf

T25	**Rehabilitation and conservation of islands natural habitats key assets for Islands tourism agriculture, fisheries, and food security.**	In islands, habitats rehabilitation, conservation and monitoring actions, including control of non-indigenes species, are important measures to increase ecosystems resilience to climate change, in order to preserve habitats, biodiversity, landscape and key assets for tourism, agriculture, fisheries and food security. In this context, the EU Natura 2000 protected areas, and UNESCO World heritage Sites and Biosphere reserves, are important tools for conservation and management that help islands to preserve their natural, cultural, or mixed heritage.	Local knowledge	4	4	4	3	3	a: https://www.ipcc.ch/search/?search=small+islands b: https://www.ipcc.ch/site/assets/uploads/2018/02/ar4-wg2-chapter16-2.pdf c: https://climate-adapt.eea.europa.eu/metadata/adaptation-options/adaptation-of-fire-management-plans/#source d: https://ec.europa.eu/environment/nature/natura2000/index_en.htm e: https://whc.unesco.org/en/activities/497/ f: Local Experts
T26	**Diversification of economic activities to reduce the dependence from tourism activities**	The climate change extreme events can cause disruption on tourism activity. For that reason, it is important to diversify the island economy to increase resilience of socioeconomic systems. Promote the development of primary sector activities taking into consideration innovative and sustainable approaches are important to increase self-sufficiency in food products and reduce its carbon footprint, contribution to increase economy diversification in islands. Fair trade, quality, certification and differentiation can increase competitiveness of islands cash crops (and sub products) and traditional handcrafts contributing to economy diversification from tourism. Digital innovative products and services can also be explored in islands as an economy diversification vector.	Local knowledge	4	3	4	4	3	a: https://www.adaptation-undp.org/economic-diversification b: Local Expert

T27	**Promote islands as telework tourism destinations**	The pandemic COVID-19 accelerated the adoption of video conferencing, cloud collaboration and teleworking, opening new possibilities for remote working lifestyles. Telework tourism opens new perspectives for individuals, couples, families, and groups, who are interested to combine a possibility of a new format of remote office work, and leisure in a foreign country. The territorial expansion and strength of digital infrastructures, the adaptation of traditional lodging products, and the provision of family support services are important to the promotion of islands as teleworking destinations and should be explored to ensure lodgement occupation and reduce tourism seasonality.	Local knowledge	**3**	**1**	**4**	**4**	**4**	a: https://worldshoppingtourism.com/downloads/GJC_THE_TOURISM_INDUSTRY_AND_THE_IMPACT_OF_COVID_19.pdf b: https://vandensky.com/2020/08/03/e-tourism-long-term-work-and-leisure-fusion/ c: Local Experts

T28	**Increase knowledge and modelling tools on climate change for islands**	Outermost regions, namely Atlantic islands, are located in existing climate models boundaries. Support downscaling climate modelling and ensure reliable systematic climate data collection is important to face islands additional constraints and support decision making processes and resources allocation for climate change adaptation.It must be underlined, that small and fragmented territories are disadvantages of islands and archipelagos regarding climate change assessment that must be considered by Member states and by EU, as adaptation measures and allocated resources should deal with higher uncertainty.Specific characterization, monitorization, inspection data collection and processing in the scope of public health and, marine and terrestrial ecosystems (natural and artificial reefs, natural inland ecosystems, forest ecosystems, agricultural ecosystems, fluvial ecosystems) and potentially threaten infrastructures (coastal infrastructures, roads, tunnels, bridges, airports, dams, water streams, water channels, hydraulic drainage systems, desalination plants, energy infrastructures, health care infrastructures, communication infrastructures, etc.) should be implemented taking into consideration innovative approaches (including satellite information, geographic information systems and real-time data collection systems) to overcome knowledge gaps on climate change vulnerability and impacts on islands (sea level rise, storms, floods, flush floods, forest fires) and to better deal with climate change projections uncertainty.Given the high dependence from air transports, specific climate forecast models and climate data collection systems to ensure islands airports real-time operation must be specially promoted in other to decrease islands vulnerability to climate change.	Local knowledge	**4**	**3**	**3**	**4**	**4**	Local Experts
T29	**Control measures for terrestrial and maritime tourist activities**	Climate change can originate higher pressures on natural ecosystems. For that reason, additional measures could be necessary to protect those ecosystems from some touristic activities, including regulations and normative instructions in order to ensure sustainable development of terrestrial and maritime tourism activities, such as limitations of volume visitors in fragile and restricted areas, and promote the practice of respectful wildlife watching, such as birds, marine turtles, cetaceans, and others.	Local knowledge	**4**	**3**	**4**	**4**	**2**	Local Experts

T30	**Implement waste reduction and management procedures to reduce dependence from exterior and pressures in natural ecosystems**	In islands, highly dependent from goods importation, waste reduction and waste management regulations and procedures should be implemented to reduce waste production, increase waste selective collection for recycling and decrease pressure in natural habitats, that will be under stress by climate change. Given the lack of scale to make recycling viable in many insular territories, special support should be given to cover the exportation costs of these materials to be recycled in the mainland or bigger islands. Particular attention should be given to dangerous waste, as small islands do not have scale dimension to implement local adequate treatment, and maritime transport of these dangerous waste must be done in special security conditions. Organic waste valorisation (composting or bioenergy production) should be considered as there is lack of space in islands for final disposal. Incineration with energy recovery should also be studied as a solution to reduce final disposal. In archipelagos, maritime transport of waste to bigger islands should be assessed as an option for smaller islands. Specific policies to reduce overpackaging and plastic use, particularly disposable plastics, should be implemented in islands. Real-time Monitoring systems to detect and characterize marine litter, high seas pollution focus (namely by fossil fuels), coastal discharges and algae blooms should be implemented with support of innovative technologies and procedures. Dedicated awareness raising campaigns for economic actors, residents, and tourists, should be implemented to reduce waste production, increase reutilization and promote adequate waste selective collection for recycling.	Local knowledge	**2**	**4**	**4**	**3**	**3**	Local Experts

7.2 Annex B – Adaptation pathway trajectories

7.2.1 Annex BI – Aquaculture sector

APT A – Minimum intervention (Low investment, low commitment to policy change)

	Short - until 2030			Medium - between 2030 and 2050			Long - between 2050 and 2100		
	ID	Name	Ratio	ID	Nome	Ratio	ID	Nome	Ratio
ADDRESSING DRIVERS OF VULNERABILITY	A9	Awareness campaigns for behavioural change	61%	A10	Efficient feed management	74%	A10	Efficient feed management	70%
DISASTER RISK REDUCTION	A18	Risk-based zoning and site selection	87%	A18	Risk-based zoning and site selection	74%	A18	Risk-based zoning and site selection	61%
	A21	Mainstreaming Disaster Risk Management (DRM)	100%	A22	Contingency for emergency management, early harvest and/or relocation	61%	A22	Contingency for emergency management, early harvest and/or relocation	57%
	A23	Recovery Post-Disaster plans	87%	A23	Recovery Post-Disaster plans	74%	A23	Recovery Post-Disaster plans	78%
SOCIAL - ECOLOGICAL RESILIENCE	A3	Feed production	61%	A3	Feed production	70%	A3	Feed production	61%
LOCAL KNOWLEDGE	A29	Aquaculture as an alternative to fishing	48%	A29	Aquaculture as an alternative to fishing	48%	A29	Aquaculture as an alternative to fishing	43%
	A25	Long-term environmental data collection and management at regional	39%	A25	Long-term environmental data collection and management at regional	22%	A25	Long-term environmental data collection and management at regional	22%

APT B – Economic Capacity Expansion (High investment, low commitment to policy change)

	Short - untill 2030			Medium - beween 2030 and 2050			Long - between 2050 and 2100		
	ID	Name	Ratio	ID	Nome	Ratio	ID	Nome	Ratio
ADDRESSING DRIVERS OF VULNERABILITY	A1	Financial schemes, insurance and loans	74%	A1	Financial schemes, insurance and loans	78%	A2	Tax benefits and subsidies	57%
	A9	Awareness campaigns for behavioural change	74%	A9	Awareness campaigns for behavioural change	57%	A9	Awareness campaigns for behavioural change	57%
	A16	Submersible cages	74%	A16	Submersible cages	74%	A16	Submersible cages	78%
DISASTER RISK REDUCTION	A17	Climate proof aquaculture activities	61%	A17	Climate proof aquaculture activities	83%	A17	Climate proof aquaculture activities	78%
SOCIAL - ECOLOGICAL RESILIENCE	A3	Feed production	74%	A3	Feed production	78%	A3	Feed production	70%
	A5	Selective breeding	57%	A5	Selective breeding	65%	A5	Selective breeding	65%
LOCAL KNOWLEDGE	A29	Aquaculture as an alternative to fishing	48%	A29	Aquaculture as an alternative to fishing	52%	A29	Aquaculture as an alternative to fishing	39%
	A26	Implementation of local sanitary programs at regional scale	22%	A28	Implement measures for increasing local industry self-sufficiency	30%	A28	Implement measures for increasing local industry self-sufficiency	30%

APT C – Efficiency Enhancement (Medium investment, medium commitment to policy change)

	Short - untill 2030			Medium - beween 2030 and 2050			Long - between 2050 and 2100		
	ID	Name	Ratio	ID	Nome	Ratio	ID	Nome	Ratio
ADDRESSING DRIVERS OF VULNERABILITY	A10	Efficient feed management	57%	A10	Efficient feed management	57%	A9	Awareness campaigns for behavioural change	52%
	A12	Promote cooperation to local consumption	57%	A11	Addressing consumer and environmental concerns at the local level	52%	A11	Addressing consumer and environmental concerns at the local level	70%
	A14	Short-cycle aquaculture	65%	A14	Short-cycle aquaculture	61%	A14	Short-cycle aquaculture	61%
DISASTER RISK REDUCTION	A18	Risk-based zoning and site selection	87%	A17	Climate proof aquaculture activities	70%	A17	Climate proof aquaculture activities	74%
	A19	Disease prevention methods	78%	A19	Disease prevention methods	70%	A19	Disease prevention methods	61%
SOCIAL - ECOLOGICAL RESILIENCE	A3	Feed production	61%	A4	Species selection	70%	A4	Species selection	78%
	A6	Best Management Practices	87%	A6	Best Management Practices	83%	A5	Selective breeding	52%
	A8	Promote aquaculture cuisine	61%	A7	Create educational visits	70%	A7	Create educational visits	57%
LOCAL KNOWLEDGE	A29	Aquaculture as an alternative to fishing	39%	A27	Aquaculture and circular economy	61%	A27	Aquaculture and circular economy	30%
	A25	Long-term environmental data collection and management at regional	26%				A28	Implement measures for increasing local industry self-sufficiency	52%

APT D – System Restructuring (High investment, high commitment to policy change)

	Short - untill 2030			Medium - beween 2030 and 2050			Long - between 2050 and 2100		
	ID	Name	Ratio	ID	Nome	Ratio	ID	Nome	Ratio
ADDRESSING DRIVERS OF VULNERABILITY	A10	Efficient feed management	57%	A10	Efficient feed management	57%	A9	Awareness campaigns for behavioural change	52%
	A12	Promote cooperation to local consumption	57%	A11	Addressing consumer and environmental concerns at the local level	52%	A11	Addressing consumer and environmental concerns at the local level	70%
	A14	Short-cycle aquaculture	65%	A14	Short-cycle aquaculture	61%	A14	Short-cycle aquaculture	61%
DISASTER RISK REDUCTION	A18	Risk-based zoning and site selection	87%	A17	Climate proof aquaculture activities	70%	A17	Climate proof aquaculture activities	74%
	A19	Disease prevention methods	78%	A19	Disease prevention methods	70%	A19	Disease prevention methods	61%
SOCIAL - ECOLOGICAL RESILIENCE	A3	Feed production	61%	A4	Species selection	70%	A4	Species selection	78%
	A6	Best Management Practices	87%	A6	Best Management Practices	83%	A5	Selective breeding	52%
	A8	Promote aquaculture cuisine	61%	A7	Create educational visits	70%	A7	Create educational visits	57%
LOCAL KNOWLEDGE	A29	Aquaculture as an alternative to fishing	39%	A27	Aquaculture and circular economy	61%	A27	Aquaculture and circular economy	30%
	A25	Long-term environmental data collection and management at regional	26%				A28	Implement measures for increasing local industry self-sufficiency	52%

7.2.2 Annex BII – Energy sector

APT A – Minimum intervention (Low investment, low commitment to policy change)

	Short - until 2030			Medium - between 2030 and 2050			Long - between 2050 and 2100		
	ID	Name	Ratio	ID	Nome	Ratio	ID	Nome	Ratio
ADDRESSING DRIVERS OF VULNERABILITY	E10	Public information service on climate action	76%	E9	Green jobs and businesses	56%	E10	Public information service on climate action	52%
DISASTER RISK REDUCTION	E17	Review building codes of the energy infrastructure	76%	E17	Review building codes of the energy infrastructure	56%	E17	Review building codes of the energy infrastructure	56%
	E21	Study and develop energy grid connections	52%	E22	Energy-independent facilities (generators)	56%	E22	Energy-independent facilities (generators)	52%
	E23	Energy recovery microgrids	64%	E23	Energy recovery microgrids	68%	E24	Local recovery energy outage capacity	56%
SOCIAL - ECOLOGICAL RESILIENCE	E3	Energy efficiency in urban water management	80%	E3	Energy efficiency in urban water management	60%	E3	Energy efficiency in urban water management	64%
LOCAL KNOWLEDGE	E25	Minimize islands energy dependence from imported fossil fuels to increase resilience to climate change	36%	E25	Minimize islands energy dependence from imported fossil fuels to increase resilience to climate change	32%	E25	Minimize islands energy dependence from imported fossil fuels to increase resilience to climate change	28%
	E27	Implement electricity prices for renewable energy generation on islands based on actual local costs to stimulate the RES generation	20%	E26	Diversification on energy supply and electricity generation	20%	E26	Diversification on energy supply and electricity generation	24%
							E27	Implement electricity prices for renewable energy generation on islands based on actual local costs to stimulate the RES generation	20%

APT B – Economic Capacity Expansion (High investment, low commitment to policy change)

	Short - until 2030			Medium - between 2030 and 2050			Long - between 2050 and 2100		
	ID	Name	Ratio	ID	Nome	Ratio	ID	Nome	Ratio
ADDRESSING DRIVERS OF VULNERABILITY	E1	Financial support for buildings with low energy needs	56%	E2	Financial support for smart control of energy in houses and buildings	52%	E2	Financial support for smart control of energy in houses and buildings	72%
	E9	Green jobs and businesses	52%	E9	Green jobs and businesses	76%	E9	Green jobs and businesses	72%
	E16	Demand Side Mangement (DSM) of Energy	56%	E16	Demand Side Mangement (DSM) of Energy	60%	E16	Demand Side Mangement (DSM) of Energy	60%
DISASTER RISK REDUCTION	E17	Review building codes of the energy infrastructure	56%	E18	Upgrade evaporative cooling systems	68%	E18	Upgrade evaporative cooling systems	64%
SOCIAL - ECOLOGICAL RESILIENCE	E3	Energy efficiency in urban water management	80%	E3	Energy efficiency in urban water management	64%	E3	Energy efficiency in urban water management	60%
	E6	Urban green corridors	52%	E6	Urban green corridors	60%	E6	Urban green corridors	56%
LOCAL KNOWLEDGE	E25	Minimize islands energy dependence from imported fossil fuels to increase resilience to climate change	28%	E25	Minimize islands energy dependence from imported fossil fuels to increase resilience to climate change	28%	E25	Minimize islands energy dependence from imported fossil fuels to increase resilience to climate change	24%
	E26	Diversification on energy supply and electricity generation	32%	E26	Diversification on energy supply and electricity generation	28%	E26	Diversification on energy supply and electricity generation	24%
				E29	Promote electric mobility integrated in smart grids with smart-charging and vehicle-to-grid infrastructure	20%	E29	Promote electric mobility integrated in smart grids with smart-charging and vehicle-to-grid infrastructure	24%

APT C – Efficiency Enhancement (Medium investment, medium commitment to policy change)

	Short - until 2030			Medium - between 2030 and 2050			Long - between 2050 and 2100		
	ID	Name	Ratio	ID	Nome	Ratio	ID	Nome	Ratio
ADDRESSING DRIVERS OF VULNERABILITY	E10	Public information service on climate action	56%	E9	Green jobs and businesses	76%	E9	Green jobs and businesses	84%
	E11	Small scale production and consumption (prosumers)	64%	E11	Small scale production and consumption (prosumers)	64%	E11	Small scale production and consumption (prosumers)	60%
	E13	Energy storage systems	60%	E13	Energy storage systems	64%	E13	Energy storage systems	64%
DISASTER RISK REDUCTION	E17	Review building codes of the energy infrastructure	72%	E18	Upgrade evaporative cooling systems	52%	E18	Upgrade evaporative cooling systems	68%
	E19	Early Warning Systems (EWS)	56%	E20	Grid reliability	60%	E20	Grid reliability	60%
SOCIAL - ECOLOGICAL RESILIENCE	E3	Energy efficiency in urban water management	84%	E3	Energy efficiency in urban water management	64%	E3	Energy efficiency in urban water management	56%
	E5	Biomass power from household waste	52%	E6	Urban green corridors	52%	E5	Biomass power from household waste	56%
	E7	Educational garden plots	84%	E7	Educational garden plots	68%	E7	Educational garden plots	56%
LOCAL KNOWLEDGE	E25	Minimize islands energy dependence from imported fossil fuels to increase resilience to climate change	40%	E25	Minimize islands energy dependence from imported fossil fuels to increase resilience to climate change	28%	E25	Minimize islands energy dependence from imported fossil fuels to increase resilience to climate change	28%
	E29	Promote electric mobility integrated in smart grids with smart-charging and vehicle-to-grid infrastructure	20%	E29	Promote electric mobility integrated in smart grids with smart-charging and vehicle-to-grid infrastructure	32%	E29	Promote electric mobility integrated in smart grids with smart-charging and vehicle-to-grid infrastructure	24%
				E26	Diversification on energy supply and electricity generation	24%			

APT D – System Restructuring (High investment, high commitment to policy change)

	Short - until 2030			Medium - between 2030 and 2050			Long - between 2050 and 2100		
	ID	Name	Ratio	ID	Nome	Ratio	ID	Nome	Ratio
ADDRESSING DRIVERS OF VULNERABILITY	E1	Financial support for buildings with low energy needs	56%	E2	Financial support for smart control of energy in houses and buildings	56%	E2	Financial support for smart control of energy in houses and buildings	64%
	E9	Green jobs and businesses	56%	E9	Green jobs and businesses	80%	E9	Green jobs and businesses	84%
	E13	Energy storage systems	76%	E13	Energy storage systems	68%	E13	Energy storage systems	76%
DISASTER RISK REDUCTION	E17	Review building codes of the energy infrastructure	76%	E17	Review building codes of the energy infrastructure	60%	E18	Upgrade evaporative cooling systems	60%
	E23	Energy recovery microgrids	60%	E23	Energy recovery microgrids	56%	E23	Energy recovery microgrids	52%
SOCIAL - ECOLOGICAL RESILIENCE	E3	Energy efficiency in urban water management	76%	E3	Energy efficiency in urban water management	72%	E3	Energy efficiency in urban water management	56%
LOCAL KNOWLEDGE	E25	Minimize islands energy dependence from imported fossil fuels to increase resilience to climate change	36%	E25	Minimize islands energy dependence from imported fossil fuels to increase resilience to climate change	28%	E25	Minimize islands energy dependence from imported fossil fuels to increase resilience to climate change	32%
	E29	Promote electric mobility integrated in smart grids with smart-charging and vehicle-to-grid infrastructure	24%	E26	Diversification on energy supply and electricity generation	28%	E26	Diversification on energy supply and electricity generation	24%

7.2.3 Annex BIII – Maritime transport sector

APT A – Minimum intervention (Low investment, low commitment to policy change)

	Short - until 2030			Medium - between 2030 and 2050			Long - between 2050 and 2100		
	ID	Name	Ratio	ID	Nome	Ratio	ID	Nome	Ratio
ADDRESSING DRIVERS OF VULNERABILITY	**MT9**	Awareness campaigns for behavioural change	71%	**MT10**	Social dialogue for training in the port sector	63%	**MT10**	Social dialogue for training in the port sector	63%
DISASTER RISK REDUCTION	**MT17**	Climate proof ports and port activities	63%	**MT17**	Climate proof ports and port activities	58%	**MT17**	Climate proof ports and port activities	54%
	MT22	Prepare for service delays or cancellations	67%	**MT21**	Inteligent Transport Systems (ITS)	63%	**MT21**	Inteligent Transport Systems (ITS)	75%
	MT23	Backup routes and infrastructures during extreme weather	67%	**MT23**	Backup routes and infrastructures during extreme weather	83%	**MT23**	Backup routes and infrastructures during extreme weather	67%
SOCIAL - ECOLOGICAL RESILIENCE	**MT3**	Marine life friendly coastal protection structures	88%	**MT3**	Marine life friendly coastal protection structures	58%	**MT3**	Marine life friendly coastal protection structures	50%
							MT4	Combined protection and wave energy infrastructures	50%
LOCAL KNOWLEDGE	**MT27**	Increase knowledge and modelling tools on climate change for islands	71%	**MT27**	Increase knowledge and modelling tools on climate change for islands	25%	**MT27**	Increase knowledge and modelling tools on climate change for islands	33%
				MT28	City ports as coastal protection infrastructures against extreme climate events (sea level rise combined with sea storm)	29%			
				MT25	Specific requirements to increase climate change resilience of maritime transports services in islands	33%	**MT25**	Specific requirements to increase climate change resilience of maritime transports services in islands	33%

APT B – Economic Capacity Expansion (High investment, low commitment to policy change)

	Short - until 2030			Medium - between 2030 and 2050			Long - between 2050 and 2100		
	ID	Name	Ratio	ID	Nome	Ratio	ID	Nome	Ratio
ADDRESSING DRIVERS OF VULNERABILITY	MT1	Insurance mechanisms for ports	58%	MT1	Insurance mechanisms for ports	54%	MT1	Insurance mechanisms for ports	50%
							MT2	Financial incentives to retreat from high-risk areas	50%
	MT9	Awareness campaigns for behavioural change	75%	MT9	Awareness campaigns for behavioural change	50%	MT10	Social dialogue for training in the port sector	63%
				MT10	Social dialogue for training in the port sector	50%			
	MT16	Increase operational speed and flexibility in ports	50%	MT16	Increase operational speed and flexibility in ports	71%	MT16	Increase operational speed and flexibility in ports	54%
	MT15	Sturdiness improvement of vessels	50%						
DISASTER RISK REDUCTION	MT18	Consider expansion/retreat of ports in urban planning	54%	MT18	Consider expansion/retreat of ports in urban planning	50%	MT17	Climate proof ports and port activities	67%
				MT17	Climate proof ports and port	50%			
SOCIAL - ECOLOGICAL RESILIENCE	MT3	Marine life friendly coastal protection structures	67%	MT4	Combined protection and wave energy infrastructures	67%	MT4	Combined protection and wave energy infrastructures	79%
	MT6	Coastal protection structures	83%	MT6	Coastal protection structures	50%	MT6	Coastal protection structures	64%
				MT5	Hybrid and full electric ship propulsion	50%			
LOCAL KNOWLEDGE	MT27	Increase knowledge and modelling tools on climate change for islands	29%	MT28	City ports as coastal protection infrastructures against extreme climate events (sea level rise combined with sea storm)	29%	MT28	City ports as coastal protection infrastructures against extreme climate events (sea level rise combined with sea storm)	38%
	MT25	Specific requirements to increase climate change resilience of maritime transports services in islands	25%	MT25	Specific requirements to increase climate change resilience of maritime transports services in islands	38%	MT26	Prepare islands ports to supply alternative fuels and electricity	25%
	MT26	Prepare islands ports to supply alternative fuels and electricity	33%						

APT C – Efficiency Enhancement (Medium investment, medium commitment to policy change)

	Short - until 2030			Medium - between 2030 and 2050			Long - between 2050 and 2100		
	ID	Name	Ratio	ID	Nome	Ratio	ID	Nome	Ratio
ADDRESSING DRIVERS OF VULNERABILITY	MT9	Awareness campaigns for behavioural change	67%	MT10	Social dialogue for training in the port sector	54%	MT10	Social dialogue for training in the port sector	67%
	MT12	Climate resilient economy and jobs	54%	MT12	Climate resilient economy and jobs	63%	MT12	Climate resilient economy and jobs	67%
	MT14	Restrict development and settlement in low-lying areas	54%	MT14	Restrict development and settlement in low-lying areas	50%	MT14	Restrict development and settlement in low-lying areas	79%
				MT13	Refrigeration, cooling and ventilation systems	50%			
DISASTER RISK REDUCTION	MT18	Consider expansion/retreat of ports in urban planning	58%	MT17	Climate proof ports and port activities	63%	MT18	Consider expansion/retreat of ports in urban planning	58%
	MT20	Early Warning Systems (EWS) and climate change monitoring	50%	MT20	Early Warning Systems (EWS) and climate change monitoring	63%	MT20	Early Warning Systems (EWS) and climate change monitoring	54%
	MT19	Reinforcement of inspection, repair and maintenance of infrastructures	50%						
SOCIAL - ECOLOGICAL RESILIENCE	MT3	Marine life friendly coastal protection structures	67%	MT4	Combined protection and wave energy infrastructures	54%	MT4	Combined protection and wave energy infrastructures	83%
	MT6	Coastal protection structures	75%	MT5	Hybrid and full electric ship propulsion	54%	MT5	Hybrid and full electric ship propulsion	88%
	MT7	Integrate ports in urban tissue	88%	MT8	Ocean pools	54%	MT7	Integrate ports in urban tissue	54%
LOCAL KNOWLEDGE	MT27	Increase knowledge and modelling tools on climate change for islands	33%	MT25	Specific requirements to increase climate change resilience of maritime transports services in islands	25%	MT28	City ports as coastal protection infrastructures against extreme climate events (sea level rise combined with sea storm)	42%
	MT26	Prepare islands ports to supply alternative fuels and electricity	29%	MT26	Prepare islands ports to supply alternative fuels and electricity	42%	MT25	Specific requirements to increase climate change resilience of maritime transports services in islands	33%

APT D – System Restructuring (High investment, high commitment to policy change)

	Short - until 2030			Medium - between 2030 and 2050			Long - between 2050 and 2100		
	ID	Name	Ratio	ID	Nome	Ratio	ID	Nome	Ratio
ADDRESSING DRIVERS OF VULNERABILITY	MT2	Financial incentives to retreat from high-risk areas	67%	MT2	Financial incentives to retreat from high-risk areas	79%	MT2	Financial incentives to retreat from high-risk areas	58%
	MT9	Awareness campaigns for behavioural change	58%	MT10	Social dialogue for training in the port sector	54%	MT10	Social dialogue for training in the port sector	75%
	MT14	Restrict development and settlement in low-lying areas	54%	MT14	Restrict development and settlement in low-lying areas	58%	MT14	Restrict development and settlement in low-lying areas	71%
DISASTER RISK REDUCTION	MT17	Climate proof ports and port activities	50%	MT17	Climate proof ports and port activities	58%	MT18	Consider expansion/retreat of ports in urban planning	54%
	MT18	Consider expansion/retreat of ports in urban planning	50%						
	MT23	Backup routes and infrastructures during extreme weather	67%	MT23	Backup routes and infrastructures during extreme weather	75%	MT23	Backup routes and infrastructures during extreme weather	50%
							MT24	Post-Disaster recovery funds	50%
SOCIAL - ECOLOGICAL RESILIENCE	MT3	Marine life friendly coastal protection structures	54%	MT4	Combined protection and wave energy infrastructures	71%	MT4	Combined protection and wave energy infrastructures	83%
LOCAL KNOWLEDGE	MT27	Increase knowledge and modelling tools on climate change for islands	38%	MT28	City ports as coastal protection infrastructures against extreme climate events (sea level rise combined with sea storm)	38%	MT27	Increase knowledge and modelling tools on climate change for islands	29%
	MT28	City ports as coastal protection infrastructures against extreme climate events (sea level rise combined with sea storm)	25%	MT25	Specific requirements to increase climate change resilience of maritime transports services in islands	25%	MT28	City ports as coastal protection infrastructures against extreme climate events (sea level rise combined with sea storm)	46%
	MT26	Prepare islands ports to supply alternative fuels and electricity	25%						

7.2.4 Annex BIV – Energy sector

APT A – Minimum intervention (Low investment, low commitment to policy change)

	Short - until 2030			Medium - between 2030 and 2050			Long - between 2050 and 2100		
	ID	Name	Ratio	ID	Nome	Ratio	ID	Nome	Ratio
ADDRESSING DRIVERS OF VULNERABILITY	T10	Public awareness programmes	68%	T10	Public awareness programmes	52%	T10	Public awareness programmes	52%
DISASTER RISK REDUCTION	T18	Drought and water conservation plans	74%	T17	Coastal protection structures	55%	T17	Coastal protection structures	55%
	T21	Fire management plans	65%	T21	Fire management plans	58%	T22	Health care delivery systems	52%
	T24	Pre-disaster early recovery planning	61%	T23	Post-Disaster recovery funds	52%	T24	Pre-disaster early recovery planning	55%
SOCIAL - ECOLOGICAL RESILIENCE	T4	Monitoring, modelling and forecasting systems	65%	T3	Adaptation of groundwater management	61%	T4	Monitoring, modelling and forecasting systems	61%
LOCAL KNOWLEDGE	T25	Rehabilitation and conservation of islands natural habitats key assets for Islands tourism agriculture, fisheries, and food security.	26%	T26	Diversification of economic activities to reduce the dependence from tourism activities	32%	T25	Rehabilitation and conservation of islands natural habitats key assets for Islands tourism agriculture, fisheries, and food security.	19%
	T27	Promote islands as telework tourism destinations	32%	T29	Control measures for terrestrial and maritime tourist activities	19%	T28	Increase knowledge and modelling tools on climate change for islands	19%

APT B – Economic Capacity Expansion (High investment, low commitment to policy change)

	Short - until 2030			Medium - between 2030 and 2050			Long - between 2050 and 2100		
	ID	Name	Ratio	ID	Nome	Ratio	ID	Nome	Ratio
ADDRESSING DRIVERS OF VULNERABILITY	T1	Economic Policy Instruments (EPIs)	55%	T2	Financial incentives to retreat from high-risk areas	52%	T1	Economic Policy Instruments (EPIs)	55%
	T10	Public awareness programmes	52%	T9	Activity and product diversification	61%	T9	Activity and product diversification	68%
	T15	Beach nourishment	58%	T16	Desalination	65%	T16	Desalination	68%
DISASTER RISK REDUCTION	T17	Coastal protection structures	61%	T17	Coastal protection structures	61%	T17	Coastal protection structures	55%
SOCIAL - ECOLOGICAL RESILIENCE	T4	Monitoring, modelling and forecasting systems	55%	T3	Adaptation of groundwater management	52%	T4	Monitoring, modelling and forecasting systems	52%
	T6	River rehabilitation and restoration	55%	T6	River rehabilitation and restoration	58%	T6	River rehabilitation and restoration	65%
LOCAL KNOWLEDGE	T25	Rehabilitation and conservation of islands natural habitats key assets for Islands tourism agriculture, fisheries, and food security.	23%	T25	Rehabilitation and conservation of islands natural habitats key assets for Islands tourism agriculture, fisheries, and food security.	39%	T25	Rehabilitation and conservation of islands natural habitats key assets for Islands tourism agriculture, fisheries, and food security.	19%
	T26	Diversification of economic activities to reduce the dependence from tourism activities	32%	T26	Diversification of economic activities to reduce the dependence from tourism activities	29%	T26	Diversification of economic activities to reduce the dependence from tourism activities	26%
	T28	Increase knowledge and modelling tools on climate change for islands	23%				T30	Implement waste reduction and management procedures to reduce dependence from exterior and pressures in natural ecosystems	26%

APT C – Efficiency Enhancement (Medium investment, medium commitment to policy change)

	Short - until 2030			Medium - between 2030 and 2050			Long - between 2050 and 2100		
	ID	Name	Ratio	ID	Nome	Ratio	ID	Nome	Ratio
ADDRESSING DRIVERS OF VULNERABILITY	T10	Public awareness programmes	58%	T9	Activity and product diversification	81%	T9	Activity and product diversification	65%
	T11	Local circular economy	65%	T11	Local circular economy	71%	T11	Local circular economy	68%
	T14	Water restrictions, consumption cuts and grey-water recycling	52%	T14	Water restrictions, consumption cuts and grey-water recycling	65%	T14	Water restrictions, consumption cuts and grey-water recycling	61%
DISASTER RISK REDUCTION	T18	Drought and water conservation plans	58%	T18	Drought and water conservation plans	52%	T17	Coastal protection structures	58%
	T19	Mainstreaming Disaster Risk Management (DRM)	84%	T19	Mainstreaming Disaster Risk Management (DRM)	77%	T19	Mainstreaming Disaster Risk Management (DRM)	65%
SOCIAL - ECOLOGICAL RESILIENCE	T4	Monitoring, modelling and forecasting systems	61%	T4	Monitoring, modelling and forecasting systems	55%	T3	Adaptation of groundwater management	52%
	T6	River rehabilitation and restoration	52%	T6	River rehabilitation and restoration	52%	T6	River rehabilitation and restoration	55%
	T7	Adaptive management of natural habitats	74%	T7	Adaptive management of natural habitats	71%	T7	Adaptive management of natural habitats	71%
LOCAL KNOWLEDGE	T25	Rehabilitation and conservation of islands natural habitats key assets for Islands tourism agriculture, fisheries, and food security.	32%	T25	Rehabilitation and conservation of islands natural habitats key assets for Islands tourism agriculture, fisheries, and food security.	19%	T25	Rehabilitation and conservation of islands natural habitats key assets for Islands tourism agriculture, fisheries, and food security.	19%
	T28	Increase knowledge and modelling tools on climate change for islands	23%	T26	Diversification of economic activities to reduce the dependence from tourism activities	32%	T26	Diversification of economic activities to reduce the dependence from tourism activities	23%
	T30	Implement waste reduction and management procedures to reduce dependence from exterior and pressures in natural ecosystems	19%	T28	Increase knowledge and modelling tools on climate change for islands	19%	T30	Implement waste reduction and management procedures to reduce dependence from exterior and pressures in natural ecosystems	35%

APT D – System Restructuring (High investment, high commitment to policy change)

	Short - until 2030			Medium - between 2030 and 2050			Long - between 2050 and 2100		
	ID	Name	Ratio	ID	Nome	Ratio	ID	Nome	Ratio
ADDRESSING DRIVERS OF VULNERABILITY	T2	Financial incentives to retreat from high-risk areas	58%	T2	Financial incentives to retreat from high-risk areas	61%	T2	Financial incentives to retreat from high-risk areas	65%
	T9	Activity and product diversification	52%	T9	Activity and product diversification	71%	T9	Activity and product diversification	74%
	T14	Water restrictions, consumption cuts and grey-water recycling	65%	T14	Water restrictions, consumption cuts and grey-water recycling	71%	T14	Water restrictions, consumption cuts and grey-water recycling	65%
DISASTER RISK REDUCTION	T18	Drought and water conservation plans	71%	T17	Coastal protection structures	58%	T17	Coastal protection structures	71%
	T24	Pre-disaster early recovery planning	77%	T24	Pre-disaster early recovery planning	58%	T23	Post-Disaster recovery funds	58%
SOCIAL - ECOLOGICAL RESILIENCE	T4	Monitoring, modelling and forecasting systems	68%	T4	Monitoring, modelling and forecasting systems	58%	T3	Adaptation of groundwater management	58%
LOCAL KNOWLEDGE	T25	Rehabilitation and conservation of islands natural habitats key assets for Islands tourism agriculture, fisheries, and food security.	32%	T25	Rehabilitation and conservation of islands natural habitats key assets for Islands tourism agriculture, fisheries, and food security.	26%	T26	Diversification of economic activities to reduce the dependence from tourism activities	23%
	T26	Diversification of economic activities to reduce the dependence from tourism activities	19%	T26	Diversification of economic activities to reduce the dependence from tourism activities	23%			
	T28	Increase knowledge and modelling tools on climate change for islands	23%	T28	Increase knowledge and modelling tools on climate change for islands	19%	T30	Implement waste reduction and management procedures to reduce dependence from exterior and pressures in natural ecosystems	29%
	T30	Implement waste reduction and management procedures to reduce dependence from exterior and pressures in natural ecosystems	19%						

This project has received funding from the European Union's Horizon 2020 research and innovation programme under Grant Agreement No776661

SOCLIMPACT

Downscaling climate impacts and decarbonisation pathways in EU islands, and enhancing socioeconomic and non-market evaluation of Climate Change for Europe, for 2050 and beyond

SOCLIMPACT

This project has received funding from the European Union's Horizon 2020 research and innovation programme under Grant Agreement No776661

Work Package 7:

This is a result of Tasks 7.3. This deliverable will include the agendas, the list of participants, and the workshops outputs including the decisions taken.

Deliverable 7.3.

Workshop Report - Malta

Island Focal Point coordinated by AquaBioTech Group.

Kyra Hoevenaars, Lena Schenke, and Nesrine Boulila

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1 Introduction

This document presents the results of the stakeholders' consultation process to design the SOCLIMPACT Adaptation Pathways Workshops in Malta. The SOCLIMPACT Regional Workshops are included in SOCLIMPACT Task 7.3 - Engage islands' stakeholders in the design of alternative pathways. Two workshops were organised by AquaBioTech Group, the Island Focal Point (IFP) for Malta. These online workshops used the background material prepared in Task 7.2/D7.2 and include the main results from previous WPs.

The workshops were held with the following objectives:

16. **Identify and present the characterized packages of adaptation and risk management options** available for each archipelago/island.
17. **Develop detailed archipelago/island integrated adaptation pathways**, in three timeframes: Short term (up to 2030), Mid-century (up to 2050) and End-century (up to 2100).
18. **Evaluate** and rank pathways for Blue Economy sectors.

All four Blue Economy sectors of SOCLIMPACT (Aquaculture, Tourism, Energy and Marine Transport) were covered in the workshop. Due to COVID, these workshops were held online as webinars using MS Teams. The following schedule was followed:

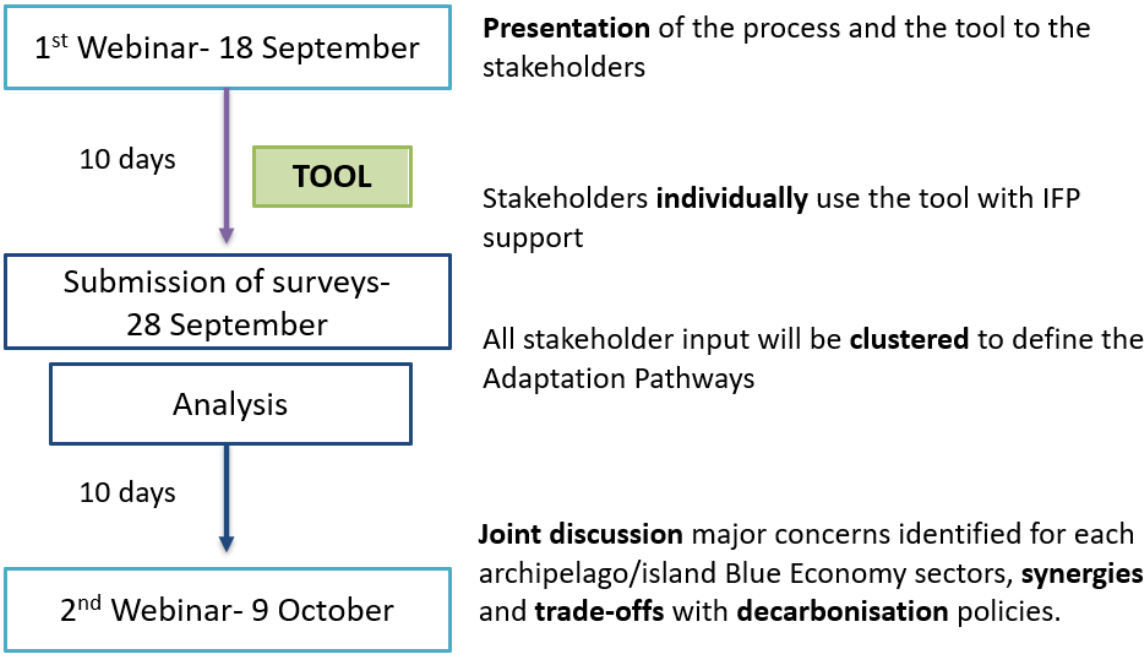


Figure 132 - Malta Schedule for the online workshops.

The original plan was to hold physical workshops in each archipelago. However, health and travel limitations due to Covid-19 forced changes to the original plan and partners decided to develop two shorter online sessions mixed with an online survey. The rationale was to make it as easier as possible for both IFP and LWG (stakeholders) to carry out the proposed work, without seriously compromising the scientific quality of the projects' outcomes.

The webinars were performed on the 18th of September 2020 and on the 9th of October 2020. The workshop was performed taking into consideration the specific requirements of the region and the resources available (Figure 1).

The report follows what was defined in the proposal by presenting the online workshop materials, namely: (1) decisions taken; (2) agendas and (3) list of participants.

The **Adaptation Pathways methodology applied in SOCPLIMPACT was based in the framework developed by** Suckall et al. (2018) **and considered the three main strategic vectors for climate resilience: (1) vulnerability reduction** - Five capitals of Sustainable Livelihoods Approach (SLA); **(2) Disaster Risk Reduction** – developed throughout Hyogo and Sendai Frameworks; **(3) Social-Ecological Resilience** – that emerge from the Millennium Ecosystem Assessment (MEA) and Common International Classification of Ecosystem Services (CICES).

The **Adaptation Pathways** aim to capture the policy preferences in time and the relevancy of the context traduced in investment and commitment (Suckall et al., 2018). These Adaptation Pathways Trajectories (APT) were delineated as a set of adaptation classes each one with two options/measures to choose from. Each individual stakeholder choices contribute to create a policy pathway together with the other choices made by different stakeholders. If most of the stakeholders chose one option, then that measure was incorporated in the island adaptation pathway for that specific class in each APT, per sector. The result of the series of choices in the three timeframes defines the pathway. If there is a tie between two options, then they will both be included and become part of the adaptation pathway in each time frame. The options were included in the pathway when they were selected 50% or more in each time frame of each APT. There was the possibility to include a Local Knowledge choice per APT, but this was not pursued for Malta.

Pathway options are grouped around three objectives: (1) actions to reduce socio-economic vulnerability; (2) actions that address disaster risk reduction; and (3) actions that affect social-ecological resilience. Adaptation policy under **vulnerability reduction**, **disaster risk reduction**, and **social-ecological resilience** were developed considering classes of adaptation (Figure 2) under which the participants decide which are the most relevant options for Malta.

For **vulnerability reduction** five classes were considered: (1) Financial capital; (2) Human capital; (3) Social capital; (4) Natural capital; and (5) Physical capital. For **Disaster Risk Reduction** four classes were considered: (6) managing long term risk; (7) preparedness; (8) response; (9) post disaster recovery and rehabilitation. For **Social-Ecological Resilience** three classes were considered: (10) Post disaster recovery and rehabilitation; (11) Provisioning services; and (12) Regulating and Maintenance Services.

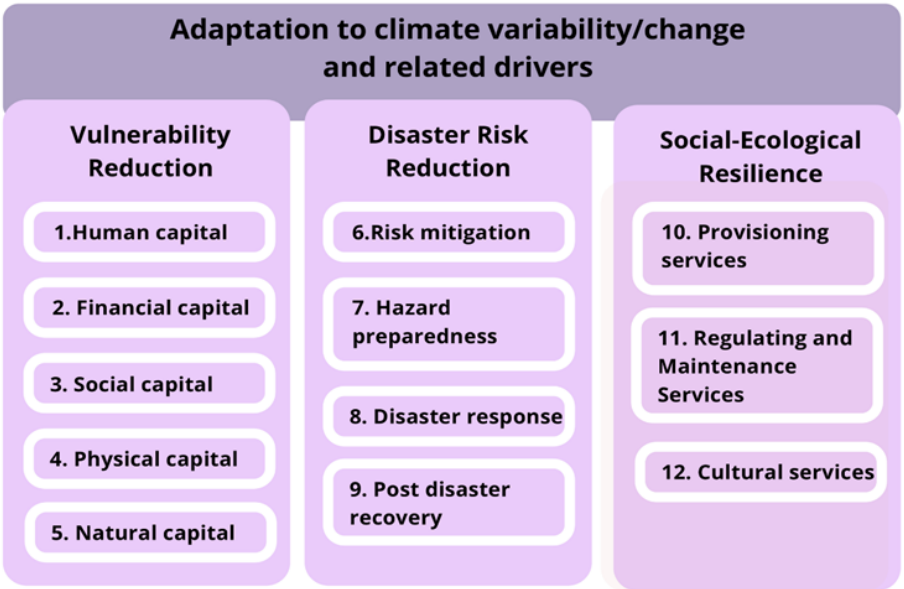


Figure 133 - The 12 classes of adaptation in the figure are structured in three broader objectives (Vulnerability reduction, Disaster Risk reduction and Ecosystem and social resilience).

The results of the Adaptation Pathways are presented in this report in two different outputs per sector: **(1) Selected Adaptation Pathways; and (2) Sustainability Performance.**

The (**1) Selected Adaptation Pathways** outputs aim to capture the acceptance of each adaptation option by calculating the options (number of times) selected within the maximum number of times they can be selected (Ratio – Selected/Maximum). This considers the number of times the option was selected by all stakeholders in all four APTs and three timeframes.

The **(2) Sustainability performance** outputs aim to characterize each pathway through the evaluation of the options chosen in each APT. The options selected in each APTs are evaluated considering a set of criteria: Cost Efficiency; Environmental protection; Mitigation (GHG emissions) win-wins and trade-offs; Technical applicability; Social acceptability (Table 3).

Table 20 – Description of the criteria used to evaluate the adaptation pathways performance.

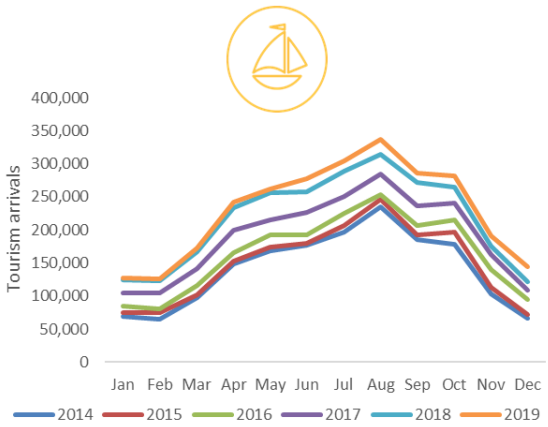
Criteria	Description	
Cost Efficiency	Ability to efficiently address current or future climate hazards/risks in the most economical way	Higher score = higher cost efficiency
Environmental protection	Ability to protect the environment, now and in the future	Higher score = higher environmental protection
Mitigation (GHG emissions) win-wins and trade-offs	Current ability to meet (win-win) or not (trade-off) the island/archipelago's mitigation objectives	Higher score = higher mitigation win-wins and lower trade-offs
Technical applicability	Current ability to technically implement the option/measure in the island/archipelago	Higher score = higher technical applicability
Social acceptability	Current social acceptability of the option/measure in the island/archipelago	Higher score = higher social acceptability

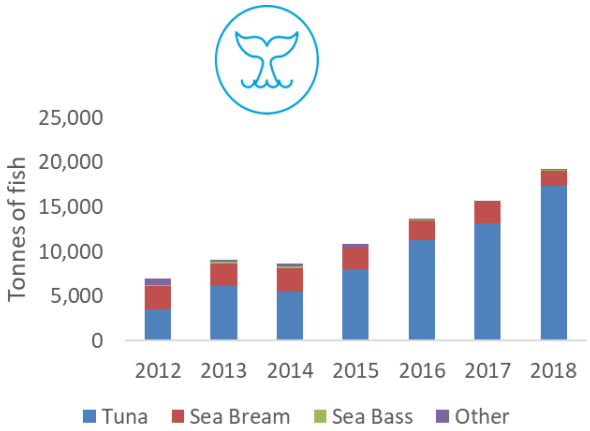
The results are presented in a spider diagram and is the average of all options chosen for the participants in each APT pathway.

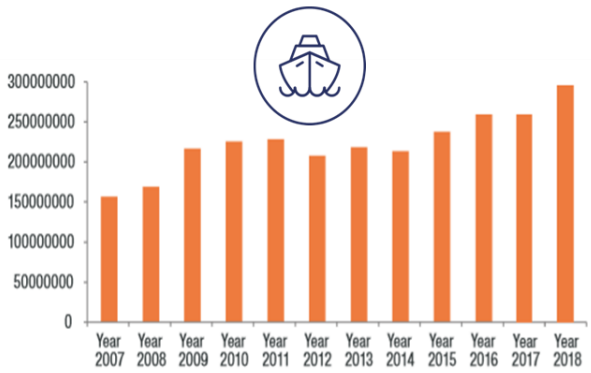
2 Background Material

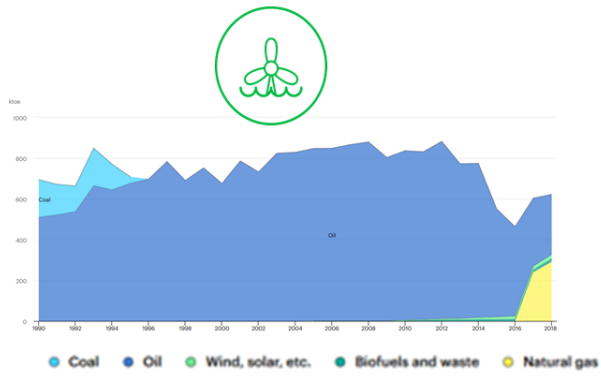
To support the decisions within the Online Survey Tool and to define the Adaptation Pathways, relevant information related with climate, socio-economy and adaptation were presented to stakeholders. The deliverable 7.2 (Background Materials) were the preferential source information but additional and tailored information was developed. The background material was based on results of the SOCLIMPACT project for Malta. The most relevant and interesting results were presented.

2.1 Sector characteristics



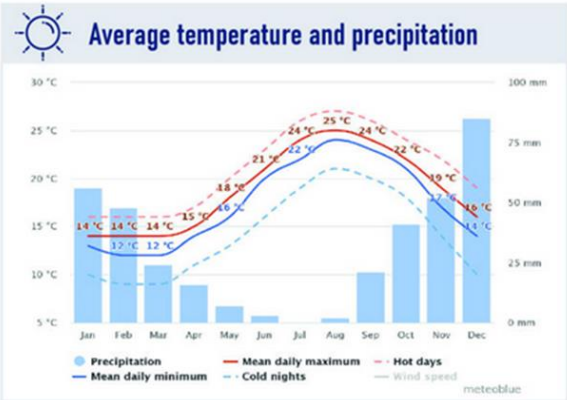


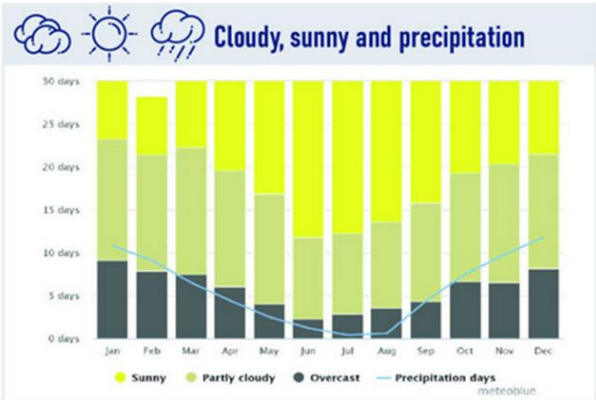


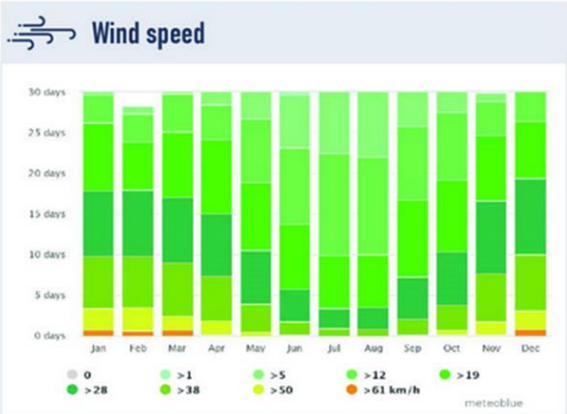


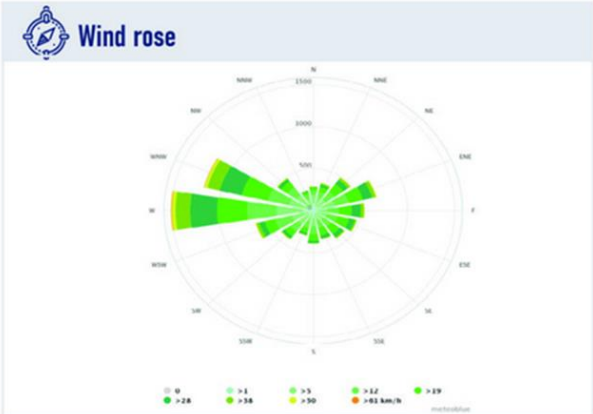
1) Inbound tourism development per month increasing
2) Fish farming sales by species increasing over the years
3) Gross Tonnage of Vessels were handled are increasing over time
4) Electricity generation by source is changing

2.2 Climate characteristics









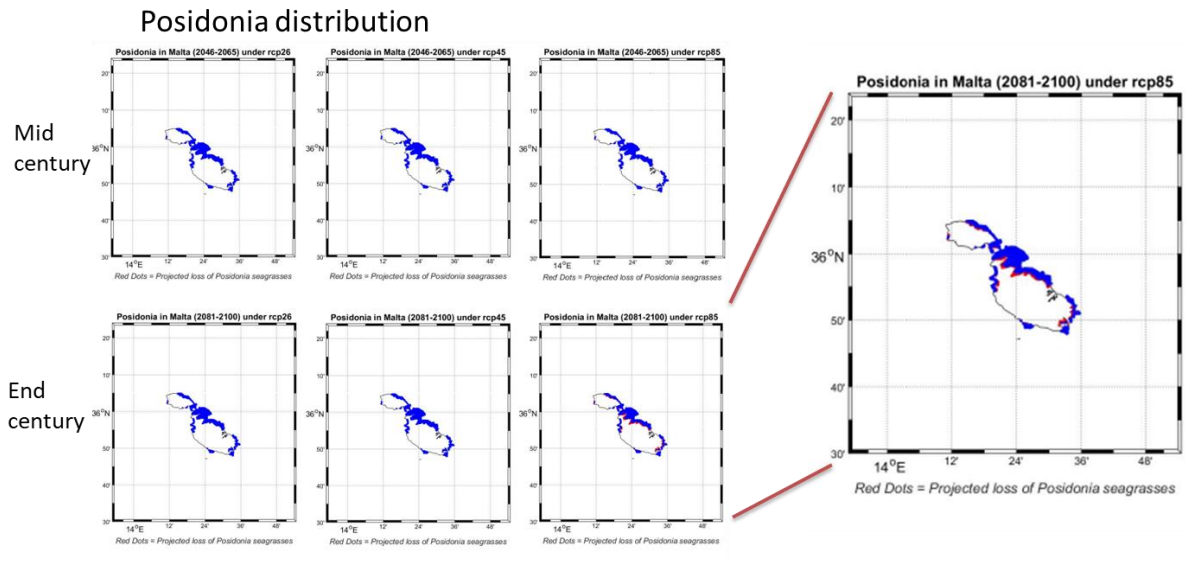
Malta has the most days with sun in Europe and wind is coming mostly from the West to North-West.

2.3 Climate change Outlook

2.3.1 Tourism

Posidonia distribution

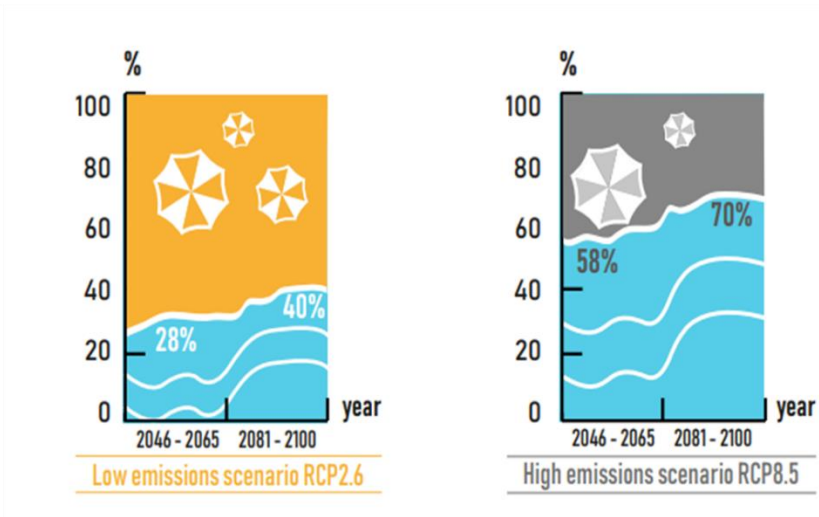
Posidonia Oceanica is a foundation species in Mediterranean waters which have a large contribution towards creating and maintaining habitats that support other species. In Malta, the results of RCP8.5 projections indicate a decrease of 20% of coverage area of Posidonia for the end-century from 144 km2 to 115 km 2. Although the projected reduction may seem moderate, it has to be kept in mind that the losses will be localized in the nearshore areas, so it is expected a large impact on water transparency in beach areas.



Beach reduction

One of the consequences of an increase in the mean sea level will be the flooding of coastal areas. This includes sandy beaches, which are the main asset for tourism activities. Therefore, estimating the potential risk of beach loss due to climate change is of important for the economy.

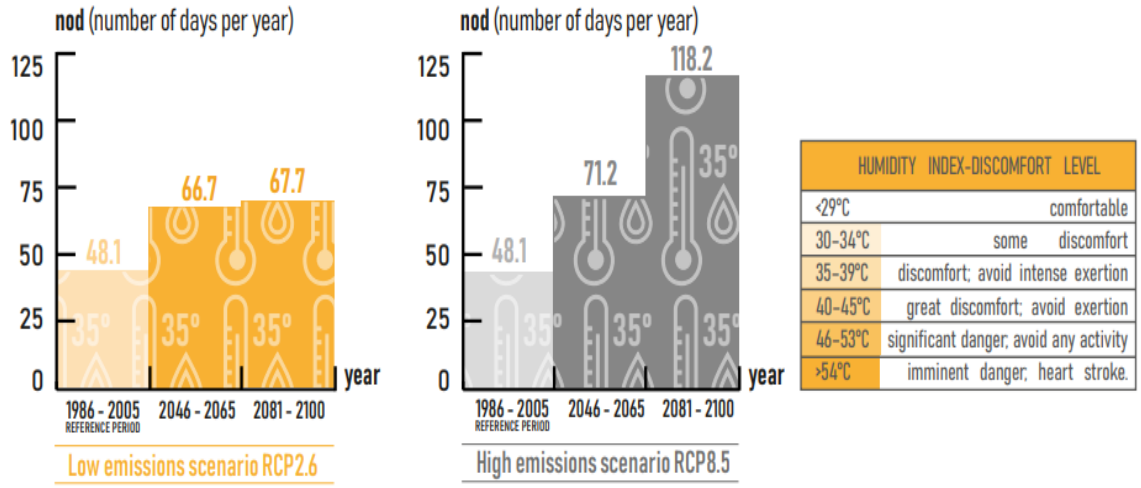
Under mean conditions, we find that, at end of century, the total beach surface loss ranges from ~40% under scenario RCP2.6 to ~70% under scenario RCP8.5.



Humidity index

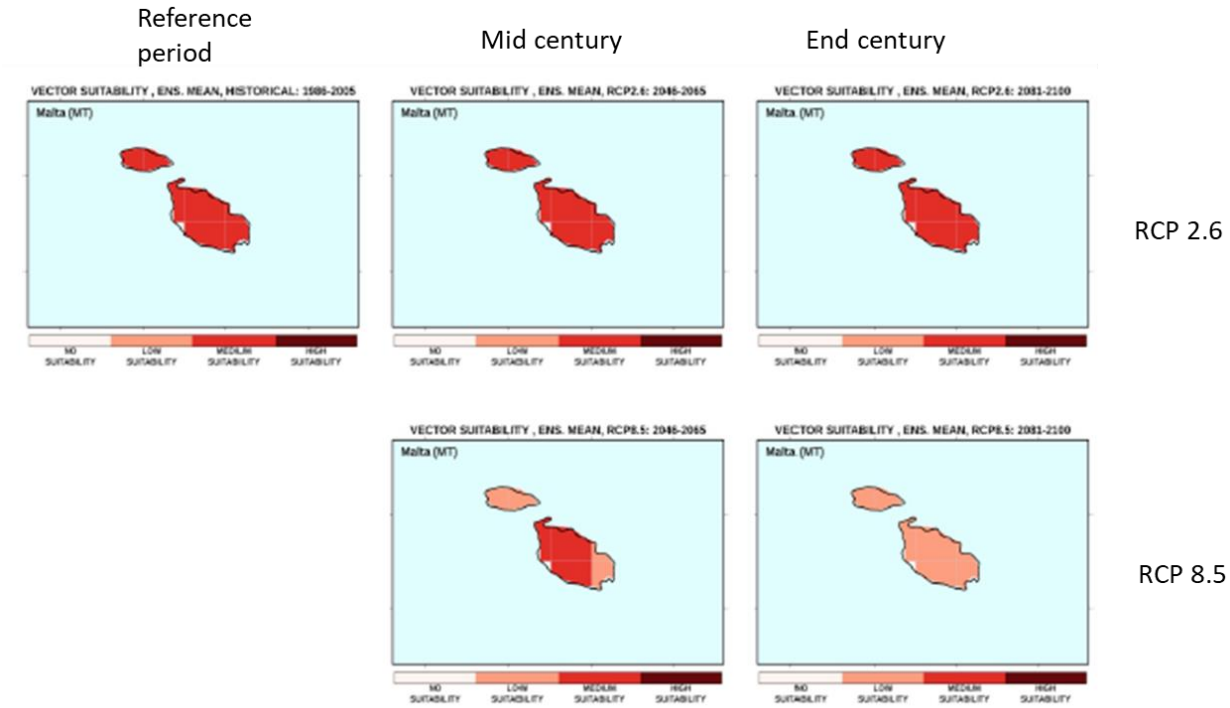
Humidex value is an equivalent to temperature, which expresses the temperature perceived by people (what humans feel), given the actual air temperature and relative humidity. The Number of Days per year (nod) with Humidex greater than 35°C was selected as the threshold for discomfort. From the current 1.5 month in the present climate and above 2 months in the mid-century for both scenarios, Malta will have almost 4 months of nod discomfort conditions by the end of the century under RCP8.5.

This project has received funding from the European Union's Horizon 2020 research and innovation programme under Grant Agreement No776661



Habitat suitability for Tiger Mosquito

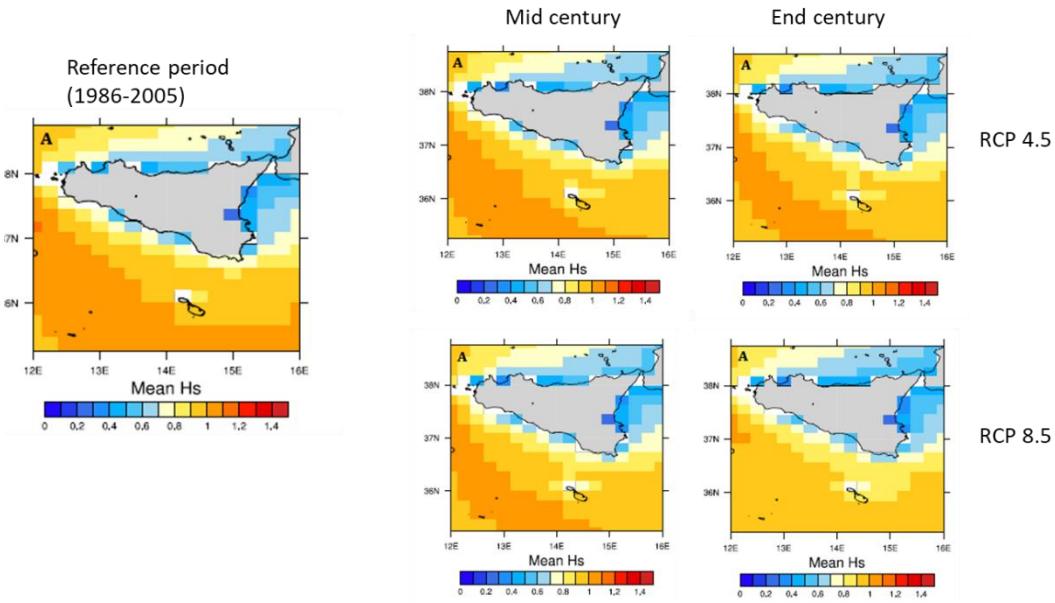
The Asian tiger mosquito can transmit viral pathogens and infectious agents that cause dengue fever, yellow fever and various encephalitis (affects the brain). Here we looked at the suitability of habitat in Malta. Under RCP 8.5 the suitability will decrease.



2.3.2 Aquaculture

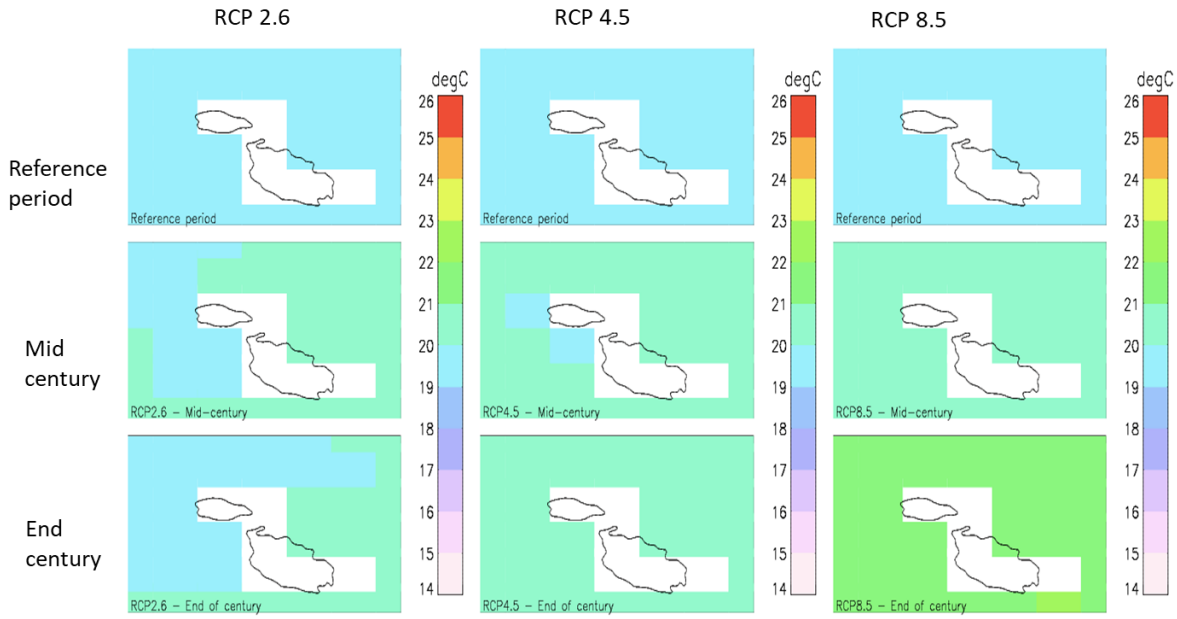
Annual Significant Wave Height

Wave height will no change much and will even decrease in some areas.



Sea Surface Temperature

Temperature will increase with 1 or 2 degrees over time. From 19-20 to max 22-23.



This table provides the number of days exceeding the optimal sea surface temperature for different species which can affect growth rate or increase risks for diseases. In Malta, the is mainly tuna (90%) and sea bream (10%). Once temperature is higher than 24 degrees conditions are no longer optimal for these species.

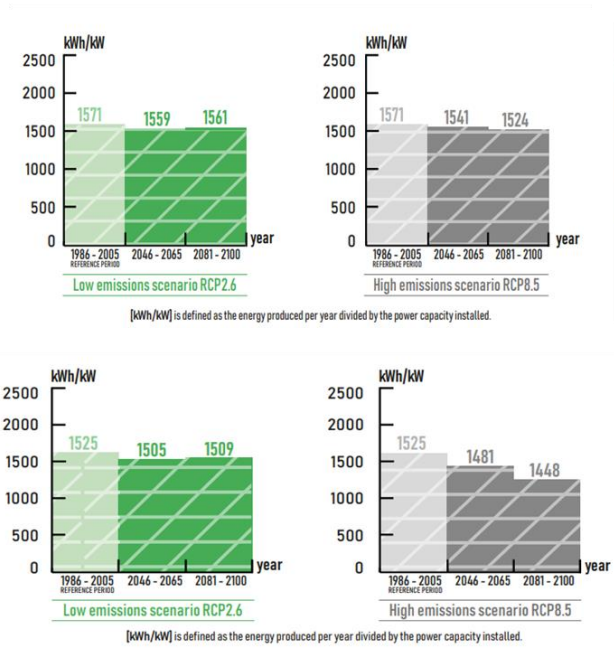
	Longest event (days) >20 degrees Mussels & clams	Longest event (days) >24 degrees Sea bream/Tuna	Longest event (days) >25 degrees Sea bass
Historic (1986-2005)	152 days	62 days	43 days
RCP 8.5 - mid century (2046-2065)	175 days	95 days	72 days
RCP 8.5 - end century (2081-2100)	201 days	123 days	98 days

2.3.3 Energy

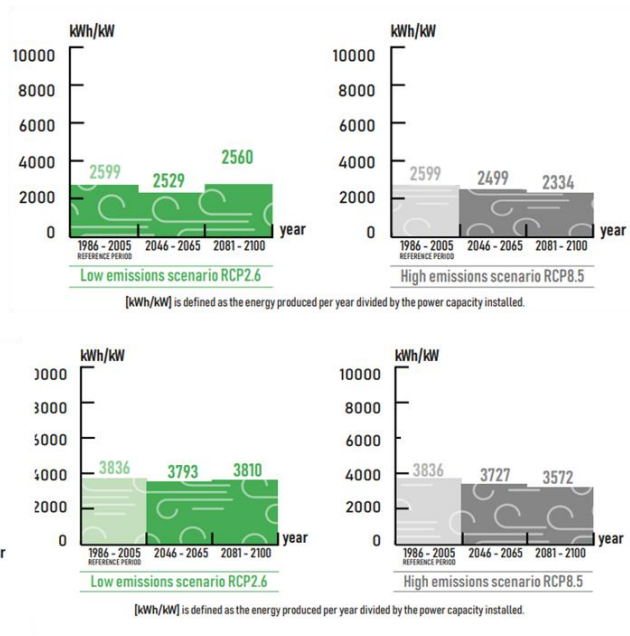
Productivity of PV and wind energy

PV productivity and wind energy productivity are decreasing for both scenarios.

PV productivity

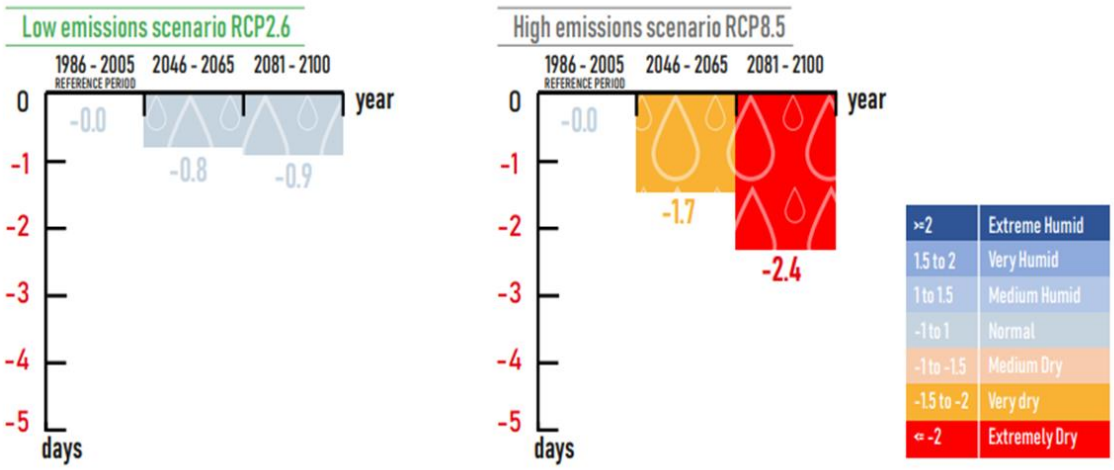


Wind energy productivity



Standardized Precipitation Evapotranspiration Index

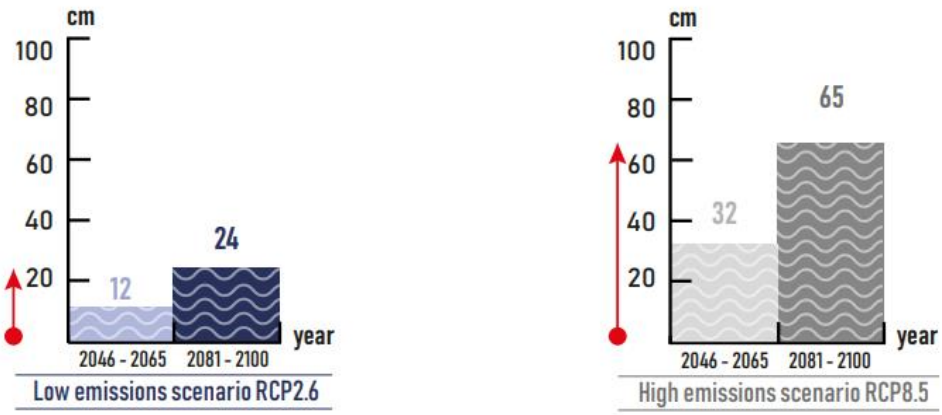
The Standardized Precipitation- Evapotranspiration Index is used as an indicator of water availability. It can serve as a representative indicator for increases in water demand for islands' residents, tourists, and agriculture, while it also provides an indication on the available water stored in underground resources. There are strong indications towards moderate and extreme drier conditions under RCP8.5 and negative but near-normal values under RCP2.6. This will lead in additional increases in desalination and water pumping needs, a scenario which will substantially increase the cost for adaptation.



2.3.4 Maritime Transport

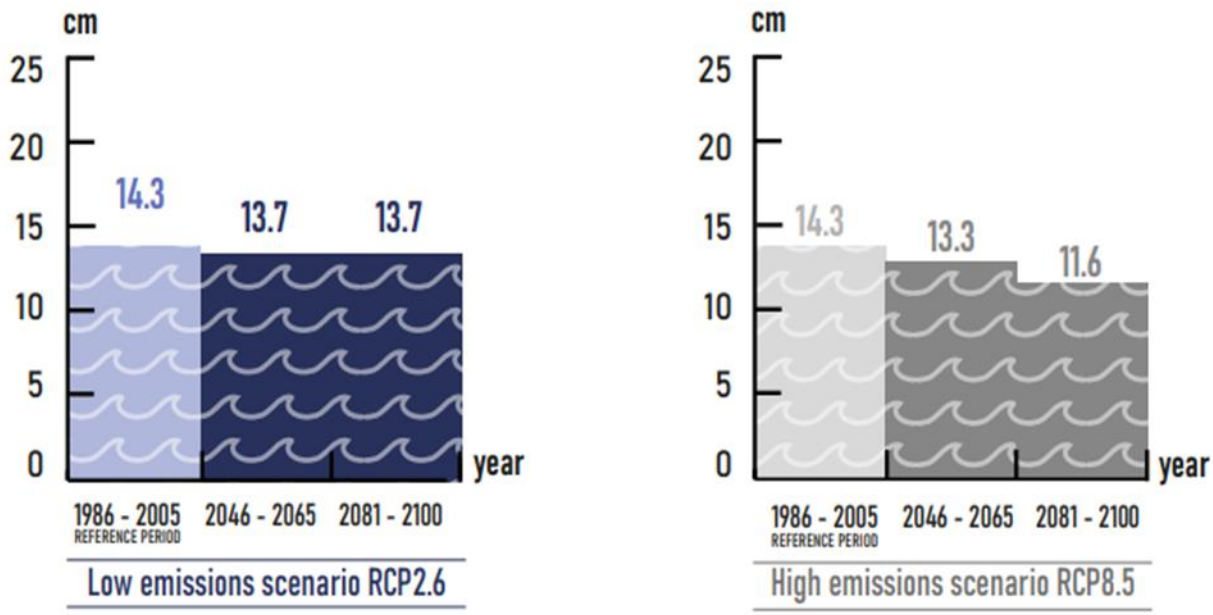
Mean sea level rise

Sea level rise (SLR) is one of the major threats linked to climate change. It would induce permanent flooding of coastal areas with a profound impact on society, economy, and environment. Moreover, an increase in the mean sea level would result in a larger impact of coastal storms with the consequent increase of risk.



Storm surge events

Storm surge events, characterized by positive extreme sea levels and mechanically forced by atmospheric pressure and wind are the main responsible for coastal flooding, especially when combined with high tides. Storm surge extremes reduce over time by 20% in the end of the century under RCP8.5.

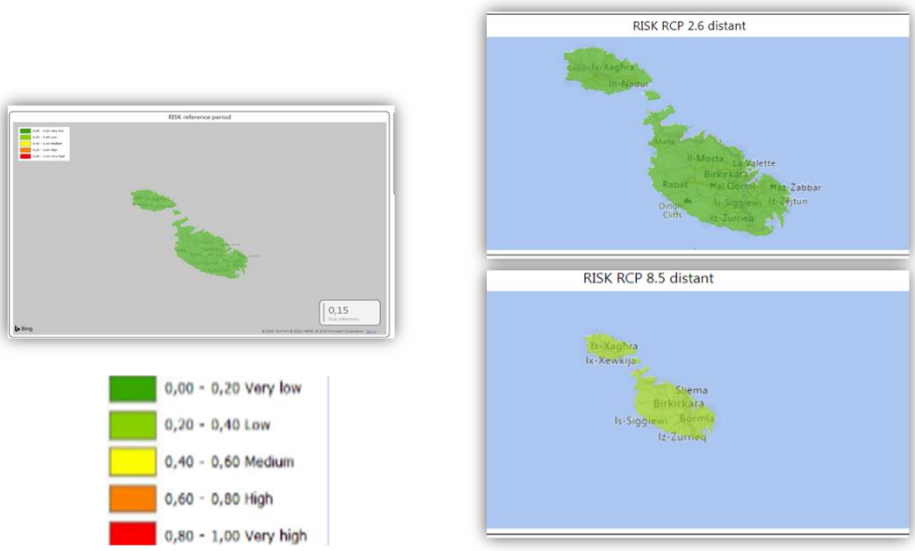


2.4 Climate change risk

2.4.1 Tourism

Forest fire risk and impact on tourist destination

Malta has currently a very low risk because of the low level of exposure and vulnerability (with low sensitivity since there are very few forests) and progresses to low risk (an increase in risk) towards the end of the century in RCP 8.5.



2.4.2 Aquaculture

Increased fragility of the aquaculture activity due to an increase of extreme weather

As can be seen there is not a large change in risks and at the end of the century and for RCP 8.5 even a decrease in risk for some islands. Malta has an increased risk mid-century in the worst-case scenario (RCP 8.5), due to an increase in the climate hazard. Malta, together with Sicily south and Sardinia west are found to be the most vulnerable with risk exceeding 0.45 due to a higher climate hazard risk. Malta also has the highest exposure of all islands.

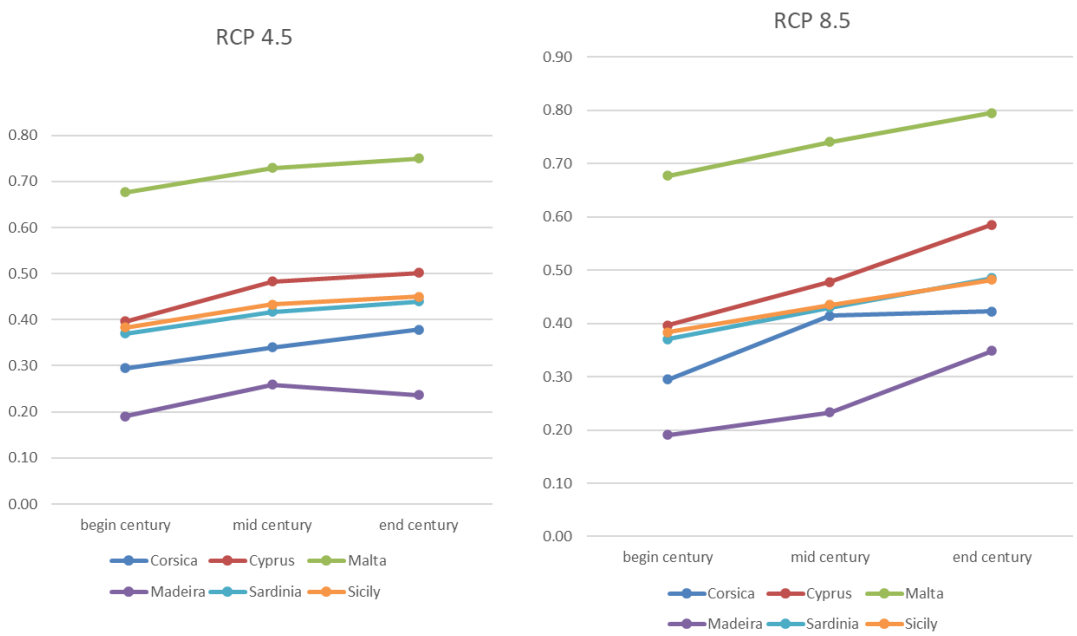
Worst case	Historic	RCP 4.5		RCP 8.5	
		mid century	end century	mid century	end century
Malta	0.37	0.45	0.45	0.56	0.36
Sicily North	0.34	0.39	0.39	0.36	0.30
Sicily East	0.17	0.20	0.20	0.20	0.20
Sicily South	0.41	0.42	0.40	0.42	0.30
Corsica West	0.37	0.32	0.37	0.34	0.34
Corsica East	0.18	0.18	0.18	0.18	0.19
Sardinia West	0.40	0.46	0.47	0.47	0.44
Sardinia East	0.39	0.20	0.20	0.20	0.18
Cyprus	0.23	0.23	0.23	0.23	0.22

0.00 – 0.20	0.20 – 0.40	0.40 – 0.60	0.60 – 0.80	0.80 – 1.00
Very low	Low	Medium	High	Very high

In February 19 a storm destroyed fish farms in Malta which indicates that the sector needs adaptation to climate risk. Even though it is expected that this risk will luckily not increase, measures are needed.

Change in production due to an increase in surface water temperature

The hazard is based on sea surface temperature and the hazard criteria is then calculated depending on the species cultured for each island and the temperature thresholds of these species. This is not an estimate of the risk but rather a ranking between islands since a lot of the data was normalised based on min-max of the islands. A proper risk assessment would need additional data from farmers and a detailed model of farming results as a function of temperature. Malta has a much higher risk than the other islands due to the high exposure, Malta's farm produce on average 3.5 to 22 times more than the farms on other islands.



2.4.3 Energy

Risk of changes in energy demand due to changes in precipitation and temperatures

Risks in the energy sector caused by changes in precipitation and temperatures include the increase in cooling energy demand and desalination demand. According to the risk analysis, it is expected a large cooling energy demand increase. The desalination demand, which is already high, should also increase for both emissions scenarios but much more under RCP8.5. The risk associated to cooling energy demand shows presently a medium value, which would remain almost constant under RCP2.6 and would nearly reach a high value under RCP8.5 by the end of the century.

Risk scores	*Hist. ref.*	*RCP2.6 (2046-2065)*	*RCP2.6 (2081-2100)*	*RCP8.5 (2046-2065)*	*RCP8.5 (2081-2100)*
Cooling	0.49	0.51	0.51	0.53	0.57
Desalination	0.47	0.54	0.55	0.61	0.67

0.00 – 0.20 Very low	0.20 – 0.40 Low	0.40 – 0.60 Medium	0.60 – 0.80 High	0.80 – 1.00 Very high

Malta is an island with large constraints on land-based renewable energy systems, due to its small size and large population density. Additionally, present onshore wind energy resources are limited. PV energy potential is good, and the energy droughts indicator shows a high stability. PV energy can be integrated in buildings and has therefore a higher potential, though its installation in apartment blocks faces uncertainties like the possibility of redevelopment of existing buildings based on an increase in the number of storeys. As a consequence, the National energy and climate plan only projects a very limited increase of RES share

from a present value of 9% to 11.5% in 2030. Such a low share moves Malta away from the EU targets for decarbonization.

Reducing demand

-Water losses in the distribution network were tackled through a leak management strategy during several years in such a way that the water losses were nearly halved from 2004 to 2009.

-A clear demand management option for reducing cooling demand is the improvement of the energy efficiency of buildings.

2.4.4 Maritime Transport

Risk of transport disruption

Risks are low for all islands and increasing just a bit, however Malta is the most vulnerable (risk values 0.335-0.414) -> due to high exposure & vulnerability components due to the combination of small number of ports and high value of goods.

RISK VALUE PER ISLAND	Historical Reference	RCP2.6 MID	RCP2.6 END	RCP8.5 MID	RCP8.5 END
CYPRUS	0.241	0.210	0.218	0.258	0.292
CRETE	0.229	0.208	0.201	0.257	0.282
MALTA	0.376	0.347	0.335	0.395	0.414
CORSICA	0.220	0.194	0.194	0.243	0.273
CANARY ISLANDS	0.336	0.292	0.250	0.346	0.341
BALEARIC ISLANDS	0.326	0.281	0.264	0.331	0.344

0.00 – 0.20 Very low	0.20 – 0.40 Low	0.40 – 0.60 Medium	0.60 – 0.80 High	0.80 – 1.00 Very high

Two other contributors to the relatively higher risk value, related to increased vulnerability, are the small number of harbour alternatives (e.g., airports) and the small percentage of renewables in the total energy mix.

The full background information was provided in the survey tool with links to the SOCLIMAPCT website (www.soclimpact.net) under the section findings.

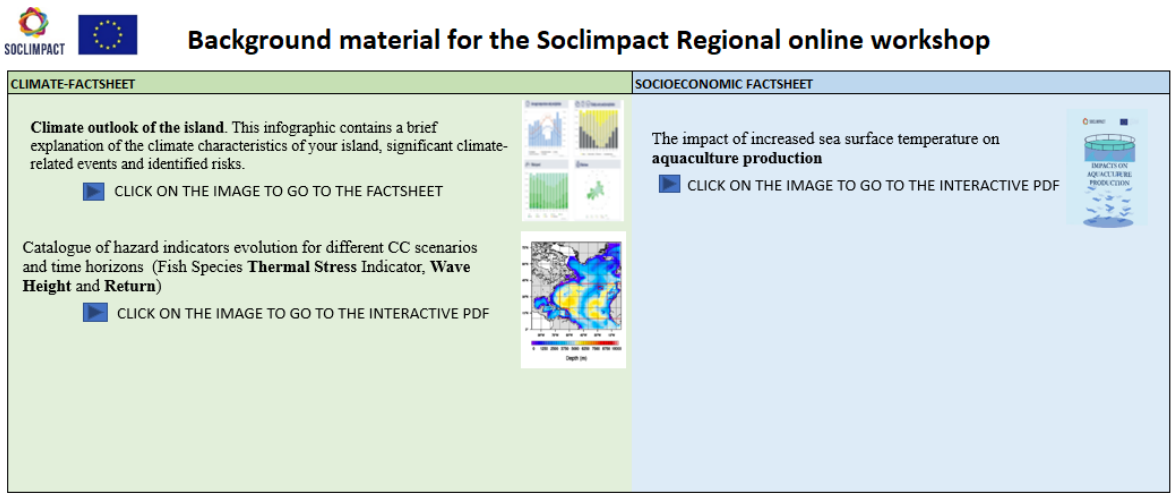


Figure 134- Visual representation of how the background material was presented and delivered in the Online Tool Survey for Malta

3 Sector Adaptation Pathways

Each APT has a set of adaptation classes each one with two options/measures to choose from. Each individual stakeholder choices will be clustered with other choices made by different stakeholders. If the majority of the stakeholders chose one option, then that measure will be in the island adaptation pathway for that specific class in a given APT, per sector. The result for the series of choices in the three timeframes will define the pathway. If there is a tie between two options, then they will both be included and become part of the adaptation pathway in a given time frame. There was the possibility to include a Local Knowledge choice per APT, but this was not pursued for Malta.

Definition: Measures which were chosen 50% or more per APT and per time frame

Adaptation aims and used frameworks (Suckall et al. (2018)):

(1) vulnerability reduction - Five capitals of Sustainable Livelihoods Approach (SLA).

(2) Disaster Risk Reduction - Hyogo and Sendai Frameworks.

(3) Social-Ecological Resilience - Millennium Ecosystem Assessment (MEA) and Common International Classification of Ecosystem Services (CICES).

IFP from Malta had received 5 responses from the aquaculture stakeholders, 2 from the maritime transport sector, 1 from the tourist sector and one from the energy sector. Therefore, only the aquaculture sector could be analysed. The other results will be used for the analysis of all EU islands. In the second webinar however, stakeholders from the tourism and maritime transport sectors responded to the climate situation in Malta and measures that would be most useful to implement in the future.

SOCLIMPACT

This project has received funding from the European Union's Horizon 2020 research and innovation programme under Grant Agreement No776661

4 Selected Adaptation Pathways in Aquaculture

The aquaculture pathways are based on choices made by 5 expert island stakeholders and were the only pathways which were possible to produce for Malta.

ID	Name	Class number ↑	APT A			APT B			APT C			APT D		
			S	M	L	S	M	L	S	M	L	S	M	L
A1	Financial schemes, insurance and loans	1					**B**						**D**	
A2	Tax benefits and subsidies	1					**B**						**D**	
A10	Efficient feed management	2		**A**			**B**			**C**			**D**	
A9	Awareness campaigns for behavioural change	2		**A**			**B**			**C**			**D**	
A12	Promote cooperation to local consumption	3								**C**				
A11	Addressing consumer and environmental concerns at the	3								**C**				
A13	Integrated multi-trophic aquaculture (IMTA)	4								**C**			**D**	
A14	Short-cycle aquaculture	4								**C**			**D**	
A16	Submersible cages	5					**B**							
A15	Recirculation Aquaculture Systems (RAS)	5					**B**							
A18	Risk-based zoning and site selection	6		**A**			**B**			**C**			**D**	
A17	Climate proof aquaculture activities	6		**A**			**B**			**C**			**D**	
A20	Environmental monitoring and Early Warning Systems (EWS)	7								**C**				
A19	Disease prevention methods	7								**C**				
A21	Mainstreaming Disaster Risk Management (DRM)	8		**A**										
A22	Contingency for emergency management, early	8		**A**										
A23	Recovery Post-Disaster plans	9		**A**									**D**	
A24	Recovery Post-Disaster funds	9		**A**									**D**	
A4	Species selection	10		**A**			**B**			**C**			**D**	
A3	Feed production	10		**A**			**B**			**C**			**D**	
A6	Best Management Practices	11					**B**			**C**				
A5	Selective breeding	11					**B**			**C**				
A7	Create educational visits	12								**C**				
A8	Promote aquaculture cuisine	12								**C**				

Figure 135- Adaptation options for the Aquaculture sector. Options are identified with an ID number, full name, and class of adaptation number. Adaptation objectives are identified in each option by colour: ***vulnerability reduction (red),*** *Disaster* ***Risk Reduction (blue);*** ***Social-Ecological Resilience (green);*** *Each ATP (APT A; APT B; APT C; APT D) is represented in three timeframes: S - Short term (up to 2030), M- Medium term (up to 2050), L - Long term (until 2100). Bold letters in each ATP indicate the option was available to be selected. Highlighted options indicate the measure was selected in each ATP and timeframe: ATP A (light blue); ATP B (light green); ATP C (Light orange) and ATP D (light purple). Space with colour: option was selected for the timeframe: Short term, Medium term, or Long term. Bold letter: option is available in the APT.*

Overall, the adaptation pathways for the Aquaculture sector in Malta is characterized by a significant heterogeneity across the four potential adaptation policy trajectories (APTs) and across adaptation objectives.

Under **APT A: Minimum intervention** (low investment, low commitment to policy change) for the human capital class, for all terms, efficient feed management was preferred over awareness campaigns for behavioural change. To reduce disaster risk, in class 6, risk mitigation, risk bases zoning and site selection was preferred over climate proof aquaculture (strengthening infrastructure) while in the disaster response class, disaster Risk management (prevention, protection, preparedness, response, recovery) was preferred over Contingency for emergency management. In class 8, post disaster recovery, recovery plans (good practices) were preferred over recovery funds (makes sense since this is the low investment trajectory). Finally, to improve socio-Ecological resistance, class of provisioning services, species selection was preferred over feed production (alternative feed ingredients). Species selection is more optimal and efficient than the feed production.

For **APT B: Economic Capacity Expansion** (high investment, low commitment to policy change), in the financial capital in vulnerability reduction for short term, tax benefits was selected over financial schemes, insurance, and loans, while for the medium- and long-term financial schemes insurance and loans is preferred. Classes 2 and 6 had the same results as under APT A. For physical capital, Recirculation Aquaculture Systems (RAS) was preferred for the short term, while for mid and long-term submersible cages was selected more frequently. To improve socio-Ecological resistance, class of provisioning services, for the short term more sustainable feed production is preferred while for mid and long term, species selection was most selected. However, for APT A species selection was chosen for the short term as well. This can be explained because this can also be a strategy, to diversify species in the short-term to choose species that are most efficient for aquaculture. In regulating and maintenance services, for all terms Best Management Practices was preferred over selective breeding.

In **APT C: Efficiency Enhancement** (medium investment, medium commitment to policy change), again, efficient feed management was selected for short and long term. However, we see a change of selected measure for the mid-term where awareness campaigns were preferred. There is no clear explanation for this. In the social capital class, for short and mid-term Promotion of local consumption (reduce transport costs, create value addition) was preferred over promotion of economy and jobs to address CC to address consumer and environmental concerns. For the long term it was the other way around. For natural capital, for the short term, short cycle aquaculture (stock larger fish in cages) was preferred over IMTA, while for the mid and long term IMTA was selected more frequently. In the risk mitigation class, we see the same results as for APT A&B. For hazard preparedness, environmental monitoring and Early Warning Systems were preferred for all terms over disease prevention (vaccines, probiotics, strict hygiene procedures). Classes provisioning, and regulating and maintenance services, we have the same results as for APT B. In the third class in social-ecological resilience, cultural services, in the short-term promoting aquaculture cuisine was preferred while for the mid and long-term, educational visits were selected as the most suitable adaptation measure.

APT D: System Restructuring (high investment, high commitment to policy change) has some similar results as other APTs. For financial capital the same results were obtained as in APT B, and for natural capital the same as APT C. For provisioning services, the same results were found as in APT A. For the human capital, again, efficient feed management was selected for short and mid-term. However, we see a change of selected measure for the long term where awareness campaigns were preferred. Efficient feed management was chosen for most the different time periods for all APTs. In the risk mitigation class, for APT A, B, C risk-based zoning and site selection was always preferred. In APT D too for the short and mid-terms, however for the long term, climate proof aquaculture activities (strengthening infrastructure) was selected. Climate proof aquaculture activities was chosen for the long term in APT D because this measure requires high investment and high commitment. On the long term, when we could run out of other options this can be a suitable measure. In the post disaster recovery class, for the short and long terms, plans were preferred while for the mid-term funds were selected more often.

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ID	Name	Class number	Ratio	APT A			APT B			APT C			APT D		
				S	M	L	S	M	L	S	M	L	S	M	L
A1	Financial schemes, insurance and loans	1	60%					B						D	
A2	Tax benefits and subsidies	1	40%					B						D	
A10	Efficient feed management	2	73%		A			B			C			D	
A9	Awareness campaigns for behavioural change	2	27%		A			B			C			D	
A12	Promote cooperation to local consumption	3	60%								C				
A11	Addressing consumer and environmental concerns at the local	3	40%								C				
A13	Integrated multi-trophic aquaculture (IMTA)	4	60%								C			D	
A14	Short-cycle aquaculture	4	40%								C			D	
A16	Submersible cages	5	60%					B							
A15	Recirculation Aquaculture Systems (RAS)	5	40%					B							
A18	Risk-based zoning and site selection	6	65%		A			B			C			D	
A17	Climate proof aquaculture activities	6	35%		A			B			C			D	
A20	Environmental monitoring and Early Warning Systems (EWS)	7	67%								C				
A19	Disease prevention methods	7	33%								C				
A21	Mainstreaming Disaster Risk Management (DRM)	8	67%		A										
A22	Contingency for emergency management, early	8	33%		A										
A23	Recovery Post-Disaster plans	9	60%		A									D	
A24	Recovery Post-Disaster funds	9	40%		A									D	
A4	Species selection	10	68%		A			B			C			D	
A3	Feed production	10	32%		A			B			C			D	
A6	Best Management Practices	11	77%					B			C				
A5	Selective breeding	11	23%					B			C				
A7	Create educational visits	12	60%								C				
A8	Promote aquaculture cuisine	12	40%								C				

Figure 136 : Ranking of adaptation measures selected by experts for aquaculture from high to low.

The 24 measures were all selected at least once. The top 3 measures selected were Best Management Practices, efficient feed management and species selection.

The least preferred measures, logically from the same classes, were the use of alternative ingredients in feed production, awareness campaigns and selective breeding.

5 Sustainability Performance

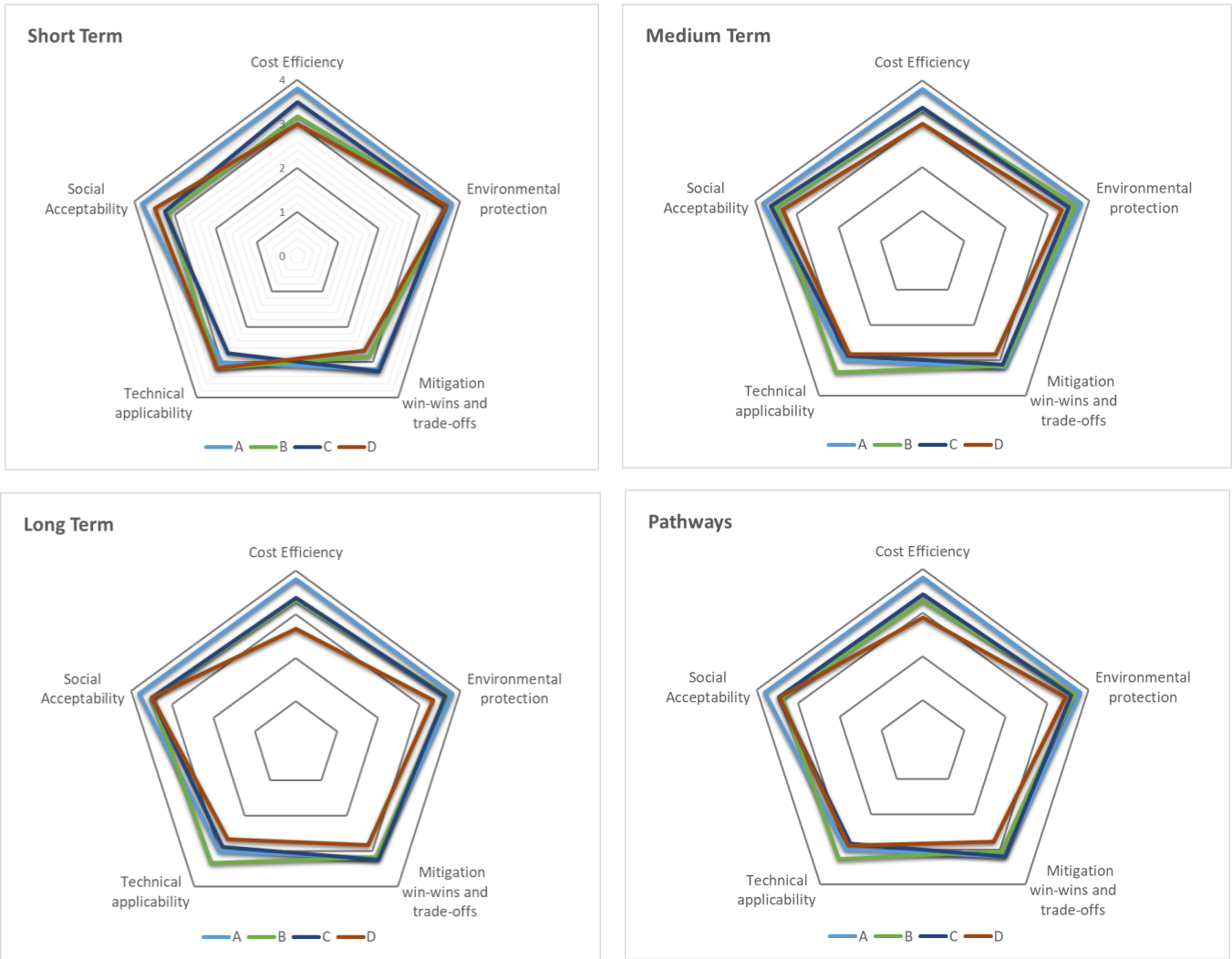

Figure 137 - Pathways evaluation for aquaculture sector considering: Cost Efficiency; Environmental protection; Mitigation (GHG emissions) win-wins and trade-offs; Technical applicability; Social acceptability. The policy pathways scenarios: APT A - Minimum Intervention; APT B - Economic Capacity Expansion (ECE); APT C- Efficiency Enhancement (EE); APT D - System Restructuring (SR), for different timeframes: short, medium, and long term

All four pathways in the Aquaculture sector have a similar evaluation across all timeframes. The analysis showed little differences in the scoring of criteria as a reflection of the different ATP narratives. In general, all scenarios show high levels of cost efficiency, environmental protection, mitigation trade-offs, technical applicability and social acceptability. The cost efficiency of APT D for the long term is slightly lower. Environmental protection has an overall high value but with differences in APT D (lower value), APT C (intermediate value) and APT A and B (highest value).

Mitigation performance shows a small range of values, APT D (minimal intervention) has the lowest value and APT C (capacity expansion) the highest, leaving A and B in the middle. APT A scores highest for all performance indicators with the exception of technical ability, which is highest in APT B for all terms.

Social acceptability has the highest values with APT A having more and APT D less. It can be expected that APT D would have the most challenging options in terms of social acceptability because it is the scenario with the highest commitment to policy change. It is assumed that a higher commitment could better cope with options which have a lower social acceptance. Using the same principal, in APT A (Minimum Intervention) could have had a higher (than D) social acceptability result.

APTs B and C have intermediate results, which are within what can be expected from them, especially for C. In APT B this is because there are is also low commitment, which limits the available options, and APT C because it is an intermediate policy scenario (medium commitment with medium investment).

6 Discussion and Conclusions from second webinar

6.1 Aquaculture

For most APTs and terms, efficient feed management was preferred over awareness campaigns for behaviour-al change. The aquaculture stakeholders agree that efficient feed management is the preferred option over awareness campaigns for behavioural change. This can be explained by effectiveness of the measure on feed management. However, depending on if the stakeholder is a producer or a researcher, priorities can be different. Efficient feed management will also reduce costs and financial matters are always a problem for researchers, according to a representative of the Department of Fisheries and Aquaculture.

Risk bases zoning and site selection was preferred over climate proof aquaculture since the site is seen as more important than strength of infrastructure. Once a 'safe' site is chosen, the strength of the infrastructure is less important. The infrastructure strength is of more importance when the site is more exposed to high waves and extreme events.

Species selection was in general preferred over improved feed production since species selection is more optimal and efficient than the feed production. Species selection is the key to sustainable aquaculture, using traits of fish to make production more efficient as opposed to just improve feeds. But this will take time, so therefore feed production was chosen for the short term for APT B & C. However, species selection was chosen for the short term as well in APT A & D. This can be explained because this can also be a strategy, to diversify species in the short-term to choose species that are most efficient for aquaculture.

The use of Recirculating Aquaculture was not chosen for the mid- and long term since land is limited in Malta and will not cater for growth of the sector. It will be more beneficial to invest in better technology for the submerged cages and install them far from the shore, however we do not have cost-effective technology available yet or infrastructure to service submersible cages therefore for the short-term this option was not favoured.

For all terms Best Management Practices was preferred over selective breeding. Selective breeding is a very specific field and cannot be done by farmers itself while Best Management Practices can be implemented during all stages of the aquaculture operation and by all farmers.

6.2 Tourism

A representative of the Ministry for Tourism and Consumer Protection said that coastal protection is always the most important measure to be implemented. Tourism awareness campaigns is another important measure to for example adapt to reduction of marine habitats.

6.3 Maritime transport

There is not a significant problem with waves, since the break water provides sufficient protected except with southern wind, but it is not an issue. Sea level rise could be an issue. The height of the key is 1.8 meters. With a sea level rise of 0,6m is significant. This can also cause opportunity since the port is just deep enough at the moment. The terminal however could have issues with drains when levels rise.

The main concern are the extreme weather conditions (winds) have been experienced over the last 3 years.

Mark Sultana from the Malta Freeport identified the following measures as most important to implement:

Reinforcement of inspection, repair, and maintenance of infrastructures. This is being implemented already, the key wall is under continuous maintenance and repair.

The terminal has completely revised its *response strategy* to wind hazards. Before when key cranes indicated high winds, the operations would stop. However, now when high winds are forecasted all operations start to shut down before the storm arrives to render the equipment save, we are planning ahead. In this case early-warning systems are important, while before the key crane sensors were the only indications. This

leads to more downtime, which causes delays in meeting connection times at other ports. This results in increase in fuel consumption since boats go faster to catch up. Crane manufacturers also need to up their game to making key cranes more robust (now 44m/s but should be increased).

There is more disruption to operations but the impact of not stopping operations on time is catastrophic. Winds are not always predictable, e.g. during thunderstorms and therefore the risk can never be totally eliminated. The consequences can be falling containers, empty container can start to move (4-high stacked) can start moving with a wind of 4-6/7. The contingency plan takes this into consideration.

In a container terminal there are many opportunities to reduce greenhouse gas emission. *Efficiency can be improved, consumption of fuel, reduction of energy use, use of renewable energy*. This is continuously evaluated and implemented.

Improving efficiency and logistics is the way forward and therefore one of the most important measures. The main objective of the terminal from a financial and environmental point of view is to turn around a vessel in the shortest time possible (currently 23k TEU takes around 30 hrs).

Insurance policies need to involve climate change effects. TT Club (https://www.ttclub.com/) is one of the largest insurance companies in shipping, they focus on extreme weather taking into consideration the effect of climate change in their policy.

6.4 Energy

No participants from the energy sector joined for the second webinar.

6.5 Conclusion

The survey tool was not user friendly; it took a high effort for stakeholders to fill it up. Of course, the best way would have been round-table discussions, but this was not possible due to the COVID-19 situation. However, we should have made it easier to fill it up (in the form of an online questionnaire). We think this might have resulted in more replies.

The tool was designed in a way that pre-selections of measures was made per class, ruling out other measures[22]. Also, some measures were seen as not relevant, but if these are taken into account (since it was required to not leave any option blank) this may provide results that are not actually preferred.

For aquaculture in Malta the most preferred adaptation measures are the implementation of Best Management Practices, efficient feed management and species selection. Early Warning Systems and Disaster Risk management were also preferred with a ratio of 67%.

7 References

Suckall, N., Tompkins, E. L., Nicholls, R. J., Kebede, A. S., Lázár, A. N., Hutton, C., Vincent, K., Allan, A., Chapman, A., Rahman, R., Ghosh, T., & Mensah, A. (2018). A framework for identifying and selecting long term adaptation policy directions for deltas. *Science of the Total Environment*, *633*, 946–957. https://doi.org/10.1016/j.scitotenv.2018.03.234

[22] There were Local knowledge options which could have been added

8 Webinars

8.1 1st Webinar

8.1.1 Objectives

1. Introduction to the Project: Sectors, Models and Outputs
2. Background material on climate change impacts and risks
3. Present the Online Survey Tool – Design of adaptation pathways for Malta
   - Adaptation options up to 2030, 2050 and until the end of the century
   - How to fill in and submit the Online Survey Tool

8.1.2 Agenda

8.2 2nd Webinar

8.2.1 Objectives

1. Present the final Pathways Adaptation Malta
2. Discuss the Pathways Adaptation results

8.2.2 Agenda

8.3 List of participants

First Name	Last Name	Organization	1st webinar	2nd webinar	Sector
Jes	Brinch-Iversen	Maltaqua	✓		Aquaculture
Michael	Schembri	Energy and Water Agency	✓		Energy
Doris	Gambin	Aquaculture Research Cente	✓	✓	Aquaculture
Lina	Anezaki	Region of Crete	✓		SCP
ASJA	GABARDI	THE PEOPLE FOR CHANGE FUNDATION	✓		n/a
Laura	Klatt	IGB Berlin	✓		n/a
Jeanie	Orate	Student	✓		n/a
Constantinos	Stylianou	Interfusion Services / Tourism	✓		SCP
Sharad	DC	Institute of Agriculture & Animal Science	✓		n/a
Anna	Ikonen	AquaBioTech	✓		Aquaculture
Mohamed	Keznine	Institut			n/a
Clifford	Borg	Ambjent Malta	✓	✓	Energy
Alessandro	Gibertini	Marine science student	✓		n/a
Mark	sultana	Malta Freeport Terminals Ltd	✓	✓	Maritime transport
Josianne	Farrugia	MECP	✓		All
Elodie	Briche	Ramboll	✓		SCP
Suzanne	Maas	University of Malta / sustainable mobility	✓		Maritime transport
Mary Rose	Briffa	MTCP	✓	✓	Tourism
Sara	Di Salvo	Climate KIC Pioneer	✓	✓	Maritime Transport-Energy
Mark	Vella	Malta Freeport Corporation	✓		Maritime transport
Tamas	Bardocz	ABT	✓		Aquaculture
Zoey	Fletcher	ABT	✓	✓	Aquaculture
Stefano	Moncado	UM	✓		Maritime transport
David	Muscat	MECP	✓		All
Giovanna	Pisacane	ENEA	✓		SCP

SOCLIMPACT
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9 Annexes - Malta

9.1 Adaptation Options Evaluation

9.1.1 Aquaculture

Options Characterization				Criteria (see explanation below)				
ID	Name	Description	Class of adaptation	Cost Efficiency	Environmental protection	Mitigation (GHG emissions) win-wins and trade-offs	Technical applicability	Social Acceptability
A1	**Financial schemes, insurance and loans**	Financial schemes, insurance and loans are public or private risk-sharing mechanisms that aim to support farmers to respond to loss of production and infrastructures damages due to extreme weather, such as strong winds, heavy rains, floods or tidal surges. Additionally, it can provide capital to farm relocation, infrastructure and equipment upgrade, repair or replacement required.	1. Financial capital	1	3	2	4	3
A2	**Tax benefits and subsidies**	Tax benefits and subsidies consists in financial public policy instruments to promote or benefit economic or aquaculture sustainable practices and operator's overall resilience to climate change.	1. Financial capital	1	3	2	4	2
A3	**Feed production**	An important indirect impact to aquaculture is the change in fisheries production due to climate change. Aquaculture of finfish is highly dependent on fisheries for feed ingredients. This already a current problem with many fisheries overexploited and will only intensify in the future. Therefore, alternative feed ingredients are being developed such as insect meal and algae.	10. Provisioning services	4	4	3	2	2
A4	**Species selection**	Species selection consists of selecting species that are less sensitive to changes in the environment, less prone to diseases and less dependent on fish meal and oil. For example, choosing non-carnivorous species reduces food dependence and stocking larger hatchery fingerlings reduces the culture cycle and expusure to diseases.	10. Provisioning services	4	4	3	4	4

A5	**Selective breeding**	Selective breeding consists of genetic selection of species or strains with a focus on developing strains with a higher tolerance to changes in temperature, that grow faster, and which are more resilient to diseases. This is done by selecting and mating only the fish with desirable traits as broodfish. For example, choosing species with a wider temperature tolerance range may reduce the risk of future mortality.	11. Regulating and Maintenance Services	**3**	**3**	**3**	**2**	**2**
A6	**Best Management Practices**	Implementing Best Management Practices at farms which focus on food safety, fish health, environmental impact (including climate change) and social responsibility. These practices improve the farms capacity to participate in value chains with the aim of improving the overall resilience of the farm. For example, increasing hygiene will improve resilience of species to diseases.	11. Regulating and Maintenance Services	**4**	**4**	**4**	**3**	**4**
A7	**Create educational visits**	Students, schools, institutes and organisations can organise visits to the fish farms to learn about aquaculture and the interactions between aquaculture and the environment. These visits can also increase knowledge on different impacts on aquaculture including man-made and climate impacts. Biosecurity should be strictly observed.	12. Cultural services	**2**	**2**	**1**	**4**	**3**
A8	**Promote aquaculture cuisine**	This measure promotes aquaculture via online information and uses local restaurants. Aquaculture itself can be seen as an adaptation measure to climate change as an alternative to wild fisheries, which production and yield will reduce due to climate change. Therefore, promoting aquaculture species in restaurants or setting up specific 'aquaculture' restaurants will provide both a cultural experience and promote farmed products. The online tool highlights the initiative, provides recipes and aggregates information.	12. Cultural services	**2**	**2**	**3**	**3**	**2**
A9	**Awareness campaigns for behavioural change**	Awareness campaigns aim to increase the knowledge of individuals and organisations, it could also be relevant in a region affected by a particular climate threat, groups of stakeholders, and the general public.	2. Human capital	**2**	**3**	**3**	**2**	**4**
A10	**Efficient feed management**	Efficient feed management practices that reduce the Food Conversion Ratio by using technology or practices to feed more efficient helps to reduce the cost of production and increase environmental standards.	2. Human capital	**4**	**4**	**4**	**2**	**3**
A11	**Addressing consumer and environmental concerns at the local level**	This option aims to promote economy and jobs to address the future challenges of climate change. The major challenges need to be underlined and linked to the key concerns and impacts on the aquaculture sector.	3. Social capital	**2**	**4**	**4**	**2**	**3**
A12	**Promote cooperation to local consumption**	Cooperation to promote local consumption of aquaculture produced fish specially in tourist sector will reduce the cost of distribution and will improve the creation of add value in local products or by-products in innovative industries.	3. Social capital	**4**	**4**	**4**	**2**	**3**

A13	**Integrated multi-trophic aquaculture (IMTA)**	Integrated multi-trophic aquaculture (IMTA) is an ecosystem-based approach to culture species from different trophic levels (fish, shellfish, seaweeds) in an integrated farm to create balanced systems for environmental sustainability. IMTA can increase resilience due to its tolerance to wider ranges of climatic factors such as temperature and salinity.	4. Natural capital	**3**	**3**	**3**	**1**	**3**
A14	**Short-cycle aquaculture**	Short-cycle aquaculture shortens the farming period and the time in marine cages by stocking larger fingerlings in the nursery stage (land-based) or selecting species with a shorter culture cycle.	4. Natural capital	**2**	**3**	**1**	**3**	**4**
A15	**Recirculation Aquaculture Systems (RAS)**	Recirculation Aquaculture Systems (RAS) are land-based indoor fish farms with closed containment rearing systems where filtration is applied to purify and regulate water parameters and remove toxic metabolic wastes of fish. Since RAS is land-based and indoor it limits the risk of infrastructure destruction due to extreme events in the ocean.	5. Physical capital	**2**	**3**	**1**	**4**	**4**
A16	**Submersible cages**	Submersible cages are oceanic depth-adjustable and can be moved up and down in the sea to escape the worst effects of storms, parasite outbreaks, surface algal blooms and to keep species at an optimal temperature.	5. Physical capital	**3**	**3**	**3**	**3**	**3**
A17	**Climate proof aquaculture activities**	Climate-proof activities refer to investments that consider climate change projections to manage future risks to infrastructures and improve operational safety conditions. E.g. strengthening mooring systems, cage structures and nets.	6. Managing long term risk	**3**	**3**	**3**	**3**	**3**
A18	**Risk-based zoning and site selection**	Risk-based zoning and site selection consists of taking into consideration climate change scenarios when planning and selecting a site for a farm. For example, marine cage operations should not select a site that is (or is expected to be) exposed to high waves or strong currents, and pond farming operations should select sites with low risk of flooding. Zone management can facilitate effective sharing of space and resources with other users, taking into account the carrying capacity of the site.	6. Managing long term risk	**4**	**4**	**3**	**4**	**4**
A19	**Disease prevention methods**	Disease prevention methods are preventive health measures such as vaccines, stronger fingerlings, probiotics, ensuring optimal water quality and implementing stricter hygiene procedures with the aim of reducing the risk of diseases now and in the future.	7. Preparedness	**4**	**3**	**3**	**2**	**4**
A20	**Environmental monitoring and Early Warning Systems (EWS)**	Environmental monitoring and Early Warning Systems (EWS) systematically collects and provides information to fish farmers with the aim of supporting climate risk management decision-making. Monitoring and early warning can facilitate adaptation actions, such as early harvesting or relocation of fish net pens from sites of intense harmful algae blooms. Dynamic vulnerability maps, remote sensing and GIS are typically applied in the development of this type of measures.	7. Preparedness	**4**	**4**	**4**	**3**	**4**

A21	**Mainstreaming Disaster Risk Management (DRM)**	This measure aims to plan and organize DRM considering climate change along five stages including prevention, protection, preparedness, and response, recovery and review in the aquaculture decision making and management frameworks. Examples include interventions to limit farm development in natural hazard areas; review safety engineering standards for farms; study the interactions of climate change in local ecosystems and appropriately develop strategies, arrangements, and procedures to address crises; and post-emergency recovery activities.	8. Response	**4**	**3**	**3**	**3**	**4**
A22	**Contingency for emergency management, early harvest and/or relocation**	These plans consist in moving produce or activities to sites with more suitable characteristics to protect them against climate hazards such as storms, high waves, temperature changes or water quality degradation. Relocation can mean moving activities within the same environment (ocean-ocean; land-land) or between environments (ocean to land). It also includes protocols emergency harvesting to reduce the stock loss.	8. Response	**3**	**3**	**1**	**2**	**1**
A23	**Recovery Post-Disaster plans**	Establish early recovery good practices and objectives. This option will allow to reduce socio-economic and environmental consequences of the disaster. Examples of good practices are: Identify goods and services (support facilities like boats and docks as well as farm infrastructure) that require restoration.	9. Post disaster recovery and rehabilitation	**3**	**4**	**3**	**2**	**4**
A24	**Recovery Post-Disaster funds**	Create recovery funds and plans for Post-Disaster in Aquaculture with Initiatives to get the economy running quickly, e.g. rebuild damaged critical infrastructures such boats, docks, and farm infrastructure. This option minimizes the economic and social impacts that can occur in a post-disaster context.	9. Post disaster recovery and rehabilitation	**2**	**2**	**2**	**2**	**3**

9.1.2 Maritime Transport

ID	Name	Description	Class of adaptation	Cost Efficiency	Environmental protection	Mitigation (GHG emissions) win-wins and trade-offs	Technical applicability	Social Acceptability
MT1	**Insurance mechanisms for ports**	Insurance mechanisms for ports include risk-sharing schemes that aim to assist port operators in responding to the climate risks they are enabled to reduce. Insurance outsources the risks to a third party in exchange for a regular financial compensation.	1. Financial capital	**4**	**1**	**2**	**3**	**2**
MT2	**Financial incentives to retreat from high-risk areas**	Financial incentives to retreat from high-risk areas refers to the creation of financial incentives to retreat or relocate settlements, infrastructure and productive activities from the original location due to their high exposure to risks such as flood, sea-level rise and storm surges.	1. Financial capital	**2**	**1**	**1**	**1**	**1**
MT3	**Marine life friendly coastal protection structures**	Marine life friendly coastal protection structures are coastal protection structures constructed with materials that maximize the fixation of marine organisms. This option reduces climate change impacts on local ecosystems, provides water waste depuration (made by marine organisms) and water quality bio-indicators inside the ports.	10. Provisioning services	**3**	**4**	**3**	**4**	**4**
MT4	**Combined protection and wave energy infrastructures**	Combined protection and wave energy infrastructures is an energy measure that combines sea protection structures with wave energy production. This can create economies of scale, increase coastal protection and further decrease wave propagation inside the port during normal operations.	10. Provisioning services	**2**	**4**	**4**	**1**	**4**
MT5	**Hybrid and full electric ship propulsion**	Hybrid and full electric ship propulsion is environmentally friendly for marine life, decreases carbon emissions and can increase ship manoeuvrability which is useful in small ports and under difficult weather conditions. Low speed manoeuvring with conventional engines creates air and water pollution, noise and fuel consumption. Electrically driven propulsion can address these issues while increasing manoeuvrability using for instance azimuth thrusters.	11. Regulating and Maintenance Services	**2**	**4**	**3**	**1**	**4**

MT6	**Coastal protection structures**	Coastal protection structures such as groynes, breakwaters, artificial reefs and seawalls are different types of artificial structures, built in the shoreline (or rivers), which are designed to protect the coast from SLR or storms. Those structures can be used to, for example, drift and trap sediments, protect from erosion, absorb wave energy, or allow navigation.	11. Regulating and Maintenance Services	**4**	**4**	**3**	**4**	**3**
MT7	**Integrate ports in urban tissue**	Integrate ports into the urban tissue opening port areas to other activities, namely cultural, while gaining room in the urban landscape. This allows some port activities to be pooled from low-laying areas while leisure and cultural activities can access more waterfront space.	12. Cultural services	**2**	**3**	**2**	**3**	**4**
MT8	**Ocean pools**	Ocean pools are situated by the sea where waves can wash into the pool. The width, length and depth of ocean pools varies and often depends on their location on the coastline. These recreational structures are a response to SLR, protect the coast and create alternatives to beach leisure areas.	12. Cultural services	**2**	**2**	**2**	**3**	**3**
MT9	**Awareness campaigns for behavioural change**	Awareness campaigns for behavioural change aim to increase individuals and organisations' knowledge about climate change and the risk faced by the maritime transport sector. These campaigns can be targeted to regions affected by a particular climate threat, specific groups of infrastructures or the general transport sector as a whole.	2. Human capital	**2**	**3**	**3**	**4**	**4**
MT10	**Social dialogue for training in the port sector**	Social dialogue for training in the port sector refers to social and educational issues related with the gender equality and attracting the young to the sector, while tackling climate change. It relies on social dialogue between workers and employees to define common guidelines for training. It considers key challenges that ports are facing and how the industry is adapting to change and preparing for the future.	2. Human capital	**3**	**3**	**3**	**3**	**4**
MT11	**Diversification of trade using climate resilient commodities**	Diversification of trade using climate resilient commodities aims to reduce dependency on trade of perishable goods and critical services, create larger stocks of goods that are climate resilient and consider were changing trading systems to endure changes in climate is economically feasible, strategically justifiable and equitable.	3. Social capital	**3**	**3**	**4**	**2**	**3**
MT12	**Climate resilient economy and jobs**	Climate resilient economy and jobs aims to shift the economy and jobs towards a more climate resilient society. Perishable goods and some critical services rely heavily on the marine transport which can be affected by unpredictable extreme	3. Social capital	**4**	**4**	**4**	**2**	**3**

		weather events. To address this the economy needs to adapt by shifting to products and services that depend less on Just In Time (JIT) operations, using for instance larger stocks.						
MT13	**Refrigeration, cooling and ventilation systems**	Improve the efficiency of refrigeration, cooling and ventilation systems in order to reduce costs in warmer weather and maintain operations during heat waves. Human thermal comfort provided by efficient ventilation and cooling is relevant to ensure the health and safety of passengers and port workers. Refrigeration is relevant for managing goods that need low temperatures.	4. Natural capital	**3**	**4**	**4**	**4**	**4**
MT14	**Restrict development and settlement in low-lying areas**	Restrict development and settlement in low-lying areas means to assure that ports are not further developed in low-laying areas exposed to SLR. Planning must consider the long-term potential risks.	4. Natural capital	**4**	**4**	**3**	**4**	**4**
MT15	**Sturdiness improvement of vessels**	Improve the strength of vessels to sea storms while decreasing the noise and increasing efficiency. Wave-induced loads on the ship structures are a major concern in hull design process. Ship owners should prefer designs that allow for more demanding wave regimes (for instance including the survivability to rouge waves).	5. Physical capital	**3**	**4**	**4**	**3**	**4**
MT16	**Increase operational speed and flexibility in ports**	Increase operational speed and flexibility in ports aims to increase the attractiveness of ship transport in order to capture more freight and passenger movement. This can promote a modal shift towards shipping and create new opportunities including those related with exports and tourism. Faster operations also reduce the effects of heat waves on goods and people as well as decarbonise the economy.	5. Physical capital	**3**	**4**	**4**	**2**	**4**
MT17	**Climate proof ports and port activities**	Climate-proof ports and port activities refers to investments that consider specific climate change projections to manage future risks in port infrastructures and improve operational safety conditions. These can include retrofitting or reconfiguring breakwaters and other port structures to avoid overtops and flooding due to storm surges, heavy precipitation, extreme heat, strong winds events and extreme swell conditions. The Copernicus Emergency Management Services (EMS) services can provide regarding climate change and disaster risk reduction.	6. Managing long term risk	**3**	**4**	**3**	**3**	**4**

MT18	**Consider expansion/retreat of ports in urban planning**	Consider expansion/retreat of ports in urban planning means to consider the expansion or reallocation of areas for future maritime transport infrastructures due to climate change risks. The urban planning and expansion should consider the potential requirements for port expansion/retreat options.	6. Managing long term risk	**3**	**2**	**2**	**2**	**1**
MT19	**Reinforcement of inspection, repair and maintenance of infrastructures**	A continuous reinforcement of inspection, repair and maintenance of infrastructures aims to adapt monitoring to a new climate context. Changes in the frequency and/or intensity of storms, SLR or temperature, for example, may have impacts in infrastructure, increasing degradation of the materials and requiring new maintenance plans.	7. Preparedness	**3**	**4**	**4**	**3**	**4**
MT20	**Early Warning Systems (EWS) and climate change monitoring**	Early Warning Systems (EWS) is an information system with several components that assesses climate risks and relays that information to decision makers, companies utilities and the general public in real time. Transport operators should integrate this tool in procedures in order to protect the safety of people and goods. The collected data can also be used to study the evolution of climate impacts as time progresses, for instance the impact of heat waves and storms in operations.	7. Preparedness	**4**	**4**	**4**	**3**	**4**
MT21	**Intelligent Transport Systems (ITS)**	Intelligent Transport Systems (ITS) are technologies that relay automated and tailored data and safety-related messages to ships, regarding climate hazards and other relevant information. ITS use communication and information standards that are uniform and widely accepted by other ports that the island is linked to.	8. Response	**4**	**4**	**4**	**2**	**4**
MT22	**Prepare for service delays or cancellations**	Prepare for service delays or cancellations aims to promote the creation of new procedures, alternative options and channels to sell goods and transport passengers, as well as better communication to deal with delays or cancellations. Dealing with more frequency and/or intensity of storms (which will happen in some regions) improves port reputation and customer preferences.	8. Response	**4**	**3**	**3**	**3**	**4**
MT23	**Backup routes and infrastructures during extreme weather**	Backup routes and infrastructures during extreme weather aims to creates a post disaster response that ensures available alternatives when the main ports are damaged or inaccessible due to extreme weather events. It considers alternative ports and access roads. Alternative ports can be smaller in size, simpler and be used for other purposes, but should have a different location and orientation from the main ones.	9. Post disaster recovery and rehabilitation	**2**	**1**	**1**	**2**	**3**

MT24	**Post-Disaster recovery funds**	Post-Disaster recovery funds is the creation of recovery funds for the maritime transport sector to recover after disasters, through initiatives that get the economy up and running quickly while building-back-better (e.g. rebuild damaged critical infrastructures such as ports and roads). The aim is to minimize the economic and social impacts that can occur in a post-disaster context.	9. Post disaster recovery and rehabilitation	**1**	**2**	**2**	**3**	**4**

9.1.3 Tourism

ID	Name	Description	Class of adaptation	Cost Efficiency	Environmental protection	Mitigation (GHG emissions) win-wins and trade-offs	Technical applicability	Social Acceptability
T1	**Economic Policy Instruments (EPIs)**	Economic Policy Instruments (EPIs) are incentives designed and implemented with the purpose of adapting individual decisions to collectively agreed goals. Diferent type of instruments can be aplied, like: pricing (e.g. water tariffs), environmental taxes and charges, subsidies; trading (e.g. tradable permit for pollution or water abstraction, compensation mechanisms, payments for environmental services); and voluntary agreements and risk management schemes such as insurances.	1. Financial capital	**3**	**3**	**4**	**2**	**3**
T2	**Financial incentives to retreat from high-risk areas**	Financial incentives to retreat from high-risk areas refers to the creation of financial incentives to retreat or relocate settlements, infrastructure and productive activities from the original location due to their high exposure to risks such as flood, sea-level rise and storm surges.	1. Financial capital	**2**	**2**	**1**	**1**	**1**
T3	**Adaptation of groundwater management**	Adaptation of groundwater management can be used to (1) conserve groundwater reservoirs, limiting water use and optimizing water reuse, and (2) restore or increase natural infiltration capacity. Both contribute to adaptation in circumstances of reduced precipitation and sea saltwater intrusion aggravated with groundwater over-exploitation. Different packages of interventions usually inlcude: freshwater injection, modifying pumping practice, delayed inflow, artificial recharge or efficient use of freshwater.	10. Provisioning services	**3**	**3**	**3**	**3**	**3**

T4	**Monitoring, modelling and forecasting systems**	Monitoring, modelling and forecasting systems are information system that provide timely and reliable climate information, as well as up-to-date data on the occurrence and severity of extreme events, possible impacts and their duration. Different systems can be implemented to respond to different climate hazards, such as drought-related, water quality monitoring, water resources management and predicting and managing flood risks.	10. Provisioning services	**4**	**3**	**3**	**3**	**4**
T5	**Coastal restoration and rehabilitation**	Coastal restoration and rehabilitation refers to the strengthening of the flood safety and sand reservoir functions of dunes and other coastal structures. Erosion happens as a result of wind action, marine erosion, human activities and Sea Level Rise (SLR). Possible technics examples include: grass planting, thatching and fencing.	11. Regulating and Maintenance Services	**2**	**3**	**3**	**3**	**4**
T6	**River and valley rehabilitation and restoration**	River and valley rehabilitation and restoration are measures that emphasise the natural functions of rivers/valleys and create vegetated buffer zones alongside watercourses. This contributes to the improvement of micro-climatic conditions, reduces run-off and erosion, and increases groundwater recharge. For Tourism, this option also increases available leisure areas, increases thermal comfort areas and the availability of water.	11. Regulating and Maintenance Services	**4**	**4**	**4**	**3**	**4**
T7	**Adaptive management of natural habitats**	Adaptive management of natural habitats refers to the preservation of ecosystem services which are essential for human well-being. Human activities induce pressure and impacts on biodiversity and ecosystems that tend to be aggravated by climate change. Adaptive management measures include: understanding species response; make space for the development of rivers and coasts; aid gene flow; species translocation; targets and conservation mechanisms/plans.	12. Cultural services	**4**	**4**	**4**	**3**	**4**
T8	**Ocean pools**	Ocean pools are seawater pools located by the sea where waves can wash into the pool. The width, length and depth of ocean pools varies and often depends on their location on the coastline. These recreational structures are useful on SLR context, doubling as an additional protection of the coast and creating alternatives to beach leisure areas.	12. Cultural services	**3**	**3**	**2**	**4**	**4**

T9	**Activity and product diversification**	Activity and product diversification include actions to diversify the tourism activities and products and aim to reduce seasonality and overload in infrastructures and ecosystems. Shifting the dependency from 'sun, sea and sand' products to alternative leisure activities can reduce the impacts of heat waves, coastal erosion or ecosystem degradation, and thus help to maintain destination attractiveness.	2. Human capital	**3**	**2**	**2**	**2**	**3**
T10	**Public awareness programmes**	Public awareness programmes establish targeted programmes that raise awareness about climate change (specific values and protection needs) among guides, site managers and local communities.	2. Human capital	**2**	**3**	**3**	**4**	**4**
T11	**Local circular economy**	Local circular economy is an economic system aimed at eliminating waste and the continual use of resources that offers a valuable framework for reduced carbon emissions from materials (decarbonization) and increased resilience to climate change and its impacts.	3. Social capital	**4**	**4**	**4**	**2**	**1**
T12	**Tourist awareness campaigns**	Tourist awareness campaigns target behavioural change of visitors and aim to increase tourists (individuals and organisations) knowledge about climate change and the risk faced by tourism destinations. These campaigns can be targeted to regions affected by a particular climate threat, specific groups of visitors or the general tourism sector as a whole.	3. Social capital	**2**	**3**	**3**	**3**	**3**
T13	**Local sustainable fishing**	Local sustainable fishing refers to the promotion of fishing zones/rights for local small-scale fishers maintaining stocks and using sustainable methods. This option aims to add value to local resources and products, protect ecosystems services and decrease external dependency.	4. Natural capital	**2**	**3**	**3**	**3**	**2**
T14	**Water restrictions, consumption cuts and grey-water recycling**	Restrictions can be applied to allow water administration services to cope with water crises. Restriction (or rationing) of certain uses of water such as irrigation of lawns, car washing, filling swimming pools or hosing down pavement areas may be necessary during these times. Grey-water recycling (or reclamation) is the reuse of non-drinkable water (usually treated waste water) to cover water use needs that don't demand such a high-quality standard.	4. Natural capital	**4**	**4**	**4**	**3**	**1**
T15	**Beach nourishment**	Beach nourishment (or replenishment) is the artificial placement of sand to compensate for erosion. Beach nourishment also often aims at maintaining beach width (for tourism and recreational purposes). Several beach nourishment techniques can be used including beach, backshore and shoreface nourishment, and large scale coastal nourishment (e.g. using sand motors).	5. Physical capital	**2**	**1**	**2**	**4**	**4**

T16	**Desalination**	Desalination is the process of removing salt from sea or brackish water to make it useable for a range of purposes including drinking, and can contribute to adaptation in circumstances of current or future water scarcity problems. Technological examples include electrically driven technologies, like reverse osmosis, and thermally driven technologies, based mainly on vapor distillation processes.	5. Physical capital	**2**	**4**	**1**	**4**	**4**
T17	**Coastal protection structures**	Coastal protection structures such as groynes, breakwaters, artificial reefs and seawalls are different types of artificial structures, built in the shoreline (or rivers), which are designed to protect the coast from SLR or storms. Those structures can be used to, for example, drift and trap sediments, protect from erosion, absorb wave energy, or allow navigation.	6. Managing long term risk	**3**	**3**	**3**	**4**	**4**
T18	**Drought and water conservation plans**	Drought and water conservation plans refer to tourism-lead adaptation and/or involvement in drought management plans with the aim to reduce the economic, social, and environmental consequences of drought and water scarcity, and to reduce the loss of water and improve efficiency in the sector.	6. Managing long term risk	**3**	**3**	**4**	**3**	**3**
T19	**Mainstreaming Disaster Risk Management (DRM)**	Mainstreaming Disaster Risk Management (DRM) aims to plan and organize DRM along five stages including prevention, protection, preparedness, and response, recovery and review. Examples include interventions to limit urban development in flood prone areas; identify natural hazard prone areas; develop strategies, arrangements, and procedures to address crises; and post-emergency recovery activities.	7. Preparedness	**3**	**3**	**3**	**3**	**4**
T20	**Using water to cope with heat waves**	Water use to cope with heat waves in cities are a set of investments in water supply services and infrastructures that aim to increase urban resilience regarding heat waves. Different packages of grey interventions are usually applied, as for example: creating and/or repairing fountains for drinking water and cooling; water spray fountains; and wetting streets.	7. Preparedness	**4**	**3**	**2**	**3**	**4**
T21	**Fire management plans**	Fire management plans are management actions have wide range of application such as early warning detection, with escape routes and advice to local citizens and tourists, mobilization and suppression of unwanted and damaging fires, or use of fire to manage fuel. Additionally, these plans help to increase the understanding of the interactions of climate change with vegetation cover and fire regimes.	8. Response	**4**	**4**	**3**	**3**	**4**
T22	**Health care delivery systems**	Health care delivery systems are pre-emptive actions and adjustments that need to be made to health care systems, namely reinforcing less prepared aspects of its operation and/or logistics, in order to guarantee effectiveness and efficiency during, for example, high temperature and heat-wave situations.	8. Response	**2**	**2**	**3**	**3**	**4**

T23	**Post-Disaster recovery funds**	Post-Disaster recovery funds is the creation of recovery funds for the Tourism sector to recover after disasters, through initiatives that get the economy up and running quickly while building-back-better (e.g. rebuild damaged critical infrastructures such as ports and roads or recover the landscape from fires). The aim is to minimize the economic and social impacts (which may include future loss of the touristic destination attractiveness) that can occur in a post-disaster context.	9. Post disaster recovery and rehabilitation	**2**	**1**	**2**	**3**	**4**
T24	**Pre-disaster early recovery planning**	Pre-disaster early recovery planning processes include the development of knowledge, good practices and objectives that aim to improve the living conditions of the affected communities, while facilitating the adjustments necessary to reduce the risk of future disasters. Examples of good practices are may include identifying critical ecosystems (goods and services) that require immediate restoration after a disaster or particularly vulnerable communities.	9. Post disaster recovery and rehabilitation	**4**	**3**	**3**	**3**	**4**

9.1.4 Energy

ID	Name	Description	Class of adaptation	Cost Efficiency	Environmental protection	Mitigation (GHG emissions) win-wins and trade-offs	Technical applicability	Social Acceptability
E1	**Financial support for buildings with low energy needs**	Financial schemes in the form of loans, subsidies or tax reliefs are ways to support the reduction of energy needs of new or existing buildings, making them address climate change in a more efficient manner. For example, architecture and construction materials that rely on passive thermal comfort reduce the use of energy for human comfort, so less air-conditioning is necessary in the cooling season.	1. Financial capital	**4**	**4**	**4**	**3**	**4**

E2	**Financial support for smart control of energy in houses and buildings**	The support of smart control of energy in houses and buildings allows for an efficient and automated use of energy that enables savings and creates synergies with utilities. For example, such a system could coordinate the automated opening vents with the air conditioning operation, avoiding energy consumption when possible. This will allow for the adaptation of buildings at a controlled cost, while complying with mitigation goals.	1. Financial capital	**3**	**4**	**4**	**2**	**4**
E3	**Energy efficiency in urban water management**	Energy efficiency in urban water management is the adaptation of urban design and construction for water conservation that avoids energy use under scarcity scenarios. For instance, Water Sensitive Urban Design (WSUD) aims to plan water conservation and storm water storage with integration with elements of urban design. This both to minimises hydrological impacts on the environment and the associated energy use of water supply.	10. Provisioning services	**4**	**4**	**4**	**2**	**4**
E4	**Underground tubes and piping in urban planning**	Underground tubes and piping are used for space heating/cooling across the globe and are more resilient to climate change. These systems can be Earth Air Heat Exchanger (EAHE) and Ground Source Heat Pump (GSHP) types. Both systems use tubes or pipes that usually need to be buried beyond the footprint of the building or house. The measure considers this need, and both allows and encourages the use of such space in urban planning.	10. Provisioning services	**4**	**4**	**4**	**1**	**4**
E5	**Biomass power from household waste**	Biomass power plants burn household waste, waste from parks and public gardens and sludge generated by sewage treatment plants. Towns and cities can also realise urban production and recreational woods, which can be used for producing biomass for co-generation (Combine Heat and Power) as well as tri-generation (Combined Cold Heat and Power) plants.	11. Regulating and Maintenance Services	**4**	**4**	**4**	**4**	**2**
E6	**Urban green corridors**	Urban green areas decrease the air temperature in a city and thus decrease energy needs. Warm air tends to transport pollution and particulate matter to higher layers of atmosphere, causing a cloud of smog. Creating green corridors also promotes biodiversity, increases the touristic value and decreases water run-off during storms.	11. Regulating and Maintenance Services	**4**	**4**	**4**	**1**	**4**

E7	**Educational garden plots**	Educational garden plots are sites where people, especially children, can garden with volunteers one afternoon a week after school. The harvest can be taken home. This creates well-being while having local fresh produce reduces the energy consumption and pollution. These garden plots can be further exploring to educate people about other climate action measures, directly and indirectly related with energy such as waste to energy, composting, water retention and green corridors.	12. Cultural services	**4**	**4**	**4**	**3**	**4**
E8	**Heated pools with waste heat from power plants**	Power plants need cooling and their waste heat can be used in swimming pools for public use and tourism. This creates an attractive leisure activity in off-peak winter times which diversifies the touristic offer and promote community well-being. This type of heat recovery design is called Combined Heat and Power (CHP). Pools provide a heat sink for the power plants which increases efficiency and is useful during heat waves.	12. Cultural services	**3**	**3**	**3**	**2**	**1**
E9	**Green jobs and businesses**	The promotion of green jobs and businesses consists in training people and supporting green businesses to implement energy solutions across the economy, both in mitigation and adaptation. One example can be the support of research projects to help businesses deal with new technologies relevant to climate action.	2. Human capital	**4**	**4**	**4**	**3**	**3**
E10	**Public information service on climate action**	Public information service on climate action aims to provide the general public with information about adaptation and mitigation options available for their activities and businesses. This includes information dissemination and counselling about available solutions and the public support. This type of information is relevant, for example, to support dwellings, hotels or commerce to adapt to climate change.	2. Human capital	**3**	**3**	**3**	**3**	**4**
E11	**Small scale production and consumption (prosumers)**	Small scale production and consumption (prosumers) aims to promote cooperation by creating economies of scale both in the production and consumption of energy. This allows for a greater use of local renewable resources and waste energy recovery which allow for a better resilience when dealing with climate change events such as heat waves.	3. Social capital	**3**	**4**	**4**	**3**	**3**
E12	**Risk reporting platform**	Risk reporting platform intends to promote the communication between the general public and the administration bodies concerning the risks related with climate change. It is a platform were the general public reports directly the risks as they become aware of. These can be for example related with cliff instability, trees falling over energy lines, uncleared bushes that can be ignited by power lines or unstable structures that may fall due to strong winds.	3. Social capital	**4**	**3**	**3**	**3**	**4**

E13	**Energy storage systems**	The development of energy storage systems can provide an alternative when the main power sources fail and need time to recover. This allows for a more resilient energy grid while enabling decarbonization and peak levelling at a controlled cost. This includes not only electric batteries (like those in cars and buses), but also other forms of energy storage such as thermal tanks (heat), ice banks (cold) or water height (reversed pumping).	4. Natural capital	**3**	**3**	**4**	**2**	**4**
E14	**Collection and storage of forest fuel loads**	Collection and storage of forest fuel loads intend to promote and regulate the collection and storage of wood and combustible material to reduce wildfire hazard. Actions may include: clearing of small trees out of dense areas, reduce the amount of fuel on the ground and increasing the spacing between trees. Materials collected can be used in energy to waste applications such as pellets, biogas or other energy solutions.	4. Natural capital	**1**	**1**	**1**	**1**	**1**
E15	**Sea Water Air Conditioning (SWAC).**	The Seawater Air Conditioning (SWAC) measure is an alternate-energy system design that uses cold water from the deep ocean to provide more efficient, decarbonized and reliable cooling. The sweater is piped to heat exchangers for process cooling or to provide condensation water in air conditioning systems. It replaces air cooling units or fresh water evaporative cooling towers which performances degrades in heat waves. Other subsequent or parallel seawater uses can be combined, like for swimming pools or desalinisation.	5. Physical capital	**2**	**2**	**3**	**1**	**2**
E16	**Demand Side Management (DSM) of Energy**	Demand Side Management (DSM) of energy is an operational strategy that better coordinates producers and consumers of energy. More renewable energy use is possible while ensuring the energy service reliability and controlled costs. DMS balances off-peak and peak demand using peek shaving, which is important, for example, during heat waves.	5. Physical capital	**4**	**4**	**4**	**3**	**4**
E17	**Review building codes of the energy infrastructure**	Review energy infrastructure building codes aims to climate-proof the energy system by reviewing regulatory codes and infrastructures considering the spatial distribution of climate risks. This should include establishment of new procedures, maintenance practices, operational changes, retrofitting and the use of climate and mapping services such as those produced by the Copernicus Emergency Management Service (EMS).	6. Managing long term risk	**4**	**4**	**4**	**2**	**4**
E18	**Upgrade evaporative cooling systems**	Upgrade of evaporative cooling systems that rely on a given range of air temperature and water availability is necessary given that this type of cooling systems are a technology that can be affected by climate change and become compromised due to heat waves and water scarcity.	6. Managing long term risk	**2**	**2**	**1**	**2**	**3**

E19	**Early Warning Systems (EWS)**	Early Warning Systems (EWS) is an information system that assesses climate risks and provides real time information to decision makers, companies, utilities and the general public. Climate data used to control and monitor the energy infrastructure can be relayed to the EWS. Using this data to monitor the evolution of climate related impacts in the energy sector increases the knowledge necessary to make long term climate adaptation decisions.	7. Preparedness	**4**	**4**	**4**	**3**	**4**
E20	**Grid reliability**	Grid reliability improvement aims to find and upgrade critical components and to enhance the energy system resilience to climate risks. This may include redundant circuitry or components that provide alternative dispatch of energy, equipment upgrades (e.g. better cooling to cope with heat waves) or power downrating (e.g. decrease power output of energy transformers so that they do not overheat during heat waves).	7. Preparedness	**3**	**3**	**3**	**3**	**4**
E21	**Study and develop energy grid connections**	Energy grid connections aims to develop interconnections between islands and/or with the mainland allowing for the creation of economies of scale, energy system reliability improvements and more Renewable Energy Sources (RES) penetration.	8. Response	**4**	**4**	**3**	**3**	**4**
E22	**Energy-independent facilities (generators)**	Energy-independent facilities (generators) make it possible for buildings to temporarily create their own energy supply. In case of an energy supply failure (power outage), essential amenities remain functional and can be optimized with Combined Heat and Power (CHP) designs and other decentralised energy generation solutions.	8. Response	**2**	**1**	**1**	**3**	**3**
E23	**Energy recovery microgrids**	Energy recovery microgrids are operational elements of the energy grids that rely on distributed generation to restore systems from power outages and to stabilize the grid. This allows for a flexible and swifter recovery from power outages caused by knock-out events (e.g. tree falls on energy lines), excess demand (e.g. during heat waves) or other causes.	9. Post disaster recovery and rehabilitation	**4**	**3**	**3**	**3**	**4**
E24	**Local recovery energy outage capacity**	Local recovery energy outage capacity consists in increasing and improving the ability of the islands to recover from energy outages caused by or worsen by climate extreme events, like severe sea or windstorms that can lead to island isolation and exacerbate logistical hurdles. To facilitate a swift recovery, it's useful to have more mobile backup power, power line replacements and other grid components, logistics, supplies and personnel.	9. Post disaster recovery and rehabilitation	**3**	**2**	**2**	**3**	**4**

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9.2 Online survey Tool Visualization

APT C Efficiency Enhancement

medium investment, medium commitment

Class of Adaptation	Available adaptation options/measures	Short term (up to 2030)	Mid-century (up to 2050)	End-century (up to 2100)
2. Human capital	(A9) Awareness campaigns for behavioural change (A10) Efficient feed management	choose option here	choose option here	choose option here
3. Social capital	(A11) Addressing consumer and environmental concerns at the local level (A12) Promote cooperation to local consumption	choose option here	choose option here	choose option here
4. Natural capital	(A13) Integrated multi-trophic aquaculture (IMTA) (A14) Short-cycle aquaculture	choose option here	choose option here	choose option here
6. Managing long term risk	(A17) Climate proof aquaculture activities (A18) Risk-based zoning and site selection	choose option here	choose option here	choose option here
7. Preparedness	(A19) Disease prevention methods (A20) Environmental monitoring and Early Warning Systems (EWS)	choose option here	choose option here	choose option here
10. Provisioning services	(A3) Feed production (A4) Species selection	choose option here	choose option here	choose option here
11. Regulating and Maintenance Services	(A5) Selective breeding (A6) Best Management Practices	choose option here	choose option here	choose option here
12. Cultural services	(A7) Create educational visits (A8) Promote aquaculture cuisine	choose option here	choose option here	choose option here

READ_ME | APT Narratives | APT A PATHWAY (LWG) | APT B PATHWAY (LWG) | APT C PATHWAY (LWG) | APT D PATHWAY (LWG) | ADAPTATION OPTIONS (IFP) | Classes of adaptation | Background Material

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SOCLIMPACT

Downscaling climate impacts and decarbonisation pathways in EU islands, and enhancing socioeconomic and non-market evaluation of Climate Change for Europe, for 2050 and beyond

SOCLIMPACT

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Work Package 7:

This is a result of Tasks 7.3. This deliverable will include the agendas, the list of participants, and the workshops outputs including the decisions taken.

Deliverable 7.3.

Workshop Report - Sardinia

Island Focal Point coordinated by ANCI Sardegna

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Final version - 24/12/2020

1 Introduction

This document presents the results of the stakeholders' consultation process to design the **SOCLIMPACT Adaptation Pathways Workshops in Sardinia region**. This process is included in SOCLIMPACT Task 7.3 - Engage islands' stakeholders in the design of alternative pathways. According to the project Description of Action is expected that these online workshops use the background material prepared in Task 7.2/D7.2 and include the main results from previous WPs.

In the consultation process, the following objectives are expected to be covered:

19. **Identify and present the characterized packages of adaptation and risk management options** available for each archipelago/island.
20. **Develop detailed archipelago/island integrated adaptation pathways**, in three timeframes: Short term (up to 2030), Mid-century (up to 2050) and End-century (up to 2100).
21. **Evaluate** and rank pathways for Blue Economy sectors.

In Sardinia, the consultation process was split into two online webinars. The original plan was to hold physical workshops in each archipelago. However, health and travel limitations due to Covid-19 forced changes to the original plan and partners decided to develop two shorter online sessions mixed with an online survey. The rationale was to make it as easier as possible for both **IFP** and **LWG -** class of adaptation "Local Knowledge"- (stakeholders) to carry out the proposed work, without seriously compromising the **scientific quality** of the projects' outcomes.

The Sardinian LWG (class of adaptation "Local Knowledge") webinars were performed on the 3rd of November 2020 and on the 25th of November 2020.

The webinar included all the sectors involved in SOCLIMPACT project.

During the process and following the recommended number of stakeholders per sector (between 6 and 8, and in any case not less than 5) we could involve the following numbers of stakeholders:

- 5 for the Tourism sector;
- 6 for the Maritime Transport sector;
- 7 for the Energy sector;
- 6 for the Aquaculture sector.

Due to the importance of the sector for the Region, the IFP-Sardinian decided to maintain the Tourism sector even if we managed to involve only 5 stakeholders.

The workshop was performed taking into consideration the specific requirements of the region and the resources available.

The report follows what was defined in the proposal by presenting the online workshop materials, namely: (1) decisions taken; (2) agendas and (3) list of participants.

The **Adaptation Pathways methodology applied in SOCPLIMPACT was based in the framework developed by Suckall et al.2018 and considered the three main strategic vectors for climate resilience: (1) vulnerability reduction -** Five capitals of Sustainable Livelihoods Approach (SLA); **(2)**

Disaster Risk Reduction – developed throughout Hyogo and Sendai Frameworks; **(3) Social-Ecological Resilience** – that emerge from the Millennium Ecosystem Assessment (MEA) and Common International Classification of Ecosystem Services (CICES).

The **Adaptation Pathways** aim to capture the policy preferences in time and the relevancy of the context traduced in investment and commitment (Suckall et al., 2018). These Adaptation Pathways Trajectories (APT) were delineated as a set of adaptation classes each one with two options/measures to choose from. Each individual stakeholder choices contribute to create a policy pathway together with the other choices made by different stakeholders. If most of the stakeholders chose one option, then that measure was incorporated in the island adaptation pathway for that specific class in each APT, per sector. The result of the series of choices in the three timeframes defines the pathway. If there is a tie between two options, then they will both be included and become part of the adaptation pathway in each time frame. The options were included in the pathway when they were selected more than 50% in each time frame in each APT. Local Knowledge measures were included if they were chosen by at least 20% of all stakeholders.

Pathway options are grouped around three objectives: (1) actions to reduce socio-economic vulnerability; (2) actions that address disaster risk reduction; and (3) actions that affect social-ecological resilience. Adaptation policy under **vulnerability reduction**, **disaster risk reduction**, and **social-ecological resilience** were developed considering classes of adaptation (Figure 2) under which the participants decide which are the most relevant options for the Sardinia region.

For **vulnerability reduction** five classes were considered: (1) Financial capital; (2) Human capital; (3) Social capital; (4) Natural capital; and (5) Physical capital. For **Disaster Risk Reduction** four classes were considered: (6) managing long term risk; (7) preparedness; (8) response; (9) post disaster recovery and rehabilitation. For **Social-Ecological Resilience** three classes were considered: (10) Post disaster recovery and rehabilitation; (11) Provisioning services; and (12) Regulating and Maintenance Services Figure 5).

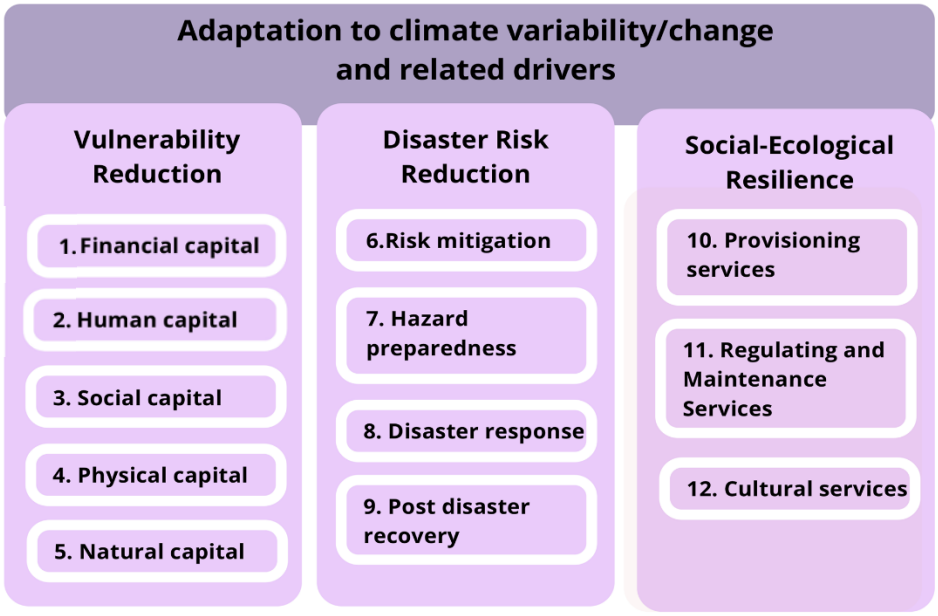

Figure 138 - The 12 classes of adaptation in the figure are structured in three broader objectives (Vulnerability reduction, Disaster Risk reduction and Ecosystem and social resilience).

The results of the Adaptation Pathways are presented in this report in two different outputs per sector: **(1) Selected Adaptation Pathways; and (2) Sustainability Performance.**

The (**1) Selected Adaptation Pathways** outputs aim to capture the acceptance of each adaptation option by calculating the options (number of times) selected within the maximum number of times they can be

selected (Ratio – Selected/Maximum). This considers the number of times the option was selected by all stakeholders in all four APTs and three timeframes.

The **(2) Sustainability performance** outputs aim to characterize each pathway through the evaluation of the options chosen in each APT. The options selected in each APTs are evaluated considering a set of criteria: Cost Efficiency; Environmental protection; Mitigation (GHG emissions) win-wins and trade-offs; Technical applicability; Social acceptability (Table 3).

Table 21 – Description of the criteria used to evaluate the adaptation pathways performance.

	Criteria	Description	
	Cost Efficiency	Ability to efficiently address current or future climate hazards/risks in the most economical way	Higher score = higher cost efficiency
	Environmental protection	Ability to protect the environment, now and in the future	Higher score = higher environmental protection
	Mitigation (GHG emissions) win-wins and trade-offs	Current ability to meet (win-win) or not (trade-off) the island/archipelago's mitigation objectives	Higher score = higher mitigation win-wins and lower trade-offs
	Technical applicability	Current ability to technically implement the option/measure in the island/archipelago	Higher score = higher technical applicability
	Social acceptability	Current social acceptability of the option/measure in the island/archipelago	Higher score = higher social acceptability

The results are presented in a spider diagram and is the average of all options chosen for the participants in each APT pathway.

2 Summary of Background Material

To support the decisions within the Online Survey Tool and to define the Adaptation Pathways, relevant information related with climate, socio-economy and adaptation were presented to stakeholders. The deliverable 7.2 (Background Materials) were the preferential source information but additional and tailored information was developed.

Following are reported the visual representation of how the background material was presented and delivered in the Online Tool Survey for Sardinia region. As one can see background material has been split for each sector in climate fact sheet and socioeconomic fact sheet.

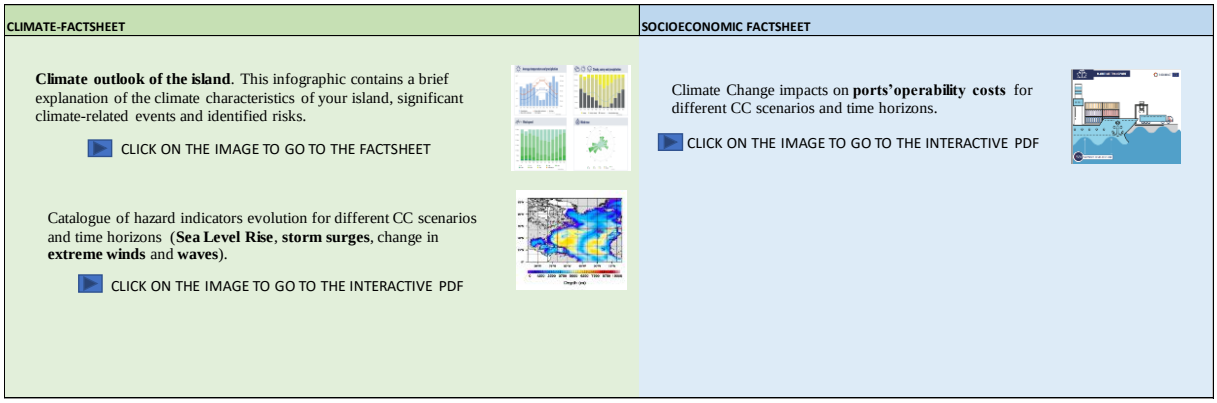

Figure 139 - Visual representation of how the background material was presented and delivered in the Online Tool Survey for Sardinia region: "Background material for the SOCLIMPACT Regional online workshop defined for Maritime Transport sector" (Referred to Deliverable D7.2).

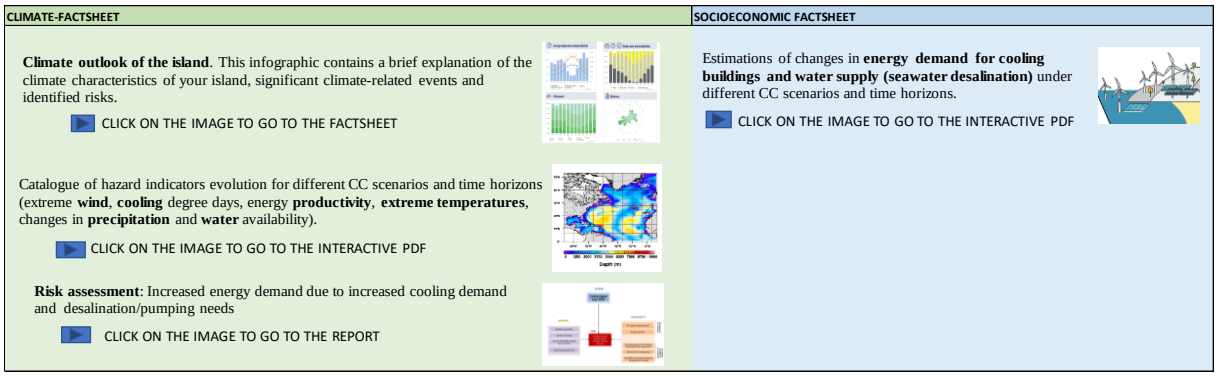

Figure 140 - Visual representation of how the background material was presented and delivered in the Online Tool Survey for Sardinia region: "Background material for the SOCLIMPACT Regional online workshop defined for Energy sector" (Referred to Deliverable D7.2).

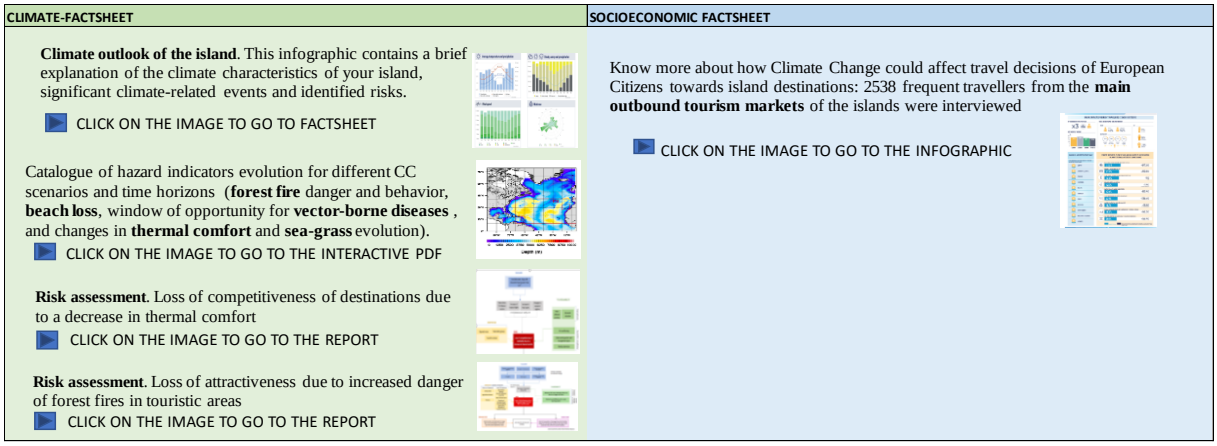

Figure 141 - Visual representation of how the background material was presented and delivered in the Online Tool Survey for Sardinia region: "Background material for the SOCLIMPACT Regional online workshop defined for Tourism sector" (Referred to Deliverable D7.2).

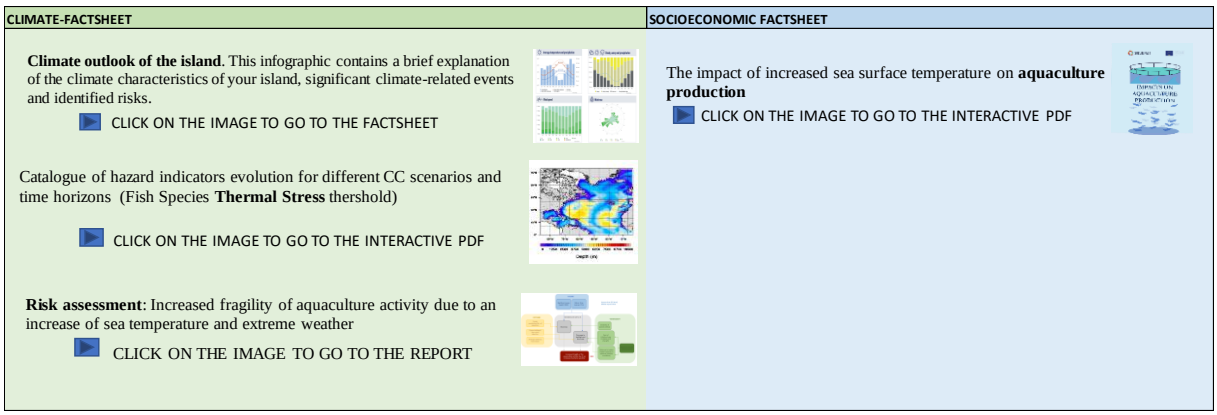

Figure 142 - Visual representation of how the background material was presented and delivered in the Online Tool Survey for Sardinia region: "Background material for the SOCLIMPACT Regional online workshop defined for Aquaculture sector" (Referred to Deliverable D7.2)

3 Sector Adaptation Pathways

3.1 Tourism

Tourism pathways are based on choices made by 5 expert island stakeholders.

3.1.1 Selected Adaptation Pathways

In the following figures have been reported the Adaptation options for the Tourism sector analysed by class (Figure 6) and by symmetry (Figure 7).

Options are identified with an ID number, full name, and class of adaptation number.

Adaptation objectives are identified in each option by colour. The **vulnerability reduction**, highlighted in red colour, considers five pairs of adaptation options. The **Risk Reduction**, highlighted in blue colour, considers four pairs of adaptation options. **Social-Ecological Resilience**, highlighted in green colour, considers three pairs of adaptation options. Each Adaptation option has been evaluated by the stakeholders for the 4 Adaptation Pathways -ATP (APT A; APT B; APT C; APT D) with regards the following three timeframes:

- short term (S) (up to 2030),
- medium term (M) (up to 2050),
- long term (L) (until 2100).

The bold letters in the four columns for ATPs indicate the options that were available to be selected by stakeholders.

The options highlighted with different colours (ATP A - blue); ATP B - light green; ATP C - light orange and ATP D - light purple) indicate the level of interest shown by stakeholders between the two coupled options for each pair. In the most frequently selected measure table in each ATP it is easily identifiable both in percentage terms and in terms of colour. It should be noted that when, in the context of a measure, the space of an ATP is coloured for the three timeframes, it means that the stakeholder has considered the measure in question conveniently applicable in the short, medium or long term.

In the following table are reported the Adaptation options for the Tourism sector analysed by class.

ID	Name	Class number	Ratio	APT A			APT B			APT C			APT D		
				S	M	L	S	M	L	S	M	L	S	M	L
T1	Economic Policy Instruments (EPIs)	1	83%					B						D	
T2	Financial incentives to retreat from high-risk areas	1	17%					B						D	
T9	Activity and product diversification	2	55%		A			B			C			D	
T10	Public awareness programmes	2	45%		A			B			C			D	
T12	Tourist awareness campaigns	3	53%								C				
T11	Local circular economy	3	47%								C				
T14	Water restrictions, consumption cuts and grey-water recycling	4	63%								C			D	
T13	Local sustainable fishing	4	37%								C			D	
T15	Beach nourishment	5	53%					B							
T16	Desalination	5	47%					B							
T18	Drought and water conservation plans	6	75%		A			B			C			D	
T17	Coastal protection structures	6	25%		A			B			C			D	
T19	Mainstreaming Disaster Risk Management (DRM)	7	80%								C				
T20	Using water to cope with heat waves	7	20%								C				
T21	Fire management plans	8	73%		A										
T22	Health care delivery systems	8	27%		A										
T24	Pre-disaster early recovery planning	9	67%		A									D	
T23	Post-Disaster recovery funds	9	33%		A									D	
T4	Monitoring, modelling and forecasting systems	10	72%		A			B			C			D	
T3	Adaptation of groundwater management	10	28%		A			B			C			D	
T6	River rehabilitation and restoration	11	53%					B			C				
T5	Dune restoration and rehabilitation	11	47%					B			C				
T7	Adaptive management of natural habitats	12	53%								C				
T8	Ocean pools	12	47%								C				

Figure 143 - Adaptation options for the Tourism sector analysed by class (adaptation objectives are identified in each option by colour: ***vulnerability reduction (red),*** *Disaster* ***Risk Reduction (blue); Social-Ecological Resilience (green);*** *Local Knowledge adaptation options (grey). Each ATP (APT A; APT B; APT C; APT D) is represented in three timeframes: S - Short term (up to 2030), M-Medium term (up to 2050), L - Long term (until 2100). Bold letters in each ATP indicate the option was available to be selected. Highlighted options indicate the measure was selected in each ATP and timeframe: ATP A (light blue); ATP B (light green); ATP C (Light orange) and ATP D (light purple). Space with colour: option was selected for the timeframe: Short term, Medium term, or Long term. Bold letter: option is available in the APT.*

Overall, adaptation paths for the Tourism sector in Sardinia are characterized by a limited heterogeneity between the four potential trajectories of adaptation policies (APTs) and between adaptation objectives.

Under APT B and D scenarios, the financial capital measures (class1) that were selected to address vulnerability reduction, indicate that the region is initially centred on the development of Economic Policy Instruments while it does not show any interest regarding the possibility of activating financial incentives to retreat from high risk areas (medium-long term). The selection of Economic Policy Instruments is related to the need rooted in the region to strongly commit in order to make structural interventions that allow to face, in an incisive and lasting way, the risks that will increase over time.

To adapt via Human Capital (class 2), diversification of the activities and products in opposition to awareness campaigns should be implemented. However, in Minimum Intervention scenario (APT A), investment in public awareness can be appropriate for mid-term and long-term. At the same time, within an Efficiency Enhancement scenario (APT C), in all time periods, the diversification of the activities and products gain importance. The same pattern occurs for Natural Capital class (class 4), where water restrictions, consumption cuts and grey-water recycling were selected in all time periods in opposition to local sustainable fishing.

In the Social Capital class (class 3), where awareness campaigns were selected for the short-term and mid-term in opposition to local circular economy which gain relevance in the long-term.

As concern Physical Capital (class 5) options taken in APT B. Beach nourishment (or replenishment) was valued in the beginning of the century while towards the end of the century, the region should invest in desalinization.

For **Disaster Risk Reduction**, for the Managing long term risk class (class 6) the drought and water conservation plans are a priority for ATPs A, B and C. In Sardinia, adequate improvement of water harvesting, and water conservation are possible in a scenario of low investment. Differently in the ATP D,

the possibility to have high investment and hight commitment can ensure an effective Restructuration of the System (SR) especially in the mid-term and long-term.

The Efficiency Enhancement scenario (ATP C) is the only scenario which considers the Preparedness class (class 6). In the short, mid and long-term, mainstreaming Disaster Risk Management was selected in detriment of using water to cope with heat waves. This result show that for the island the response to risks is rational and points above all to tackle Disaster Risk Management in terms of prevention, protection, preparedness, and response, recovery and review. The same pattern occurs for Response class (class 8) where the risks related with fire were considered hight in all time periods in Sardinia. The pathway clearly reflects the climate-risk context of the region.

Generically, to address post disaster recovery and rehabilitation (class 9) on Tourism sector, it is necessary to continue to promote planning for the mid and long term and allocate funds to develop climate change resilience in the region for the short-term.

In **Social-Ecological Resilience,** the provisioning services class (class 10) groundwater management is not urgent for the sector in all the time frames. The Region should step up its efforts in monitoring, modelling and forecasting systems.

Options for regulation and maintenance of natural services (class 11) in the Tourism sector will benefit, in the short and mid-term for both ATPs B and C, from the maintenance of the rivers/valleys functions, creating recreational areas with a positive impact on Tourism attractiveness. While, in the long-term dune restoration and rehabilitation are considered the most suitable scenarios for both ATPs B and C.

The cultural services (class 12) see the preservation of ecosystem services essential for human well-being, consequently adaptative management is predominant in short and mid-term, then that the construction of seawater pools located by the sea that have been preferred only as a long-term option.

In the following figure are reported the Adaptation options for the Tourism sector analysed by symmetry. This kind of analysis allows us to highlight which are the measures of interest considering the globality of the scenarios and the options that could be chosen by the stakeholders.

ID	Name	Class number	Ratio	APT A			APT B			APT C			APT D		
				S	M	L	S	M	L	S	M	L	S	M	L
T1	Economic Policy Instruments (EPIs)	1	83%					B						D	
T19	Mainstreaming Disaster Risk Management (DRM)	7	80%								C				
T18	Drought and water conservation plans	6	75%		A			B			C			D	
T21	Fire management plans	8	73%		A										
T4	Monitoring, modelling and forecasting systems	10	72%		A			B			C			D	
T24	Pre-disaster early recovery planning	9	67%		A									D	
T14	Water restrictions, consumption cuts and grey-water recycling	4	63%								C			D	
T9	Activity and product diversification	2	55%		A			B			C			D	
T7	Adaptive management of natural habitats	12	53%								C				
T6	River rehabilitation and restoration	11	53%					B			C				
T15	Beach nourishment	5	53%					B							
T12	Tourist awareness campaigns	3	53%								C				
T11	Local circular economy	3	47%								C				
T16	Desalination	5	47%					B			C				
T5	Dune restoration and rehabilitation	11	47%					B							
T8	Ocean pools	12	47%								C				
T10	Public awareness programmes	2	45%		A			B			C			D	
T13	Local sustainable fishing	4	37%								C			D	
T23	Post-Disaster recovery funds	9	33%		A									D	
T3	Adaptation of groundwater management	10	28%		A			B			C			D	
T22	Health care delivery systems	8	27%		A										
T17	Coastal protection structures	6	25%		A			B			C			D	
T20	Using water to cope with heat waves	7	20%								C				
T2	Financial incentives to retreat from high-risk areas	1	17%					B						D	

Figure 144 - Adaptation options for the Tourism sector analysed by symmetry (adaptation objectives are identified in each option by colour: ***vulnerability reduction (red),*** *Disaster* ***Risk Reduction (blue); Social-Ecological Resilience (green);*** *Local Knowledge adaptation options (grey). Each ATP (APT A; APT B; APT C; APT D) is represented in three timeframes: S - Short term (up to 2030), M-Medium term (up to 2050), L - Long term (until 2100). Bold letters in each ATP indicate the option was available to be selected. Highlighted options*

indicate the measure was selected in each ATP and timeframe: ATP A (light blue); ATP B (light green); ATP C (Light orange) and ATP D (light purple). Space with colour: option was selected for the timeframe: Short term, Medium term, or Long term. Bold letter: option is available in the APT.

As one can see in figure 7, the most choose adaptation options have been the follows:

- for **vulnerability reduction** the *"Economic Policy Instruments"* from Financial capital class (class 1). This choice made by the stakeholders directly calls into question the economic policy choices that the regional authorities intend to implement between now and the end of the century to ensure the profitability of one of the spearheads of the island's economy.
- for **Disaster Risk Reduction** the *"Mainstreaming disaster Risk Management"* from Preparedness class (class 7). Indeed,
- for the **Social-Ecological Resilience** the *"Monitoring, modelling and forecasting systems"* from Provisioning services class (class 10). These systems are of extreme importance in order to provide timely and reliable climate information.

3.1.2 Sustainability Performance

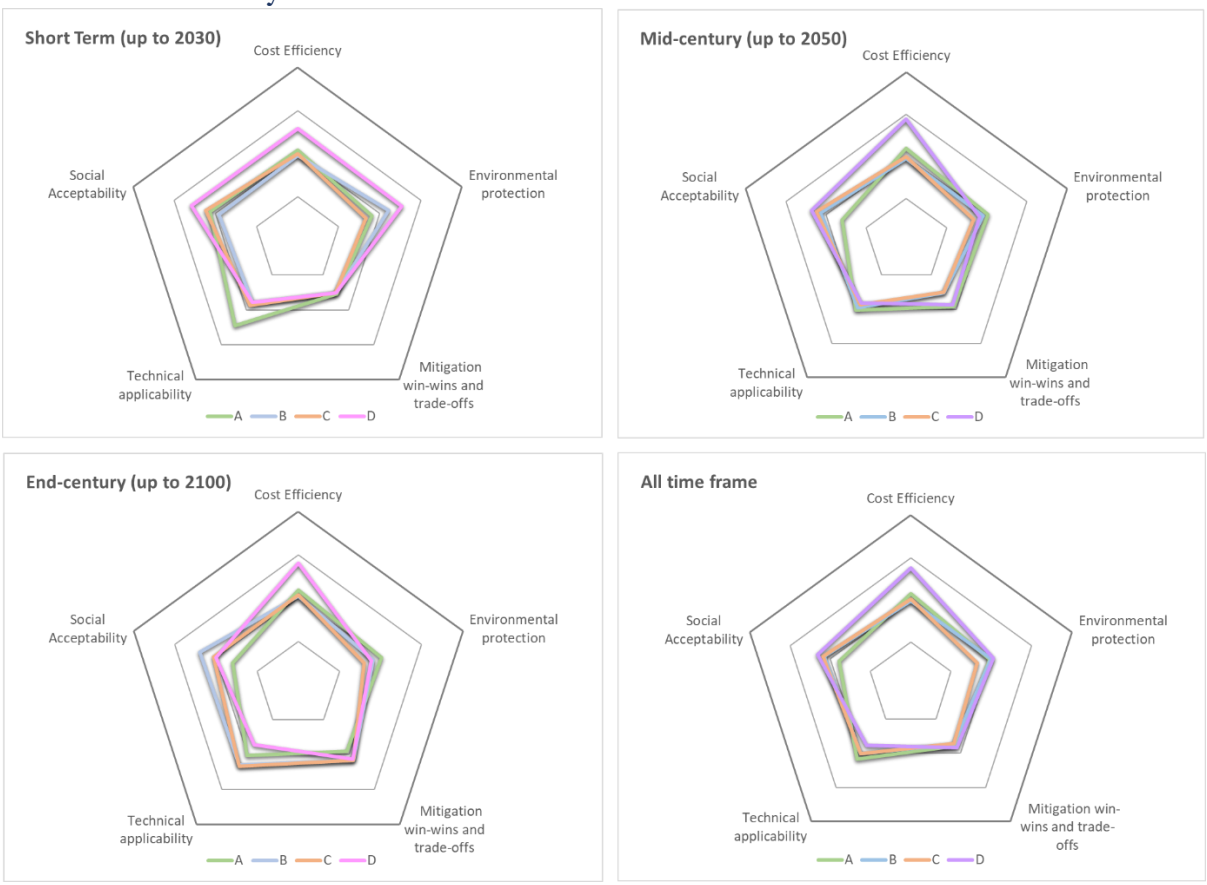

Figure 145 - Pathways evaluation for Tourism sector considering: Cost Efficiency; Environmental protection; Mitigation (GHG emissions) win-wins and trade-offs; Technical applicability; Social acceptability. The policy pathways scenarios: APT A - Minimum Intervention; APT B - Economic Capacity Expansion (ECE); APT C- Efficiency Enhancement (EE); APT D - System Restructuring (SR), for different timeframes: short, medium, and long term

The performance of the four ATP scenarios for tourism sector are considerably similar during the three timeframes considered. In general, scenarios show a high level of social acceptability and technical applicability and a medium cost efficiency and environmental protection with a low performance in mitigation win-wins and trade-offs.

The minimum intervention scenario (APT A) tends to have adaptation solutions with technical applicability at the expense of mitigation win-wins and trade-offs.

3.2 Maritime Transport

Maritime transport pathways are based on choices made by 6 expert island stakeholders.

3.2.1 Selected Adaptation Pathways

In the following tables have been reported the Adaptation options for the Maritime Transport sector analysed by class (Figure 9) and by symmetry (Figure 10).

Options are identified with an ID number, full name, and class of adaptation number.

Adaptation objectives are identified in each option by colour. The **vulnerability reduction**, highlighted in red colour, considers five pairs of adaptation options. The **Risk Reduction**, highlighted in blue colour, considers four pairs of adaptation options. **Social-Ecological Resilience**, highlighted in green colour, considers three pairs of adaptation options. Each Adaptation option have been evaluated by the stakeholders for the 4 Adaptation Pathways -ATP (APT A; APT B; APT C; APT D) in respect to the following three timeframes:

- short term (S) (up to 2030),
- medium term (M) (up to 2050),
- long term (L) (until 2100).

The bold letters in the four columns for ATPs indicate the options that were available to be selected by stakeholders.

The options highlighted with different colours (ATP A - blue); ATP B - light green; ATP C - light orange and ATP D - light purple) indicate the level of interest shown by stakeholders between the two coupled options for each pair. In the most selected measure table in each ATP it is easily identifiable both in percentage terms and in terms of colour. It should be noted that when, in the context of a measure, the space of an ATP is coloured for the three timeframes, it means that the stakeholder has considered the measure in question conveniently applicable in the short, medium or long term.

In the following figure are reported the Adaptation options for the Marine Transport sector analysed by class.

ID	Name	Class number	Ratio	APT A			APT B			APT C			APT D		
				S	M	L	S	M	L	S	M	L	S	M	L
MT2	Financial incentives to retreat from high-risk areas	1	64%					**B**						**D**	
MT1	Insurance mechanisms for ports	1	36%					**B**						**D**	
MT10	Social dialogue for training in the port sector	2	64%		**A**			**B**			**C**			**D**	
MT9	Awareness campaigns for behavioural change	2	36%		**A**			**B**			**C**			**D**	
MT12	Climate resilient economy and jobs	3	83%								**C**				
MT11	Diversification of trade using climate resilient commodities	3	17%								**C**				
MT14	Restrict development and settlement in low-lying areas	4	67%								**C**			**D**	
MT13	Refrigeration, cooling and ventilation systems	4	33%								**C**			**D**	
MT16	Increase operational speed and flexibility in ports	5	94%					**B**							
MT15	Sturdiness improvement of vessels	5	6%					**B**							
MT17	Climate proof ports and port activities	6	61%		**A**			**B**			**C**			**D**	
MT18	Consider expansion/retreat of ports in urban planning	6	39%		**A**			**B**			**C**			**D**	
MT20	Early Warning Systems (EWS) and climate change monitoring	7	61%								**C**				
MT19	Reinforcement of inspection, repair and maintenance of	7	39%								**C**				
MT21	Inteligent Transport Systems (ITS)	8	94%		**A**										
MT22	Prepare for service delays or cancellations	8	6%		**A**										
MT23	Backup routes and infrastructures during extreme weather	9	69%		**A**									**D**	
MT24	Post-Disaster recovery funds	9	31%		**A**									**D**	
MT4	Combined protection and wave energy infrastructures	10	60%		**A**			**B**			**C**			**D**	
MT3	Marine life friendly coastal protection structures	10	40%		**A**			**B**			**C**			**D**	
MT6	Coastal protection structures	11	53%					**B**			**C**				
MT5	Hybrid and full electric ship propulsion	11	47%					**B**			**C**				
MT7	Integrate ports in urban tissue	12	72%								**C**				
MT8	Ocean pools	12	28%								**C**				

Figure 146 - Adaptation options for the Maritime Transport sector analysed by class (adaptation objectives are identified in each option by colour: ***vulnerability reduction (red),*** *Disaster* ***Risk Reduction (blue); Social-Ecological Resilience (green);*** *Local Knowledge adaptation options (grey). Each ATP (APT A; APT B; APT C; APT D) is represented in three timeframes: S - Short term (up to 2030), M- Medium term (up to 2050), L - Long term (until 2100). Bold letters in each ATP indicate the option was available to be selected. Highlighted options indicate the measure was selected in each ATP and timeframe: ATP A (light blue); ATP B (light green); ATP C (Light orange) and ATP D (light purple). Space with colour: option was selected for the timeframe: Short term, Medium term, or Long term. Bold letter: option is available in the APT.*

The Sardinia Maritime Transport sector adaptation pathways are characterized by a no significant heterogeneity across the four potential adaptation policy trajectories (APTs) which they built upon.

Under APT B and D scenarios, the financial capital class (class 1) measures that were selected to address **vulnerability reduction**, indicate that the region is initially centred on the Financial incentives to retreat from high-risk areas and less on Insurance mechanisms for ports especially in the case of System Restructuring with high investment and high commitment.

To adapt via Human Capital (class 2), Social dialogue for training in the port sector has been considered the most suitable option in opposition to awareness campaigns for behavioural change. Public awareness can be appropriate only in case of short-term approaches.

For the Social Capital class (class 3) the stakeholders chosen to shift the economy and jobs towards a more climate resilient society in all time frames. Same trend has been highlighted in the classes Natural Capital (class 4) and Physical Capital (class 5), where for all time frames the stakeholders considered as most suitable only one of the two proposed options, respectively restrict development and settlement in low-lying areas for class 4 and Increase operational speed and flexibility in ports for class 5.

For **Disaster Risk Reduction**, to manage long term risk, for ATP A the stakeholder decision has been oriented on climate-proof ports and port activities, different than ATPs B,C and D where in the middle and long-term the expansion/retreat of ports in urban planning is considered.

Early Warning Systems and climate change monitoring, for Efficiency Enhancement ATP, are suitable in the middle and long-terms. In opposition, in the short term, to the aim to adapt monitoring to a new climate context a continuous reinforcement of inspection, repair and maintenance of infrastructures has been considered more appropriate.

Intelligent Transport Systems are the technologies that with low investment can be applied in short, middle and long-term in Response scenarios (class 8).

As far as the post disaster recovery and rehabilitation (class 9) are concerned, the Post-Disaster recovery funds are options to be taken into account in the short-term, while in the middle and long-term, in order to create a post disaster response backup, routes and infrastructures during extreme weather are considered to be more appropriate.

In **Social-Ecological Resilience**, for the Provisioning services scenario (class 10) the measure more selected, where the commitment to policy is low (Minimum Intervention – ATP A), has been the implementation financial incentives to retreat from high-risk areas, however also the option that include the construction of marine life friendly coastal protection structures was chosen to be a type of intervention to be carried out in the middle and long-terms.

The Regulating and Maintenance Services scenario (class 11) it divided the opinion of the stakeholders they preferred the Coastal protection structures to be implemented in short and middle-term and the use Hybrid and full electric ship propulsion for the long-term.

For the Cultural services scenarios (class 12), with a medium investment and commitment, the integration of ports into the urban tissue and the opening port areas to other activities have been considered suitable for all timeframes, at the expense of the construction of ocean pools.

In the following figure are reported the Adaptation options for the Maritime Transport sector analysed by symmetry. This kind of analysis allows us to highlight which are the measures of interest considering the globality of the scenarios and the options that could be chosen by the stakeholders.

ID	Name	Class number	Ratio	APT A			APT B			APT C			APT D		
				S	M	L	S	M	L	S	M	L	S	M	L
MT21	Inteligent Transport Systems (ITS)	8	94%		A										
MT16	Increase operational speed and flexibility in ports	5	94%					B							
MT12	Climate resilient economy and jobs	3	83%								C				
MT7	Integrate ports in urban tissue	12	72%								C				
MT23	Backup routes and infrastructures during extreme weather	9	69%		A									D	
MT14	Restrict development and settlement in low-lying areas	4	67%								C			D	
MT10	Social dialogue for training in the port sector	2	64%		A			B			C			D	
MT2	Financial incentives to retreat from high-risk areas	1	64%					B						D	
MT20	Early Warning Systems (EWS) and climate change monitoring	7	61%								C				
MT17	Climate proof ports and port activities	6	61%		A			B			C			D	
MT4	Combined protection and wave energy infrastructures	10	60%		A			B			C			D	
MT6	Coastal protection structures	11	53%					B			C				
MT5	Hybrid and full electric ship propulsion	11	47%					B			C				
MT3	Marine life friendly coastal protection structures	10	40%		A			B			C			D	
MT18	Consider expansion/retreat of ports in urban planning	6	39%								C				
MT19	Reinforcement of inspection, repair and maintenance of infrastructures	7	39%		A			B			C			D	
MT1	Insurance mechanisms for ports	1	36%		A			B			C			D	
MT9	Awareness campaigns for behavioural change	2	36%					B						D	
MT13	Refrigeration, cooling and ventilation systems	4	33%								C			D	
MT24	Post-Disaster recovery funds	9	31%		A									D	
MT8	Ocean pools	12	28%								C				
MT11	Diversification of trade using climate resilient commodities	3	17%								C				
MT15	Sturdiness improvement of vessels	5	6%		A										
MT22	Prepare for service delays or cancellations	8	6%					B							

Figure 147 - Adaptation options for the Maritime Transport sector analysed by symmetry (adaptation objectives are identified in each option by colour: ***vulnerability reduction (red),*** *Disaster* ***Risk Reduction (blue); Social-Ecological Resilience (green);*** *Local Knowledge adaptation options (grey). Each ATP (APT A; APT B; APT C; APT D) is represented in three timeframes: S - Short term (up to 2030), M- Medium term (up to 2050), L - Long term (until 2100). Bold letters in each ATP indicate the option was available to be selected. Highlighted options indicate the measure was selected in each ATP and timeframe: ATP A (light blue); ATP B (light green); ATP C (Light orange) and ATP D (light purple). Space with colour: option was selected for the timeframe: Short term, Medium term, or Long term. Bold letter: option is available in the APT.*

As one can see in figure 10, the most chosen adaptation options have been as follows:

- for **vulnerability reduction** the *"Increase operational speed and flexibility in ports"* from Physical capital class (class 5);
- for **Disaster Risk Reduction** the *"Intelligent Transport Systems"* from Response class (class 8).
- for the **Social-Ecological Resilience** the *"Integrate ports in urban tissue"* from Cultural services class (class 12).

Intelligent Transport Systems together with increasing operational speed and flexibility in ports could represent an opportunity for adaptation to climate change in the shipping sector. In fact, the possibility of choosing between numerous methods of transport would guide users towards a conscious choice regarding the "intelligent" use of transport networks, while a management of maritime traffic in the port, both from a logistical and bureaucratic point of view, would help to relaunch the competitiveness of the Sardinian port system as well as to attract investments that will make it more resilient to climate change.

3.2.2 Sustainability Performance

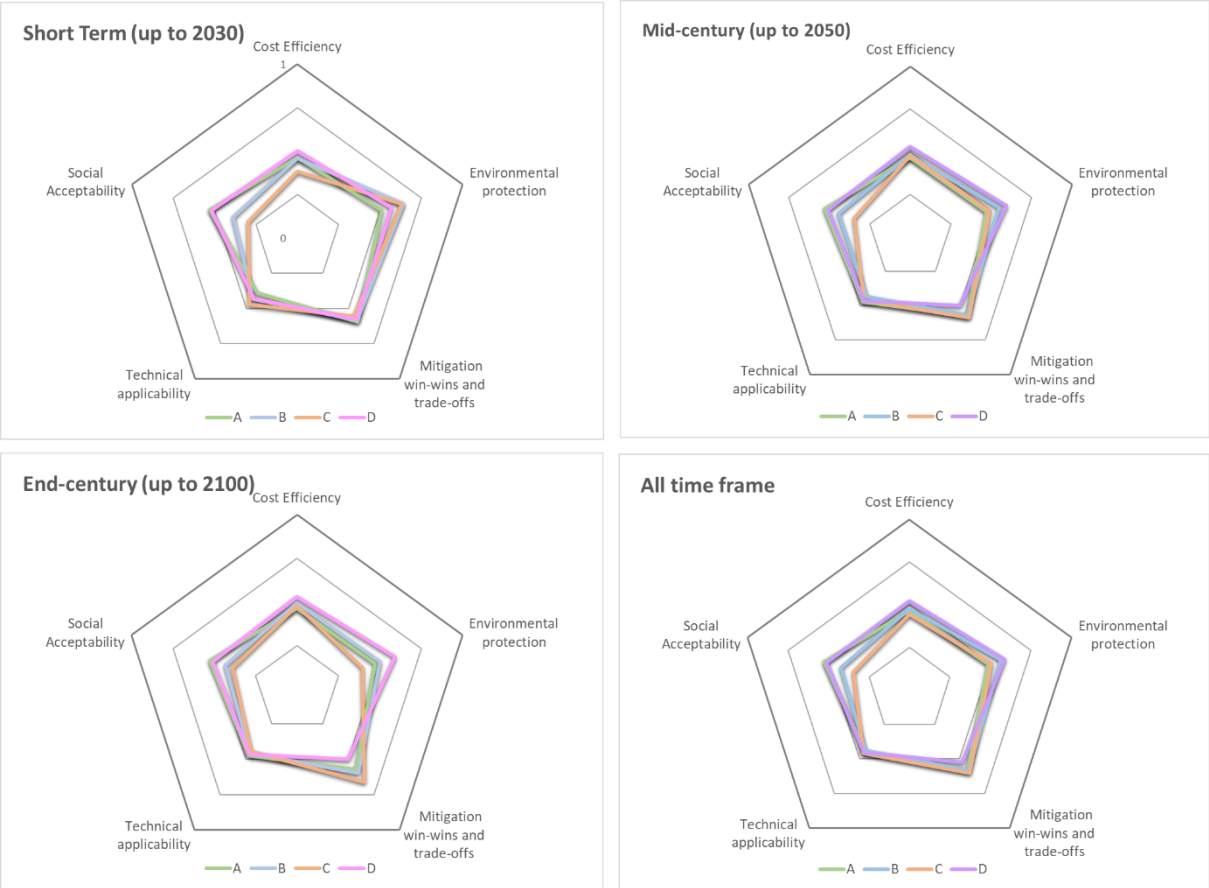

Figure 148 - Pathways evaluation for Maritime Transport sector considering: Cost Efficiency; Environmental protection; Mitigation (GHG emissions) win-wins and trade-offs; Technical applicability; Social acceptability. The policy pathways scenarios: APT A - Minimum Intervention; APT B - Economic Capacity Expansion (ECE); APT C- Efficiency Enhancement (EE); APT D - System Restructuring (SR), for different timeframes: short, medium, long term

All four pathways in the Maritime Transport sector have a similar evaluation across all timeframes. In the Energy sector, the analysis showed no differences in the scoring of criteria as a reflection of the different ATP narratives.

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3.3 Energy

Energy pathways are based on choices made by 7 expert island stakeholders.

3.3.1 Selected Adaptation Pathways

In the following figures have been reported the Adaptation options for the Energy sector analysed by class (Figure 12) and by symmetry (Figure 13).

Options are identified with an ID number, full name, and class of adaptation number.

Adaptation objectives are identified in each option by colour. The **vulnerability reduction**, highlighted in red colour, considers five pairs of adaptation options. The **Risk Reduction**, highlighted in blue colour, considers four pairs of adaptation options. **Social-Ecological Resilience**, highlighted in green colour, considers three pairs of adaptation options. Each Adaptation option have been evaluated by the stakeholders for the 4 Adaptation Pathways -ATP (APT A; APT B; APT C; APT D) in respect to the following three timeframes:

- short term (S) (up to 2030),
- medium term (M) (up to 2050),
- long term (L) (until 2100).

The bold letters in the four columns for ATPs indicate the options that were available to be selected by stakeholders.

The options highlighted with different colours (ATP A - blue); ATP B - light green; ATP C - light orange and ATP D - light purple) indicate the level of interest shown by stakeholders between the two coupled options for each pair. In the most selected measure table in each ATP it is easily identifiable both in percentage terms and in terms of colour. It should be noted that when, in the context of a measure, the space of an ATP is coloured for the three timeframes, it means that the stakeholder has considered the measure in question conveniently applicable in the short, medium or long term.

In the following figure are reported the Adaptation options for the Energy sector analysed by class.

ID	Name	Class number	Ratio	APT A			APT B			APT C			APT D		
				S	M	L	S	M	L	S	M	L	S	M	L
E1	Financial support for buildings with low energy needs	1	71%					B						D	
E2	Financial support for smart control of energy in houses and	1	29%					B						D	
E9	Green jobs and businesses	2	69%		A			B			C			D	
E10	Public information service on climate action	2	31%		A			B			C			D	
E11	Small scale production and consumption (prosumers)	3	62%								C				
E12	Risk reporting platform	3	38%								C				
E13	Energy storage systems	4	64%								C			D	
E14	Collection and storage of forest fuel loads	4	36%								C			D	
E16	Demand Side Mangement (DSM) of Energy	5	67%					B							
E15	SeaWater Air Conditioning (SWAC).	5	33%					B							
E17	Review building codes of the energy infrastructure	6	51%		A			B			C			D	
E18	Upgrade evaporative cooling systems	6	49%		A			B			C			D	
E20	Grid reliability	7	67%								C				
E19	Early Warning Systems (EWS)	7	33%								C				
E21	Study and develop energy grid connections	8	71%		A										
E22	Energy-independent facilities (generators)	8	29%		A										
E23	Energy recovery microgrids	9	57%		A									D	
E24	Local recovery energy outage capacity	9	43%		A									D	
E3	Energy efficiency in urban water management	10	50%		A			B			C			D	
E4	Underground tubes and piping in urban planning	10	50%		A			B			C			D	
E6	Urban green corridors	11	55%					B			C				
E5	Biomass power from household waste	11	45%					B			C				
E7	Educational garden plots	12	52%								C				
E8	Heated pools with waste heat from power plants	12	48%								C				

Figure 149 - Adaptation options for the Energy sector analysed by class (adaptation objectives are identified in each option by colour: ***vulnerability reduction (red),*** *Disaster* ***Risk Reduction (blue); Social-Ecological Resilience (green);*** *Local Knowledge adaptation options (grey). Each ATP (APT A; APT B; APT C; APT D) is represented in three timeframes: S - Short term (up to 2030), M-Medium term (up to 2050), L - Long term (until 2100). Bold letters in each ATP indicate the option was available to be selected. Highlighted options indicate the measure was selected in each ATP and timeframe: ATP A (light blue); ATP B (light green); ATP C (Light orange) and ATP D (light purple). Space with colour: option was selected for the timeframe: Short term, Medium term, or Long term. Bold letter: option is available in the APT.*

Under APT B and D scenarios, the financial capital class (class 1) measures that were selected to address **vulnerability reduction**, indicate that the region is centred on the Financial support for buildings with low energy needs and less on financial support for smart control of energy in houses and buildings.

To adapt via Human Capital (class 2), the promotion of green jobs and businesses via trainings dedicated to people to foster and support the development of new green businesses has been considered a valid option for all timeframes on ATPs B., C and D. With reference to the situation of Minimum Intervention with low investment and low commitment (ATP A) the public information service on climate action has been considered a valuable means in the short and middle-terms to provide the general public with information about adaptation and mitigation options available for their activities and businesses. While the promotion of green jobs and businesses are of interest only in the long-term.

For the Social Capital class (class 3) the 63% stakeholders chosen Small scale production and consumption fort the short and middle term. In opposition, the implementation of a risk reporting platform can be useful in the long term.

Similar trends have been highlighted in the classes Natural Capital (class 4) and Physical Capital (class 5). In Natural Capital class the 64% of the stakeholders selected the development of energy storage systems in all time frames for ATP C, while for ATP D, in the middle term the collection and storage of forest fuel loads has been considered suitable by the 33% of the stakeholders. In Physical Capital class the 67% of the stakeholders prefer to invest on Demand Side Management (DSM) of Energy for all time frames instead of implementation of Sea Water Air Conditioning systems.

For **Disaster Risk Reduction**, to manage long term risk, the results of the stakeholders' choices were variable. Considering a hypothesis of Minimum Intervention with low investment and low commitment (ATP A) review energy infrastructure building code has been considered the most suitable option of all timeframes. On the contrary in the case of a complete system overhaul with high investment and high commitment (ATP D) the most suitable option has been the upgrade of evaporative cooling systems. As concern the ATP B and C the results shows the same trend for the two adaptation pathways, in the short term the most suitable option has been the upgrade of evaporative cooling systems, while in the middle and long-term the review energy infrastructure building code has been considered the more suitable.

For the Preparedness scenarios the 33% of the stakeholders prefer the development of Early Warning Systems in the short-term, though the 67% of the stakeholders consider the grid reliability a good option for the middle and long-term.

for ATP A the stakeholder decision has been oriented on climate proof ports and port activities, different than ATPs B, C and D where in the middle and long-term the expansion/retreat of ports in urban planning is considered.

The study and develop energy grid connections stay the most preferred option to be applied in short, middle and long-term in Response scenarios (class 8).

With regards to the post disaster recovery and rehabilitation (class 9) the energy recovery microgrids remain options to be taken into account in the short-term, while in the middle and long-term to creates a post disaster response the local recovery energy outage capacity are considered to be more appropriate.

In **Social-Ecological Resilience**, for the Provisioning services scenario (class 10) both measures have been considered interesting. Energy efficiency in urban water management has been selected as suitable for middle and long-term interventions and underground tubes and piping in urban planning has been

considered a good option in the short-term for ATPs A, B C. On the contrary, in case of high investment and high commitment the two options have been reversed with respect to the choices made for the other ATPs.

The Regulating and Maintenance Services scenario (class 11) it divided the opinion of the stakeholders they preferred urban green corridors in the short term for ATP C and in the middle and long-term for ATP B. Similar but opposite trend has been highlighted for the biomass power from household waste.

For the Cultural services scenarios (class 12), with a medium investment and commitment, the construction of educational garden plots has been considered interesting as short term option, while heated pools with waste heat from power plants have been considered feasible only on a middle and long-term hypothesis.

In the following figure are reported the Adaptation options for the Energy sector analysed by symmetry. This kind of analysis allows us to highlight which are the measures of interest considering the globality of the scenarios and the options that could be chosen by the stakeholders.

ID	Name	Class number	Ratio	APT A			APT B			APT C			APT D		
				S	M	L	S	M	L	S	M	L	S	M	L
E21	Study and develop energy grid connections	8	71%		A										
E1	Financial support for buildings with low energy needs	1	71%					B						D	
E9	Green jobs and businesses	2	69%		A			B			C			D	
E20	Grid reliability	7	67%								C				
E16	Demand Side Mangement (DSM) of Energy	5	67%					B							
E13	Energy storage systems	4	64%								C			D	
E11	Small scale production and consumption (prosumers)	3	62%								C				
E23	Energy recovery microgrids	9	57%		A									D	
E6	Urban green corridors	11	55%					B			C				
E7	Educational garden plots	12	52%								C				
E17	Review building codes of the energy infrastructure	6	51%		A			B			C			D	
E3	Energy efficiency in urban water management	10	50%		A			B			C			D	
E4	Underground tubes and piping in urban planning	10	50%		A			B			C			D	
E18	Upgrade evaporative cooling systems	6	49%		A			B			C			D	
E8	Heated pools with waste heat from power plants	12	48%								C				
E5	Biomass power from household waste	11	45%					B			C				
E24	Local recovery energy outage capacity	9	43%		A									D	
E12	Risk reporting platform	3	38%								C				
E14	Collection and storage of forest fuel loads	4	36%								C			D	
E15	SeaWater Air Conditioning (SWAC).	5	33%					B							
E19	Early Warning Systems (EWS)	7	33%								C				
E10	Public information service on climate action	2	31%		A			B			C			D	
E2	Financial support for smart control of energy in houses and	1	29%					B						D	
E22	Energy-independent facilities (generators)	8	29%		A										

Figure 150 - Adaptation options for the Energy sector analysed by symmetry (adaptation objectives are identified in each option by colour: ***vulnerability reduction (red),*** *Disaster* ***Risk Reduction (blue); Social-Ecological Resilience (green);*** *Local Knowledge adaptation options (grey). Each ATP (APT A; APT B; APT C; APT D) is represented in three timeframes: S - Short term (up to 2030), M-Medium term (up to 2050), L - Long term (until 2100). Bold letters in each ATP indicate the option was available to be selected. Highlighted options indicate the measure was selected in each ATP and timeframe: ATP A (light blue); ATP B (light green); ATP C (Light orange) and ATP D (light purple). Space with colour: option was selected for the timeframe: Short term, Medium term, or Long term. Bold letter: option is available in the APT.*

As one can see in figure 13, the most choose adaptation options have been the follows:

- for **vulnerability reduction** the *"Financial support for buildings with low energy needs"* from Financial Capital class (class 1);
- for **Disaster Risk Reduction** the *"Study and develop energy grid connections"* from Response class (class 8);
- for the **Social-Ecological Resilience** the *"Urban green corridors"* from Regulating and Maintenance Services class (class 11) at the same level of interest with *"Educational garden plots"* from Cultural services class (class 12).

In the one hand, the study and development of connections within the electricity network (risk management) would represent an opportunity to make improvements to the grid to increase the coverage and quality of the electricity distribution services. In the other hand, the financial support for the construction of buildings with low energy requirements (reduction of vulnerability), in which stakeholders' express interest in monetary incentive measures to encourage the dissemination of technologies to ensure the energy efficiency of buildings.

3.3.2 Sustainability Performance

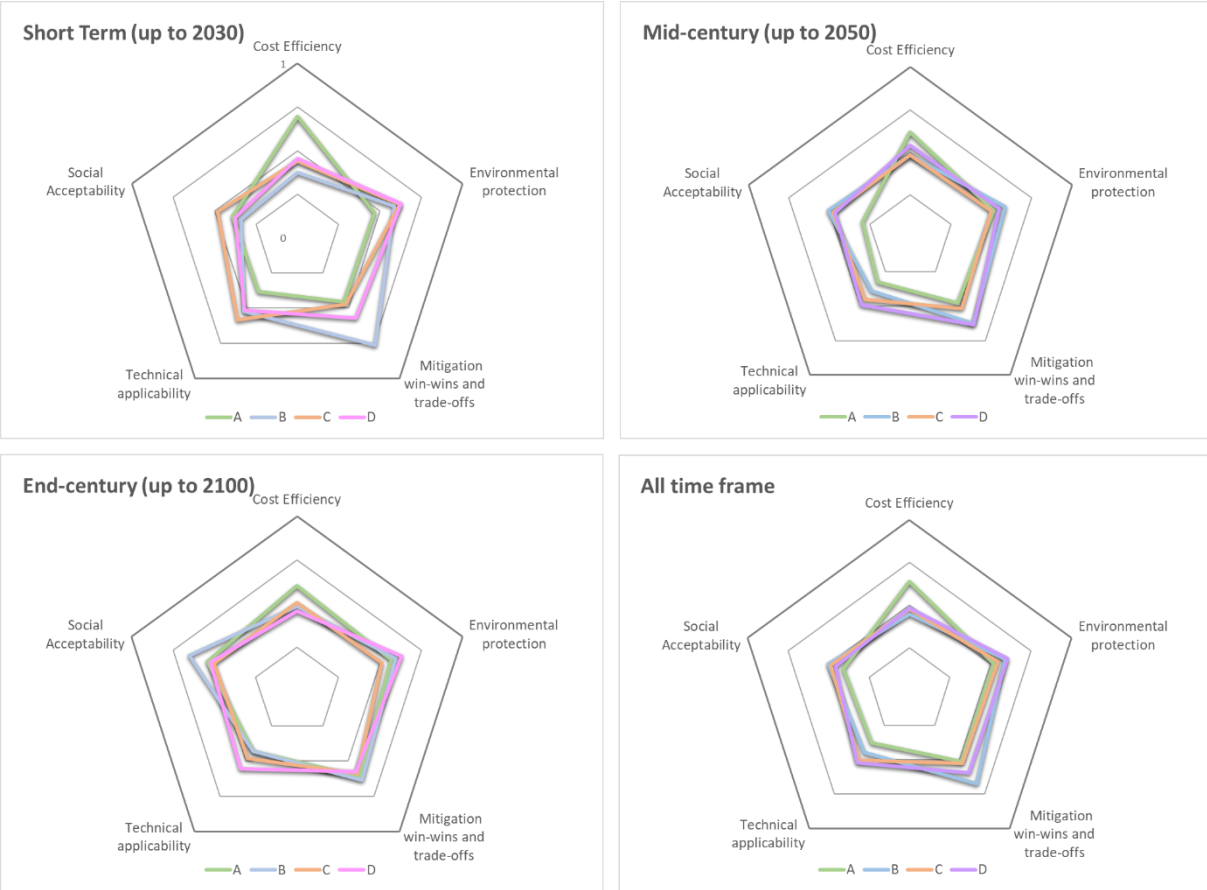

Figure 151 - Pathways evaluation for Energy sector considering: Cost Efficiency; Environmental protection; Mitigation (GHG emissions) win-wins and trade-offs; Technical applicability; Social acceptability. The policy pathways scenarios: APT A - Minimum Intervention; APT B - Economic Capacity Expansion (ECE); APT C- Efficiency Enhancement (EE); APT D - System Restructuring (SR), for different timeframes: short, medium, long term

All four adaptation pathways for the Sardinia Energy sector reveal a different structure in terms of their sustainability performance for the short term and mid-century graph.

3.4 Aquaculture

Aquaculture pathways are based on choices made by 6 expert island stakeholders.

3.4.1 Selected Adaptation Pathways

In the following figures have been reported the Adaptation options for the Aquaculture sector analysed by class (Figure 15) and by symmetry (Figure 16).

Options are identified with an ID number, full name, and class of adaptation number.

Adaptation objectives are identified in each option by colour. The **vulnerability reduction**, highlighted in red colour, considers five pairs of adaptation options. The **Risk Reduction**, highlighted in blue colour, considers four pairs of adaptation options. **Social-Ecological Resilience**, highlighted in green colour, considers three pairs of adaptation options. Each Adaptation option have been evaluated by the stakeholders for the 4 Adaptation Pathways -ATP (APT A; APT B; APT C; APT D) in respect to the following three timeframes:

- short term (S) (up to 2030),
- medium term (M) (up to 2050),
- long term (L) (until 2100).

The bold letters in the four columns for ATPs indicate the options that were available to be selected by stakeholders.

The options highlighted with different colours (ATP A - blue); ATP B - light green; ATP C - light orange and ATP D - light purple) indicate the level of interest shown by stakeholders between the two coupled options for each pair. In the most selected measure table in each ATP it is easily identifiable both in percentage terms and in terms of colour. It should be noted that when, in the context of a measure, the space of an ATP is coloured for the three timeframes, it means that the stakeholder has considered the measure in question conveniently applicable in the short, medium or long term.

In the following figure are reported the Adaptation options for the Aquaculture sector analysed by class.

ID	Name	Class number	Ratio	APT A			APT B			APT C			APT D		
				S	M	L	S	M	L	S	M	L	S	M	L
A2	Tax benefits and subsidies	1	67%					**B**						**D**	
A1	Financial schemes, insurance and loans	1	33%					**B**						**D**	
A9	Awareness campaigns for behavioural change	2	57%		**A**			**B**			**C**			**D**	
A10	Efficient feed management	2	43%		**A**			**B**			**C**			**D**	
A11	Addressing consumer and environmental concerns at the local	3	72%								**C**				
A12	Promote cooperation to local consumption	3	28%								**C**				
A13	Integrated multi-trophic aquaculture (IMTA)	4	89%								**C**			**D**	
A14	Short-cycle aquaculture	4	11%								**C**			**D**	
A15	Recirculation Aquaculture Systems (RAS)	5	67%					**B**							
A16	Submersible cages	5	33%					**B**							
A17	Climate proof aquaculture activities	6	51%		**A**			**B**			**C**			**D**	
A18	Risk-based zoning and site selection	6	49%		**A**			**B**			**C**			**D**	
A20	Environmental monitoring and Early Warning Systems (EWS)	7	89%								**C**				
A19	Disease prevention methods	7	11%								**C**				
A21	Mainstreaming Disaster Risk Management (DRM)	8	61%		**A**										
A22	Contingency for emergency management, early	8	39%		**A**										
A23	Recovery Post-Disaster plans	9	53%		**A**									**D**	
A24	Recovery Post-Disaster funds	9	47%		**A**									**D**	
A4	Species selection	10	65%		**A**			**B**			**C**			**D**	
A3	Feed production	10	35%		**A**			**B**			**C**			**D**	
A6	Best Management Practices	11	75%					**B**			**C**				
A5	Selective breeding	11	25%					**B**			**C**				
A7	Create educational visits	12	56%								**C**				
A8	Promote aquaculture cuisine	12	44%								**C**				

Figure 152 - Adaptation options for the Aquaculture sector analysed by class (adaptation objectives are identified in each option by colour: ***vulnerability reduction (red),*** *Disaster* ***Risk Reduction (blue); Social-Ecological Resilience (green);*** *Local Knowledge*

adaptation options (grey). Each ATP (APT A; APT B; APT C; APT D) is represented in three timeframes: S - Short term (up to 2030), M-Medium term (up to 2050), L - Long term (until 2100). Bold letters in each ATP indicate the option was available to be selected. Highlighted options indicate the measure was selected in each ATP and timeframe: ATP A (light blue); ATP B (light green); ATP C (Light orange) and ATP D (light purple). Space with colour: option was selected for the timeframe: Short term, Medium term, or Long term. Bold letter: option is available in the APT.

Financial schemes, insurance and loans - Tax benefits and subsidies

Under APT B and D scenarios, the Financial Capital class (class 1) the measures that were selected to address **vulnerability reduction**, indicate that the 33% of the stakeholders initially leaned towards the financial schemes, insurance and loans, while the 67% were oriented for all timeframe to proposal of tax benefits and subsidies.

To adapt via Human Capital (class 2), in general, the awareness campaigns for behavioural change are considered suitable for the short and middle term. The development of efficient feed management practices is considered useful to reduce the cost of production and increase environmental standards in short, middle and long term based on the type of APT under consideration. This variability between the preference of stakeholders represent very interesting result because demonstrate that making their choices they carefully considered the different scenarios proposed by each ATP.

For the Social Capital class (class 3), in general, the stakeholders chosen the option of addressing consumer and environmental concerns at the local level in all time frames.

Same trend has been highlighted in the classes Natural Capital (class 4) and Physical Capital (class 5), where for all time frames the stakeholders considered as most suitable only one of the two proposed options, respectively the use of integrated multi-trophic aquaculture for class 4 and the recirculation aquaculture systems for class 5.

For **Disaster Risk Reduction**, to manage long term risk (class 6), for ATP A the stakeholder decision has been oriented on climate proof aquaculture activities in the middle term and risk-based zoning and site selection in the short and long-term. Different than ATPs B, C and D where the trend is completely reversed.

For the Preparedness class (class 7) the 89% of the stakeholders chosen Environmental monitoring and Early Warning Systems for all timeframes.

Contingency for emergency management, early harvest and/or relocation can be applied in short and Mainstreaming Disaster Risk Management have been considered for the middle and long-term in Response scenarios (class 8).

As concern the post disaster recovery and rehabilitation (class 9) the rrecovery Post-Disaster plans and funds the interest of the stakeholders is divided in a diametrically opposite way for the two ATPs A e D. This result is very interesting as it demonstrates how the stakeholders identified with the different adaptation paths proposed.

In **Social-Ecological Resilience**, for the Provisioning services scenario (class 10) the measure more selected, where the species selection and in general is to be considered replicable for all time frames of APT A, C and D. Only for ATP B the second option proposed, feed production was deemed useful especially in middle and long-term.

The Regulating and Maintenance Services scenario (class 11) it divided the opinion of the stakeholders they preferred the Best Management Practices for all timeframes

For the Cultural services scenarios (class 12), with a medium investment and commitment, the creation of educational visits has been considered suitable for all timeframes in the 55% of the cases and the promotion of aquaculture cuisine has been considered an interesting option as a middle and long-term approach in the 44% of the cases.

In the following figure are reported the Adaptation options for the Aquaculture sector analysed by symmetry. This kind of analysis allows us to highlight which are the measures of interest considering the globality of the scenarios and the options that could be chosen by the stakeholders.

ID	Name	Class number	Ratio	APT A			APT B			APT C			APT D		
				S	M	L	S	M	L	S	M	L	S	M	L
A20	Environmental monitoring and Early Warning Systems (EWS)	7	89%					B						D	
A13	Integrated multi-trophic aquaculture (IMTA)	4	89%					B						D	
A6	Best Management Practices	11	75%		A			B			C			D	
A11	Addressing consumer and environmental concerns at the local	3	72%		A			B			C			D	
A15	Recirculation Aquaculture Systems (RAS)	5	67%								C				
A2	Tax benefits and subsidies	1	67%								C				
A4	Species selection	10	65%								C			D	
A21	Mainstreaming Disaster Risk Management (DRM)	8	61%								C			D	
A9	Awareness campaigns for behavioural change	2	57%					B							
A7	Create educational visits	12	56%					B							
A23	Recovery Post-Disaster plans	9	53%		A			B			C			D	
A17	Climate proof aquaculture activities	6	51%		A			B			C			D	
A18	Risk-based zoning and site selection	6	49%								C				
A24	Recovery Post-Disaster funds	9	47%								C				
A8	Promote aquaculture cuisine	12	44%		A										
A10	Efficient feed management	2	43%		A										
A22	Contingency for emergency management, early	8	39%		A									D	
A3	Feed production	10	35%		A									D	
A1	Financial schemes, insurance and loans	1	33%		A			B			C			D	
A16	Submersible cages	5	33%		A			B			C			D	
A12	Promote cooperation to local consumption	3	28%					B			C				
A5	Selective breeding	11	25%					B			C				
A14	Short-cycle aquaculture	4	11%								C				
A19	Disease prevention methods	7	11%								C				

Figure 153 - Adaptation options for the Aquaculture sector analysed by symmetry (adaptation objectives are identified in each option by colour: ***vulnerability reduction (red),*** *Disaster* ***Risk Reduction (blue); Social-Ecological Resilience (green);*** *Local Knowledge adaptation options (grey). Each ATP (APT A; APT B; APT C; APT D) is represented in three timeframes: S - Short term (up to 2030), M-Medium term (up to 2050), L - Long term (until 2100). Bold letters in each ATP indicate the option was available to be selected. Highlighted options indicate the measure was selected in each ATP and timeframe: ATP A (light blue); ATP B (light green); ATP C (Light orange) and ATP D (light purple). Space with colour: option was selected for the timeframe: Short term, Medium term, or Long term. Bold letter: option is available in the APT.*

As one can see in figure 10, the most chosen adaptation options have been as follows:

- for **vulnerability reduction** the *"Integrated multi-trophic aquaculture"* from Natural capital class (class 4);
- for **Disaster Risk Reduction** the *"Environmental monitoring and Early Warning Systems"* from Preparedness class (class 7);
- for the **Social-Ecological Resilience** the *"Best Management Practices"* from Regulating and Maintenance Services (class 11).

Environmental monitoring and early warning systems are considered in the short, medium and long term the optimal solution in order to prevent and reduce the risk of disaster.

Integrated Multi-Trophic Aquaculture, on a par with the previous measure, could represent the opportunity to ensure greater productivity and at the same time reduce the environmental impact of crops, through a transition from monoculture to polyculture in a perspective of circular economy.

This type of aquaculture, in which waste from one production process is reintroduced into the production system as raw materials for another production process, offers the double advantage of reducing wastewater and producing additional biomass.

3.4.2 Sustainability Performance

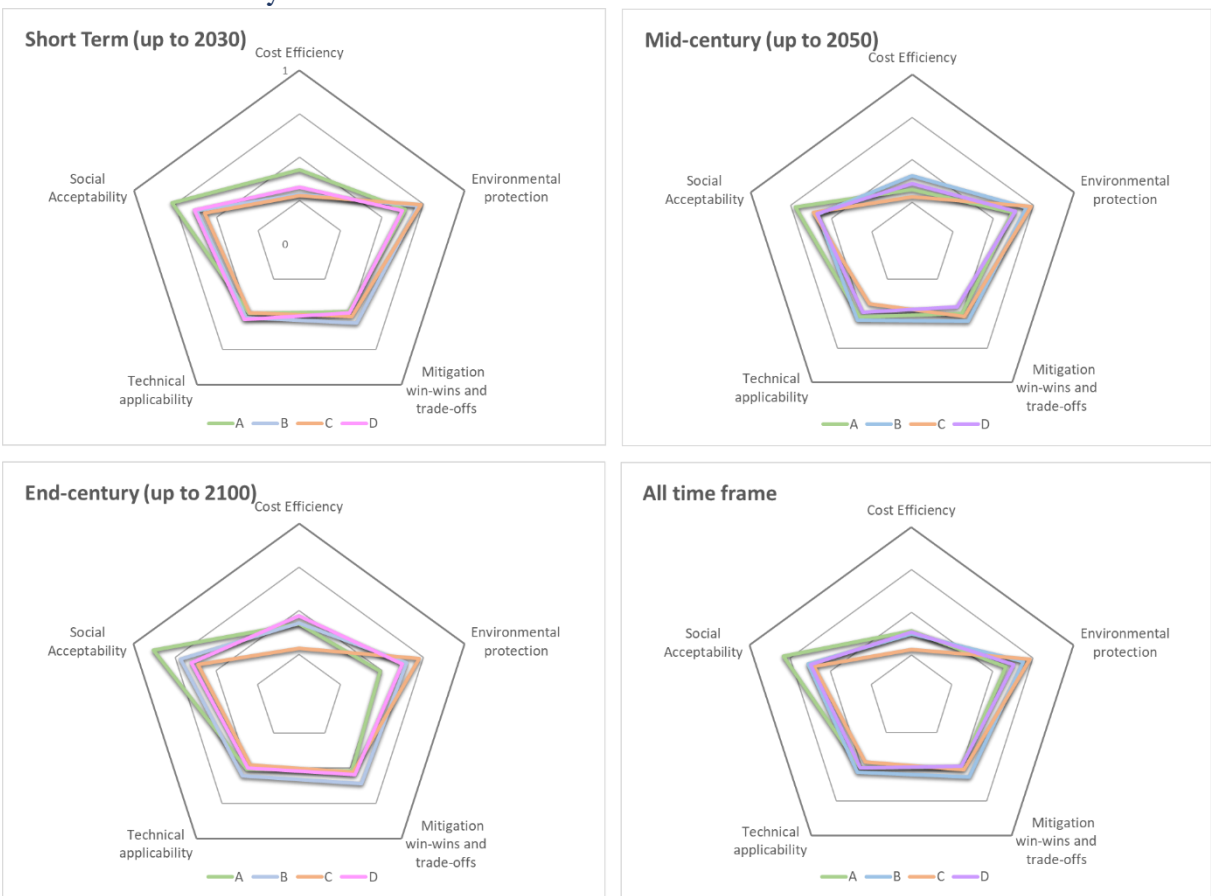

Figure 154 - Pathways evaluation for Aquaculture sector considering: Cost Efficiency; Environmental protection; Mitigation (GHG emissions) win-wins and trade-offs; Technical applicability; Social acceptability. The policy pathways scenarios: APT A - Minimum Intervention; APT B - Economic Capacity Expansion (ECE); APT C- Efficiency Enhancement (EE); APT D - System Restructuring (SR), for different timeframes: short, medium, long term

All four adaptation pathways for the Sardinian Aquaculture sector up to 2100 reveal a similar structure in terms of their sustainability performance.

4 Webinars

4.1 1st Webinar held the 3rd of November 2020

4.1.1 Objectives

The objectives of the first webinar were:

1. to present a brief introduction to the SOCLIMPACT project (Blues economy sectors scope, models involved, major limitations and the expected results of the Project for all Islands);
2. to present the results of Socioeconomic Impacts of Climate Change Scenarios obtained with the GEM-E3-ISL model;
3. to describe the way to access the background material collected and shared with the stakeholders of each sector to support their decisions;
4. to introduce the Online Survey Tool: objectives, concepts and guidance on the design of Adaptation pathways
5. to present for the Online Survey Tool for blue economy sectors (Tourism, Maritime Transport, Energy, Aquaculture) for Sardinia:
    - the adaptation options up to 2030, 2050 and until the end of the century;
    - and how to fill in and submit the Online Survey Tool;
    - expected results;
    - discussion and questions from participants.

In particular, as concern the Online Survey Tool, in order to face the difficulties related to the understanding of the English language, which the stakeholders could have encountered, we decided to translate the questionnaires into Italian so that during the compilation of the survey they also had a reference in their mother tongue.

The webinar was held in Italian language and was carried out online with the zoom platform.

During the ten days after the webinar, the stakeholders have been be supported to ensure a good use of the Online Survey Tool, through the implementation of phone calls and bilateral meeting.

4.1.2 Agenda

On Line Webinar

Development of climate adaptation pathways in the sectors of the Blue Economy in Sardinia

Tuesday, November 3rd, 2020

15:30 – 17:00

Agenda

15:30 - 15:40 **Reception and Opening**
Mrs Daniela Sitzia, ANCI Sardegna Direttor

15:40 - 15:50	**Introduction to the SOCLIMPACT project** *Mr Marcelo Mautone, SOCLIMPACT Project Coordinator*
15:50 – 16:00	**Main findings for Sardinia - SOCLIMPACT project** *Mrs Maria Laura Foddis, SOCLIMPACT project staff, ANCI Sardegna*
16:00 – 16:30	**Development of adaptation paths - Presentation of the survey tool** *Mr Alessandro Mancosu, SOCLIMPACT project staff, ANCI Sardegna*
16:00 – 16:50	**Debate / Questions and answers**
16:50 – 17:00	**Conclusion of the works and further developments**

Below is the agenda of the webinar in the Italian version that was sent to the Sardinian stakeholders.

This project has received funding from the European Union's Horizon 2020research and innovation programme under grant agreement No776661

SOCLIMPACT

On Line Webinar
Sviluppo di percorsi di adattamento climatico nei settori della Blue Economy in Sardegna

Martedì, 3 Novembre 2020
15:30 – 17:00

Programma

15:30 - 15:40	**Saluti e apertura dei lavori** *Dott.ssa Daniela Sitzia, Direttore ANCI Sardegna*
15:40 - 15:50	**Introduzione al progetto SOCLIMPACT** *Dott. Marcelo Mautone, Coordinatore del progetto SOCLIMPACT*
15:50 – 16:00	**Principali evidenze per la Sardegna – Progetto SOCLIMPACT** *Ing. Maria Laura Foddis, staff del progetto SOCLIMPACT, ANCI Sardegna*
16:00 – 16:30	**Sviluppo dei percorsi di adattamento - Presentazione dello strumento di indagine** *Dott. Alessandro Mancosu, staff del progetto SOCLIMPACT, ANCI Sardegna*
16:00 – 16:50	**Dibattito/Domande e risposte**
16:50 – 17:00	**Conclusione dei lavori e ulteriori sviluppi**

Contatti:
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Maria Laura Foddis, +39 338 529 0554

Link per accedere al webinar:
https://us02web.zoom.us/j/88187720847?pwd=RWNiVlFXTEhFSXIzbTNvd1NQTHJ2dz09
Password: 208532

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Viale Trieste 6 – 09123 Cagliari
Tel. 070 6670115

4.2 List of participants

Name	Organization	Sectors
Daniela Sitzia	ANCI	----
Maria Laura Foddis	ANCI	----
Alessandro Mancosu	ANCI	----
Michela Vincis	ANCI	----
Elisabetta Pillolla	ANCI	----
Marcelo Mautone	SOCLIMPACT -Project coordinator	----
Elena Cane	Solar Gallura srl	Energy
Valeria Fadda	Escosardegna Srl	Energy
Marcello Spano	Twelve Energy società agricola SRL	Energy
Pierpaolo Lai	Engineer	Energy
Roberto Fiori	Municipality of Castelsardo	Energy
Erika M.D. Porporato	Fondazione IMC - Centro Marino Internazionale	Aquaculture
Gianni Brundu	Fondazione IMC - Centro Marino Internazionale	Aquaculture
Stefano Guerzoni	Fondazione IMC - Centro Marino Internazionale	Aquaculture
Daniele Trogu	Fondazione IMC - Centro Marino Internazionale	Aquaculture
Elisa Serra	Fondazione IMC - Centro Marino Internazionale	Aquaculture
Pirisi Marco	Engineer	Maritime Transport
Giovanni Pizzadili	Consutant	Aquaculture
Antonio Pizzadili	Consutant	Aquaculture
Francesca Fantola	LAORE – Autonomous region of Sardinia	Aquaculture
Tommaso Betza	LAORE – Autonomous region of Sardinia	Aquaculture
Gianluca Cocco	Autonomous region of Sardinia	Aquaculture, Energy, Maritime Transport, Tourism
Annalisa Congiu	Autonomous region of Sardinia	Aquaculture, Energy, Maritime Transport, Tourism
Filippo Arras	Autonomous region of Sardinia	Aquaculture, Energy, Maritime Transport, Tourism
Martina Piras	University of Nuoro	Aquaculture, Energy, Maritime Transport
Germana Manca	Department of Civil Protection of the Sardinia Region	Energy, Tourism
Antonio Casu	Lares Sardegna Onlus	Aquaculture, Maritime Transport, Tourism
Alessandro Gibertini	Milano Bicocca	Aquaculture, Energy, Maritime Transport, Tourism
Luca Medda	Associazione Turistica Pro Loco Assemini	Tourism
Francesca Palmas	Sistur - Società Italiana Scienze del Turismo	Tourism
Myriam Carta	Municipality of Illorai	Energy, Tourism
Roberto Scotti	University of Sassari	Energy, Tourism

Roberto Bertuccelli	Port System Authority of the Sardinian Sea	Maritime Transport
Michele Marrocu	Engineer	Energy, Tourism
Roberto Spina	Municipality of Selargius	Energy, Tourism
Maria Elena Sini	Municipality of Porto Torres	Energy, Maritime Transport
Maria Sara Sechi	Municipality of Mara	Energy, Maritime Transport, Tourism
Gianmichele Medde	Engineer	Maritime Transport, Tourism
Giosue Loj	Parco nazionale della Maddalena	Maritime Transport, Tourism
Manuele Saiu	Provincia del Sud Sardegna	Aquaculture, Tourism
Nando Mannai	Amministrazione Provinciale Sud Sardegna	Aquaculture, Energy, Tourism
Tiziana Lai	Autonomous region of Sardinia	Aquaculture, Tourism
Sara Carcangiu	Engineer	Energy
Roberta Rita Lutzu	Acciona Agua	Aquaculture, Maritime Transport, Tourism
Franca Lucia Sanna	Geologyst	Tourism
Gabriele Uras	Univesity of Cagliari	Aquaculture, Energy, Maritime Transport, Tourism
Nicola Nieddu	Univesity of Cagliari	Energy, Tourism

4.3 2nd Webinar held the 25th of November 2020

4.3.1 Objectives

The objectives of the second webinar were:

1. to present the final Pathways Adaptation for Sardinia;
2. to discuss with the stakeholders the Pathways Adaptation results:
    - the most voted options;
    - the final Adaptation pathway for the Island;
    - the tables with pathways evaluation (based on options evaluation);
    - discuss of the results.

The webinar was held in Italian language and was carried out online with the zoom platform.

4.3.2 Agenda

On Line Webinar

Development of climate adaptation pathways in the sectors of the Blue Economy in Sardinia

Tuesday, November 25th, 2020

15:00 – 16:00

Agenda

15:00 - 15:10	**Greetings and opening of the webinar** *Mrs Daniela Sitzia, ANCI Sardegna Direttor*
15:10 – 15:40	**Online Survey Tool Results** *Mrs Maria Laura Foddis and Mr Alessandro Mancosu, SOCLIMPACT project staff, ANCI Sardegna*
15:40 – 15:55	**Debate and further developments**
15:55 – 16:00	**Conclusion**

Below is the agenda of the webinar in the Italian version that was sent to the Sardinian stakeholders.

This project has received funding from the European Union's Horizon 2020research and innovation programme under grant agreement No776661

SOCLIMPACT

On Line Webinar

Sviluppo di percorsi di adattamento climatico nei settori della Blue Economy in Sardegna

Martedì, 25 Novembre 2020
15:00 – 16:00

Programma

15:00 - 15:10	**Saluti e apertura dei lavori** *Dott.ssa Daniela Sitzia, Direttore ANCI Sardegna*
15:10 – 15:40	**Risultati dell'indagine sullo Sviluppo dei percorsi di adattamento** *Moderatori, ANCI Sardegna*
15:40 – 15:55	**Dibattito e ulteriori sviluppi**
15:55 – 16:00	**Conclusione dei lavori**

Moderatori:
Alessandro Mancosu +39 347 985 6178
Maria Laura Foddis, +39 338 529 0554

Link per accedere al webinar:
https://us02web.zoom.us/j/84769428223?pwd=ak1JWnc3TThvOWFEME81bndaTkpPUT09
Meeting ID: 847 6942 8223
Passcode: 270222

Anci Sardegna
Viale Trieste 6 – 09123 Cagliari
Tel. 070 6670115

4.4 List of participants

Name	Organization	Sectors

Daniela Sitzia	ANCI	
Maria Laura Foddis	ANCI	
Alessandro Mancosu	ANCI	
Michela Vincis	ANCI	
Elisabetta Pillolla	ANCI	
Germana Manca	Department of Civil Protection of the Sardinia Region	Energy, Tourism
Tommaso Betza	LAORE – Autonomous region of Sardinia	Aquaculture
Sara Carcangiu	Engineer	Energy
Pirisi Marco	Engineer	Maritime Transport
Franca Lucia Sanna	Geologyst	Tourism
Nicola Nieddu	Univesity of Cagliari	Energy, Tourism

5 Annexes - Sardinia

5.1 Adaptation Options Evaluation

With reference to adaptation option characterization, the Island Focal Point coordinated by ANCI Sardegna has decided to leave the stakeholders free to setup the values of the criteria for Cost Efficiency, Environmental protection, Mitigation (GHG emissions) win-wins and trade-offs, Technical applicability and Social Acceptability for the Characterization Options. In the tables blew are reported the choice made by the different stakeholders

5.1.1 Tourism

Following are reported the values for the criteria for the adaptation option characterization setup by the by 5 expert island stakeholders.

Options Characterization			Criteria				
ID	Name	Class of adaptation	Cost Efficiency	Environmental protection	Mitigation win-wins and trade-offs	Technical applicability	Social Acceptability
T1	Economic Policy Instruments (EPIs)	1. Financial capital	3	4	4	1	3
T2	Financial incentives to retreat from high-risk areas	1. Financial capital	2	3	4	2	2
T3	Adaptation of groundwater management	10. Provisioning services	3	1	3	4	2
T4	Monitoring, modelling and forecasting systems	10. Provisioning services	1	3	2	2	3
T5	Dune restoration and rehabilitation	11. Regulating and Maintenance Services	2	2	3	4	2
T6	River rehabilitation and restoration	11. Regulating and Maintenance Services	2	2	1	3	3
T7	Adaptive management of natural habitats	12. Cultural services	2	1	2	2	1
T8	Ocean pools	12. Cultural services	1	4	3	3	1
T9	Activity and product diversification	2. Human capital	3	1	4	3	3
T10	Public awareness programmes	2. Human capital	1	3	3	2	2
T11	Local circular economy	3. Social capital	2	2	3	4	3
T12	Tourist awareness campaigns	3. Social capital	1	3	2	2	3
T13	Local sustainable fishing	4. Natural capital	4	1	3	2	2
T14	Water restrictions, consumption cuts and grey-water recycling	4. Natural capital	4	1	3	3	4
T15	Beach nourishment	5. Physical capital	1	2	2	3	2
T16	Desalination	5. Physical capital	1	3	2	3	4
T17	Coastal protection structures	6. Managing long term risk	2	3	1	3	3
T18	Drought and water conservation plans	6. Managing long term risk	3	2	2	2	2
T19	Mainstreaming Disaster Risk Management (DRM)	7. Preparedness	3	4	3	3	3
T20	Using water to cope with heat waves	7. Preparedness	2	2	2	3	4
T21	Fire management plans	8. Response	1	3	4	3	2
T22	Health care delivery systems	8. Response	4	1	2	2	3
T23	Post-Disaster recovery funds	9. Post disaster recovery and rehabilitation	4	3	1	3	3
T24	Pre-disaster early recovery planning	9. Post disaster recovery and rehabilitation	2	2	2	2	2

Table 22 – Adaptation option characterization for Tourism sector– Stakeholder 1

Options Characterization			Criteria				
ID	Name	Class of adaptation	Cost Efficiency	Environmental protection	Mitigation win-wins and trade-offs	Technical applicability	Social Acceptability
T1	Economic Policy Instruments (EPIs)	1. Financial capital	3	4	4	2	3
T2	Financial incentives to retreat from high-risk areas	1. Financial capital	2	3	4	4	3
T3	Adaptation of groundwater management	10. Provisioning services	3	4	2	4	2
T4	Monitoring, modelling and forecasting systems	10. Provisioning services	3	4	1	2	3
T5	Dune restoration and rehabilitation	11. Regulating and Maintenance Services	3	1	3	4	2
T6	River rehabilitation and restoration	11. Regulating and Maintenance Services	2	2	1	2	3
T7	Adaptive management of natural habitats	12. Cultural services	2	1	2	2	1
T8	Ocean pools	12. Cultural services	1	4	3	3	1
T9	Activity and product diversification	2. Human capital	3	1	4	3	3
T10	Public awareness programmes	2. Human capital	4	1	3	2	2
T11	Local circular economy	3. Social capital	2	1	3	1	3
T12	Tourist awareness campaigns	3. Social capital	1	3	2	2	3
T13	Local sustainable fishing	4. Natural capital	4	1	3	2	2
T14	Water restrictions, consumption cuts and grey-water recycling	4. Natural capital	4	2	1	3	4
T15	Beach nourishment	5. Physical capital	1	2	1	3	2
T16	Desalination	5. Physical capital	1	3	2	3	4
T17	Coastal protection structures	6. Managing long term risk	2	3	1	2	3
T18	Drought and water conservation plans	6. Managing long term risk	3	2	2	3	2
T19	Mainstreaming Disaster Risk Management (DRM)	7. Preparedness	1	2	4	3	3
T20	Using water to cope with heat waves	7. Preparedness	2	4	1	3	4
T21	Fire management plans	8. Response	1	3	3	4	2
T22	Health care delivery systems	8. Response	4	1	3	1	3
T23	Post-Disaster recovery funds	9. Post disaster recovery and rehabilitation	3	4	1	3	3
T24	Pre-disaster early recovery planning	9. Post disaster recovery and rehabilitation	4	3	2	2	2

Table 23 – Adaptation option characterization for Tourism sector – Stakeholder 2

Options Characterization			Criteria				
ID	Name	Class of adaptation	Cost Efficiency	Environmental protection	Mitigation win-wins and trade-offs	Technical applicability	Social Acceptability
T1	Economic Policy Instruments (EPIs)	1. Financial capital	3	4	4	2	3
T2	Financial incentives to retreat from high-risk areas	1. Financial capital	2	3	1	2	4
T3	Adaptation of groundwater management	10. Provisioning services	3	2	4	2	3
T4	Monitoring, modelling and forecasting systems	10. Provisioning services	3	2	3	2	3
T5	Dune restoration and rehabilitation	11. Regulating and Maintenance Services	3	1	3	4	2
T6	River rehabilitation and restoration	11. Regulating and Maintenance Services	2	4	1	2	3
T7	Adaptive management of natural habitats	12. Cultural services	3	1	3	1	1
T8	Ocean pools	12. Cultural services	2	4	2	4	1
T9	Activity and product diversification	2. Human capital	3	1	2	3	3
T10	Public awareness programmes	2. Human capital	2	4	3	2	2
T11	Local circular economy	3. Social capital	2	3	3	1	3
T12	Tourist awareness campaigns	3. Social capital	1	3	2	2	3
T13	Local sustainable fishing	4. Natural capital	4	1	3	2	2
T14	Water restrictions, consumption cuts and grey-water recycling	4. Natural capital	4	2	1	3	4
T15	Beach nourishment	5. Physical capital	1	2	2	4	2
T16	Desalination	5. Physical capital	1	3	1	3	4
T17	Coastal protection structures	6. Managing long term risk	2	2	4	2	3
T18	Drought and water conservation plans	6. Managing long term risk	3	1	2	3	2
T19	Mainstreaming Disaster Risk Management (DRM)	7. Preparedness	2	4	4	3	3
T20	Using water to cope with heat waves	7. Preparedness	2	4	1	3	4
T21	Fire management plans	8. Response	1	3	3	4	2
T22	Health care delivery systems	8. Response	4	2	4	1	3
T23	Post-Disaster recovery funds	9. Post disaster recovery and rehabilitation	3	3	1	2	4
T24	Pre-disaster early recovery planning	9. Post disaster recovery and rehabilitation	4	2	4	2	3

Table 24 – Adaptation option characterization for Tourism sector – Stakeholder 3

Options Characterization			Criteria				
ID	Name	Class of adaptation	Cost Efficiency	Environmental protection	Mitigation win-wins and trade-offs	Technical applicability	Social Acceptability
T1	Economic Policy Instruments (EPIs)	1. Financial capital	2	3	2	2	3
T2	Financial incentives to retreat from high-risk areas	1. Financial capital	1	3	1	1	3
T3	Adaptation of groundwater management	10. Provisioning services	3	4	2	4	2
T4	Monitoring, modelling and forecasting systems	10. Provisioning services	3	3	1	2	3
T5	Dune restoration and rehabilitation	11. Regulating and Maintenance Services	3	2	4	4	2
T6	River rehabilitation and restoration	11. Regulating and Maintenance Services	2	2	1	2	3
T7	Adaptive management of natural habitats	12. Cultural services	2	3	1	2	1
T8	Ocean pools	12. Cultural services	1	2	4	3	1
T9	Activity and product diversification	2. Human capital	3	3	1	3	3
T10	Public awareness programmes	2. Human capital	4	2	4	2	2
T11	Local circular economy	3. Social capital	2	1	3	1	3
T12	Tourist awareness campaigns	3. Social capital	3	4	3	1	3
T13	Local sustainable fishing	4. Natural capital	2	4	2	4	2
T14	Water restrictions, consumption cuts and grey-water recycling	4. Natural capital	4	2	2	2	2
T15	Beach nourishment	5. Physical capital	1	3	1	3	1
T16	Desalination	5. Physical capital	1	3	4	3	4
T17	Coastal protection structures	6. Managing long term risk	2	2	2	2	3
T18	Drought and water conservation plans	6. Managing long term risk	3	1	3	1	2
T19	Mainstreaming Disaster Risk Management (DRM)	7. Preparedness	1	2	4	3	3
T20	Using water to cope with heat waves	7. Preparedness	2	4	1	3	4
T21	Fire management plans	8. Response	1	3	3	4	2
T22	Health care delivery systems	8. Response	4	1	3	1	3
T23	Post-Disaster recovery funds	9. Post disaster recovery and rehabilitation	3	4	1	3	3
T24	Pre-disaster early recovery planning	9. Post disaster recovery and rehabilitation	4	3	2	2	2

Table 25 – Adaptation option characterization for Tourism sector – Stakeholder 4

Options Characterization			Criteria				
ID	Name	Class of adaptation	Cost Efficiency	Environmental protection	Mitigation win-wins and trade-offs	Technical applicability	Social Acceptability
T1	Economic Policy Instruments (EPIs)	1. Financial capital	3	4	4	2	3
T2	Financial incentives to retreat from high-risk areas	1. Financial capital	2	1	2	4	3
T3	Adaptation of groundwater management	10. Provisioning services	3	4	2	1	2
T4	Monitoring, modelling and forecasting systems	10. Provisioning services	3	4	1	4	2
T5	Dune restoration and rehabilitation	11. Regulating and Maintenance Services	3	1	3	4	2
T6	River rehabilitation and restoration	11. Regulating and Maintenance Services	2	2	1	2	3
T7	Adaptive management of natural habitats	12. Cultural services	2	1	2	2	1
T8	Ocean pools	12. Cultural services	1	4	3	2	1
T9	Activity and product diversification	2. Human capital	3	1	4	2	3
T10	Public awareness programmes	2. Human capital	4	4	2	2	2
T11	Local circular economy	3. Social capital	2	1	3	1	3
T12	Tourist awareness campaigns	3. Social capital	1	3	2	2	3
T13	Local sustainable fishing	4. Natural capital	4	1	3	2	2
T14	Water restrictions, consumption cuts and grey-water recycling	4. Natural capital	4	2	1	3	4
T15	Beach nourishment	5. Physical capital	3	3	1	3	2
T16	Desalination	5. Physical capital	1	3	2	3	4
T17	Coastal protection structures	6. Managing long term risk	2	3	2	2	3
T18	Drought and water conservation plans	6. Managing long term risk	3	1	2	3	2
T19	Mainstreaming Disaster Risk Management (DRM)	7. Preparedness	2	4	2	3	3
T20	Using water to cope with heat waves	7. Preparedness	2	4	2	3	4
T21	Fire management plans	8. Response	1	1	2	4	2
T22	Health care delivery systems	8. Response	4	4	2	1	3
T23	Post-Disaster recovery funds	9. Post disaster recovery and rehabilitation	3	2	1	3	3
T24	Pre-disaster early recovery planning	9. Post disaster recovery and rehabilitation	4	3	2	2	2

Table 26 – Adaptation option characterization for Tourism sector – Stakeholder 5

5.1.2 Maritime Transport

Following are reported the values for the criteria for the adaptation option characterization setup by the by 6 expert island stakeholders.

Options Characterization			Criteria				
ID	Name	Class of adaptation	Cost Efficiency	Environmental protection	Mitigation win-wins and trade-offs	Technical applicability	Social Acceptability
MT1	Insurance mechanisms for ports	1. Financial capital	3	4	2	3	1
MT2	Financial incentives to retreat from high-risk areas	1. Financial capital	4	4	2	1	3
MT3	Marine life friendly coastal protection structures	10. Provisioning services	3	4	2	3	4
MT4	Combined protection and wave energy infrastructures	10. Provisioning services	1	3	4	2	3
MT5	Hybrid and full electric ship propulsion	11. Regulating and Maintenance Services	2	1	4	1	3
MT6	Coastal protection structures	11. Regulating and Maintenance Services	2	4	2	1	2
MT7	Integrate ports in urban tissue	12. Cultural services	3	2	3	2	1
MT8	Ocean pools	12. Cultural services	3	2	3	2	1
MT9	Awareness campaigns for behavioural change	2. Human capital	4	2	3	2	3
MT10	Social dialogue for training in the port sector	2. Human capital	1	3	4	2	2
MT11	Diversification of trade using climate resilient commodities	3. Social capital	3	2	4	2	3
MT12	Climate resilient economy and jobs	3. Social capital	4	1	2	2	2
MT13	Refrigeration, cooling and ventilation systems	4. Natural capital	3	4	3	2	1
MT14	Restrict development and settlement in low-lying areas	4. Natural capital	3	4	3	4	2
MT15	Sturdiness improvement of vessels	5. Physical capital	3	4	1	2	2
MT16	Increase operational speed and flexibility in ports	5. Physical capital	3	1	3	4	2
MT17	Climate proof ports and port activities	6. Managing long term risk	2	2	1	2	3
MT18	Consider expansion/retreat of ports in urban planning	6. Managing long term risk	4	2	3	2	1
MT19	Reinforcement of inspection, repair and maintenance of infrastructures	7. Preparedness	1	4	2	3	1
MT20	Early Warning Systems (EWS) and climate change monitoring	7. Preparedness	3	1	4	3	1
MT21	Inteligent Transport Systems (ITS)	8. Response	4	1	4	2	3
MT22	Prepare for service delays or cancellations	8. Response	2	2	4	3	1
MT23	Backup routes and infrastructures during extreme weather	9. Post disaster recovery and rehabilitation	4	2	3	2	4
MT24	Post-Disaster recovery funds	9. Post disaster recovery and rehabilitation	3	4	2	2	4

Table 27 – Adaptation option characterization for Tourism sector– Stakeholder 1

Options Characterization			Criteria				
ID	Name	Class of adaptation	Cost Efficiency	Environmental protection	Mitigation win-wins and trade-offs	Technical applicability	Social Acceptability
MT1	Insurance mechanisms for ports	1. Financial capital	3	4	2	3	1
MT2	Financial incentives to retreat from high-risk areas	1. Financial capital	4	4	2	1	3
MT3	Marine life friendly coastal protection structures	10. Provisioning services	3	1	3	4	2
MT4	Combined protection and wave energy infrastructures	10. Provisioning services	1	3	4	2	2
MT5	Hybrid and full electric ship propulsion	11. Regulating and Maintenance Services	2	1	4	1	4
MT6	Coastal protection structures	11. Regulating and Maintenance Services	2	4	2	1	2
MT7	Integrate ports in urban tissue	12. Cultural services	3	2	3	2	1
MT8	Ocean pools	12. Cultural services	3	2	3	2	1
MT9	Awareness campaigns for behavioural change	2. Human capital	1	3	4	2	1
MT10	Social dialogue for training in the port sector	2. Human capital	1	3	4	2	2
MT11	Diversification of trade using climate resilient commodities	3. Social capital	3	2	4	2	4
MT12	Climate resilient economy and jobs	3. Social capital	4	1	2	2	2
MT13	Refrigeration, cooling and ventilation systems	4. Natural capital	3	4	3	2	1
MT14	Restrict development and settlement in low-lying areas	4. Natural capital	3	4	3	4	2
MT15	Sturdiness improvement of vessels	5. Physical capital	3	4	1	2	3
MT16	Increase operational speed and flexibility in ports	5. Physical capital	3	1	3	4	2
MT17	Climate proof ports and port activities	6. Managing long term risk	2	2	1	2	3
MT18	Consider expansion/retreat of ports in urban planning	6. Managing long term risk	2	1	2	2	1
MT19	Reinforcement of inspection, repair and maintenance of infrastructures	7. Preparedness	1	4	3	3	1
MT20	Early Warning Systems (EWS) and climate change monitoring	7. Preparedness	3	1	4	3	3
MT21	Inteligent Transport Systems (ITS)	8. Response	4	1	3	2	2
MT22	Prepare for service delays or cancellations	8. Response	2	2	4	3	1
MT23	Backup routes and infrastructures during extreme weather	9. Post disaster recovery and rehabilitation	3	1	2	2	4
MT24	Post-Disaster recovery funds	9. Post disaster recovery and rehabilitation	3	4	2	2	3

Table 28 – Adaptation option characterization for Tourism sector – Stakeholder 2

Options Characterization			Criteria				
ID	Name	Class of adaptation	Cost Efficiency	Environmental protection	Mitigation win-wins and trade-offs	Technical applicability	Social Acceptability
MT1	Insurance mechanisms for ports	1. Financial capital	3	4	2	3	1
MT2	Financial incentives to retreat from high-risk areas	1. Financial capital	4	4	2	1	3
MT3	Marine life friendly coastal protection structures	10. Provisioning services	3	2	2	4	2
MT4	Combined protection and wave energy infrastructures	10. Provisioning services	1	2	4	1	2
MT5	Hybrid and full electric ship propulsion	11. Regulating and Maintenance Services	2	2	4	2	4
MT6	Coastal protection structures	11. Regulating and Maintenance Services	2	4	2	1	2
MT7	Integrate ports in urban tissue	12. Cultural services	3	2	3	2	1
MT8	Ocean pools	12. Cultural services	3	2	3	2	1
MT9	Awareness campaigns for behavioural change	2. Human capital	2	2	4	2	1
MT10	Social dialogue for training in the port sector	2. Human capital	2	4	1	2	2
MT11	Diversification of trade using climate resilient commodities	3. Social capital	2	4	2	2	4
MT12	Climate resilient economy and jobs	3. Social capital	4	1	2	2	2
MT13	Refrigeration, cooling and ventilation systems	4. Natural capital	3	4	3	2	1
MT14	Restrict development and settlement in low-lying areas	4. Natural capital	3	4	3	4	2
MT15	Sturdiness improvement of vessels	5. Physical capital	3	4	2	2	4
MT16	Increase operational speed and flexibility in ports	5. Physical capital	3	1	2	4	1
MT17	Climate proof ports and port activities	6. Managing long term risk	2	2	2	4	2
MT18	Consider expansion/retreat of ports in urban planning	6. Managing long term risk	2	1	2	2	1
MT19	Reinforcement of inspection, repair and maintenance of infrastructures	7. Preparedness	1	4	3	3	1
MT20	Early Warning Systems (EWS) and climate change monitoring	7. Preparedness	3	1	4	3	3
MT21	Inteligent Transport Systems (ITS)	8. Response	2	2	4	2	2
MT22	Prepare for service delays or cancellations	8. Response	2	4	1	3	1
MT23	Backup routes and infrastructures during extreme weather	9. Post disaster recovery and rehabilitation	2	4	2	2	4
MT24	Post-Disaster recovery funds	9. Post disaster recovery and rehabilitation	3	4	2	2	3

Table 29 – Adaptation option characterization for Tourism sector – Stakeholder 3

Options Characterization			Criteria				
ID	Name	Class of adaptation	Cost Efficiency	Environmental protection	Mitigation win-wins and trade-offs	Technical applicability	Social Acceptability
MT1	Insurance mechanisms for ports	1. Financial capital	3	4	2	2	4
MT2	Financial incentives to retreat from high-risk areas	1. Financial capital	4	4	2	2	3
MT3	Marine life friendly coastal protection structures	10. Provisioning services	2	4	2	4	2
MT4	Combined protection and wave energy infrastructures	10. Provisioning services	2	3	2	3	2
MT5	Hybrid and full electric ship propulsion	11. Regulating and Maintenance Services	2	1	4	1	4
MT6	Coastal protection structures	11. Regulating and Maintenance Services	2	4	2	1	2
MT7	Integrate ports in urban tissue	12. Cultural services	3	2	3	2	1
MT8	Ocean pools	12. Cultural services	2	4	3	2	1
MT9	Awareness campaigns for behavioural change	2. Human capital	2	3	2	4	1
MT10	Social dialogue for training in the port sector	2. Human capital	1	3	2	3	2
MT11	Diversification of trade using climate resilient commodities	3. Social capital	3	2	4	2	4
MT12	Climate resilient economy and jobs	3. Social capital	4	2	4	2	2
MT13	Refrigeration, cooling and ventilation systems	4. Natural capital	3	2	3	4	1
MT14	Restrict development and settlement in low-lying areas	4. Natural capital	3	4	2	3	2
MT15	Sturdiness improvement of vessels	5. Physical capital	3	4	1	2	3
MT16	Increase operational speed and flexibility in ports	5. Physical capital	3	1	3	4	2
MT17	Climate proof ports and port activities	6. Managing long term risk	2	2	1	2	3
MT18	Consider expansion/retreat of ports in urban planning	6. Managing long term risk	2	1	2	2	1
MT19	Reinforcement of inspection, repair and maintenance of infrastructures	7. Preparedness	1	4	3	3	1
MT20	Early Warning Systems (EWS) and climate change monitoring	7. Preparedness	3	1	2	4	3
MT21	Inteligent Transport Systems (ITS)	8. Response	2	4	2	3	2
MT22	Prepare for service delays or cancellations	8. Response	2	3	4	3	1
MT23	Backup routes and infrastructures during extreme weather	9. Post disaster recovery and rehabilitation	3	1	2	4	4
MT24	Post-Disaster recovery funds	9. Post disaster recovery and rehabilitation	3	4	2	3	3

Table 30 – Adaptation option characterization for Tourism sector – Stakeholder 4

Options Characterization			Criteria				
ID	Name	Class of adaptation	Cost Efficiency	Environmental protection	Mitigation win-wins and trade-offs	Technical applicability	Social Acceptability
MT1	Insurance mechanisms for ports	1. Financial capital	3	4	2	3	1
MT2	Financial incentives to retreat from high-risk areas	1. Financial capital	4	2	4	1	3
MT3	Marine life friendly coastal protection structures	10. Provisioning services	3	3	1	4	2
MT4	Combined protection and wave energy infrastructures	10. Provisioning services	1	3	4	2	2
MT5	Hybrid and full electric ship propulsion	11. Regulating and Maintenance Services	2	1	4	1	4
MT6	Coastal protection structures	11. Regulating and Maintenance Services	2	4	2	2	4
MT7	Integrate ports in urban tissue	12. Cultural services	3	2	3	3	1
MT8	Ocean pools	12. Cultural services	3	2	3	2	1
MT9	Awareness campaigns for behavioural change	2. Human capital	1	3	4	2	1
MT10	Social dialogue for training in the port sector	2. Human capital	4	3	4	2	2
MT11	Diversification of trade using climate resilient commodities	3. Social capital	3	2	4	2	4
MT12	Climate resilient economy and jobs	3. Social capital	2	4	4	2	2
MT13	Refrigeration, cooling and ventilation systems	4. Natural capital	3	1	4	2	1
MT14	Restrict development and settlement in low-lying areas	4. Natural capital	3	3	1	4	2
MT15	Sturdiness improvement of vessels	5. Physical capital	3	2	4	2	4
MT16	Increase operational speed and flexibility in ports	5. Physical capital	3	3	4	3	1
MT17	Climate proof ports and port activities	6. Managing long term risk	2	2	3	2	3
MT18	Consider expansion/retreat of ports in urban planning	6. Managing long term risk	2	2	4	2	1
MT19	Reinforcement of inspection, repair and maintenance of infrastructures	7. Preparedness	1	3	1	3	1
MT20	Early Warning Systems (EWS) and climate change monitoring	7. Preparedness	3	1	4	3	3
MT21	Inteligent Transport Systems (ITS)	8. Response	4	1	3	2	2
MT22	Prepare for service delays or cancellations	8. Response	2	4	2	4	1
MT23	Backup routes and infrastructures during extreme weather	9. Post disaster recovery and rehabilitation	3	1	3	1	4
MT24	Post-Disaster recovery funds	9. Post disaster recovery and rehabilitation	3	4	2	2	3

Table 31 – Adaptation option characterization for Tourism sector – Stakeholder 5

Options Characterization			Criteria				
ID	Name	Class of adaptation	Cost Efficiency	Environmental protection	Mitigation win-wins and trade-offs	Technical applicability	Social Acceptability
MT1	Insurance mechanisms for ports	1. Financial capital	3	4	2	3	3
MT2	Financial incentives to retreat from high-risk areas	1. Financial capital	4	1	4	2	3
MT3	Marine life friendly coastal protection structures	10. Provisioning services	3	3	1	4	3
MT4	Combined protection and wave energy infrastructures	10. Provisioning services	1	3	4	2	2
MT5	Hybrid and full electric ship propulsion	11. Regulating and Maintenance Services	2	3	4	1	4
MT6	Coastal protection structures	11. Regulating and Maintenance Services	2	4	2	4	4
MT7	Integrate ports in urban tissue	12. Cultural services	3	1	3	3	1
MT8	Ocean pools	12. Cultural services	3	2	3	2	1
MT9	Awareness campaigns for behavioural change	2. Human capital	1	3	4	2	1
MT10	Social dialogue for training in the port sector	2. Human capital	3	3	4	2	2
MT11	Diversification of trade using climate resilient commodities	3. Social capital	3	2	4	2	2
MT12	Climate resilient economy and jobs	3. Social capital	2	4	1	2	2
MT13	Refrigeration, cooling and ventilation systems	4. Natural capital	3	4	3	2	1
MT14	Restrict development and settlement in low-lying areas	4. Natural capital	3	3	1	4	2
MT15	Sturdiness improvement of vessels	5. Physical capital	3	2	4	2	4
MT16	Increase operational speed and flexibility in ports	5. Physical capital	3	2	4	3	1
MT17	Climate proof ports and port activities	6. Managing long term risk	2	2	3	2	3
MT18	Consider expansion/retreat of ports in urban planning	6. Managing long term risk	2	2	4	2	1
MT19	Reinforcement of inspection, repair and maintenance of infrastructures	7. Preparedness	1	3	1	3	1
MT20	Early Warning Systems (EWS) and climate change monitoring	7. Preparedness	3	1	4	3	3
MT21	Inteligent Transport Systems (ITS)	8. Response	4	2	4	2	1
MT22	Prepare for service delays or cancellations	8. Response	2	4	2	4	1
MT23	Backup routes and infrastructures during extreme weather	9. Post disaster recovery and rehabilitation	3	2	3	1	4
MT24	Post-Disaster recovery funds	9. Post disaster recovery and rehabilitation	3	4	1	2	3

Table 32 – Adaptation option characterization for Tourism sector – Stakeholder 6

5.1.3 Energy

Following are reported the values for the criteria for the adaptation option characterization setup by the by 7 expert island stakeholders.

Options Characterization			Criteria				
ID	Name	Class of adaptation	Cost Efficiency	Environmental protection	Mitigation win-wins and trade-offs	Technical applicability	Social Acceptability
E1	Financial support for buildings with low energy needs	1. Financial capital	2	2	4	3	2
E2	Financial support for smart control of energy in houses and buildings	1. Financial capital	4	2	2	2	3
E3	Energy efficiency in urban water management	10. Provisioning services	3	2	4	1	1
E4	Underground tubes and piping in urban planning	10. Provisioning services	3	2	3	2	4
E5	Biomass power from household waste	11. Regulating and Maintenance Services	2	2	4	3	2
E6	Urban green corridors	11. Regulating and Maintenance Services	2	3	3	2	3
E7	Educational garden plots	12. Cultural services	3	3	3	2	3
E8	Heated pools with waste heat from power plants	12. Cultural services	3	2	2	1	2
E9	Green jobs and businesses	2. Human capital	2	2	4	3	3
E10	Public information service on climate action	2. Human capital	2	3	1	2	2
E11	Small scale production and consumption (prosumers)	3. Social capital	2	2	2	4	3
E12	Risk reporting platform	3. Social capital	3	2	4	4	1
E13	Energy storage systems	4. Natural capital	1	3	1	3	3
E14	Collection and storage of forest fuel loads	4. Natural capital	3	1	3	1	2
E15	SeaWater Air Conditioning (SWAC).	5. Physical capital	3	3	1	2	3
E16	Demand Side Mangement (DSM) of Energy	5. Physical capital	1	2	4	2	4
E17	Review building codes of the energy infrastructure	6. Managing long term risk	4	2	1	2	3
E18	Upgrade evaporative cooling systems	6. Managing long term risk	2	4	2	4	1
E19	Early Warning Systems (EWS)	7. Preparedness	3	1	2	3	2
E20	Grid reliability	7. Preparedness	2	3	2	2	2
E21	Study and develop energy grid connections	8. Response	3	2	4	2	2
E22	Energy-independent facilities (generators)	8. Response	2	3	4	3	3
E23	Energy recovery microgrids	9. Post disaster recovery and rehabilitation	4	2	1	2	4
E24	Local recovery energy outage capacity	9. Post disaster recovery and rehabilitation	2	3	2	3	2

Table 33 – Adaptation option characterization for Energy sector– Stakeholder 1

Options Characterization			Criteria				
ID	Name	Class of adaptation	Cost Efficiency	Environmental protection	Mitigation win-wins and trade-offs	Technical applicability	Social Acceptability
E1	Financial support for buildings with low energy needs	1. Financial capital	3	2	4	1	1
E2	Financial support for smart control of energy in houses and buildings	1. Financial capital	4	2	2	4	3
E3	Energy efficiency in urban water management	10. Provisioning services	3	2	4	1	1
E4	Underground tubes and piping in urban planning	10. Provisioning services	3	2	4	2	4
E5	Biomass power from household waste	11. Regulating and Maintenance Services	2	2	4	3	2
E6	Urban green corridors	11. Regulating and Maintenance Services	2	4	3	2	3
E7	Educational garden plots	12. Cultural services	3	3	1	2	3
E8	Heated pools with waste heat from power plants	12. Cultural services	3	1	2	1	2
E9	Green jobs and businesses	2. Human capital	2	4	4	4	3
E10	Public information service on climate action	2. Human capital	2	3	1	2	2
E11	Small scale production and consumption (prosumers)	3. Social capital	2	2	2	4	3
E12	Risk reporting platform	3. Social capital	3	2	4	4	1
E13	Energy storage systems	4. Natural capital	1	3	1	2	3
E14	Collection and storage of forest fuel loads	4. Natural capital	3	1	3	1	2
E15	SeaWater Air Conditioning (SWAC).	5. Physical capital	3	3	1	2	3
E16	Demand Side Mangement (DSM) of Energy	5. Physical capital	1	2	4	2	4
E17	Review building codes of the energy infrastructure	6. Managing long term risk	4	3	1	2	3
E18	Upgrade evaporative cooling systems	6. Managing long term risk	2	4	3	4	1
E19	Early Warning Systems (EWS)	7. Preparedness	3	1	2	3	2
E20	Grid reliability	7. Preparedness	2	3	3	1	2
E21	Study and develop energy grid connections	8. Response	3	2	4	1	1
E22	Energy-independent facilities (generators)	8. Response	2	2	4	1	3
E23	Energy recovery microgrids	9. Post disaster recovery and rehabilitation	4	3	1	2	4
E24	Local recovery energy outage capacity	9. Post disaster recovery and rehabilitation	2	4	3	1	2

Table 34 – Adaptation option characterization for Energy sector – Stakeholder 2

Options Characterization			Criteria				
ID	Name	Class of adaptation	Cost Efficiency	Environmental protection	Mitigation win-wins and trade-offs	Technical applicability	Social Acceptability
E1	Financial support for buildings with low energy needs	1. Financial capital	3	2	4	1	1
E2	Financial support for smart control of energy in houses and buildings	1. Financial capital	4	2	3	2	3
E3	Energy efficiency in urban water management	10. Provisioning services	3	4	3	1	1
E4	Underground tubes and piping in urban planning	10. Provisioning services	3	3	4		3
E5	Biomass power from household waste	11. Regulating and Maintenance Services	2	2	4	3	2
E6	Urban green corridors	11. Regulating and Maintenance Services	2	4	2	3	3
E7	Educational garden plots	12. Cultural services	3	3	1	3	3
E8	Heated pools with waste heat from power plants	12. Cultural services	3	4	2	1	2
E9	Green jobs and businesses	2. Human capital	2	4	3	4	3
E10	Public information service on climate action	2. Human capital	2	3	2	2	2
E11	Small scale production and consumption (prosumers)	3. Social capital	3	2	2	4	3
E12	Risk reporting platform	3. Social capital	3	4	3	4	1
E13	Energy storage systems	4. Natural capital	3	2	1	3	3
E14	Collection and storage of forest fuel loads	4. Natural capital	3	3	3	2	2
E15	SeaWater Air Conditioning (SWAC).	5. Physical capital	3	3	1	2	3
E16	Demand Side Mangement (DSM) of Energy	5. Physical capital	1	2	4	2	4
E17	Review building codes of the energy infrastructure	6. Managing long term risk	4	3	1	2	3
E18	Upgrade evaporative cooling systems	6. Managing long term risk	2	4	3	4	1
E19	Early Warning Systems (EWS)	7. Preparedness	3	3	2	3	2
E20	Grid reliability	7. Preparedness	2	2	2	1	2
E21	Study and develop energy grid connections	8. Response	3	2	4	1	1
E22	Energy-independent facilities (generators)	8. Response	2	2	4	1	3
E23	Energy recovery microgrids	9. Post disaster recovery and rehabilitation	2	3	2	2	3
E24	Local recovery energy outage capacity	9. Post disaster recovery and rehabilitation	2	2	3	2	2

Table 35 – Adaptation option characterization for Energy sector – Stakeholder 3

Options Characterization			Criteria				
ID	Name	Class of adaptation	Cost Efficiency	Environmental protection	Mitigation win-wins and trade-offs	Technical applicability	Social Acceptability
E1	Financial support for buildings with low energy needs	1. Financial capital	2	2	4	1	1
E2	Financial support for smart control of energy in houses and buildings	1. Financial capital	4	2	3	3	3
E3	Energy efficiency in urban water management	10. Provisioning services	3	2	3	1	1
E4	Underground tubes and piping in urban planning	10. Provisioning services	3	3	4	2	4
E5	Biomass power from household waste	11. Regulating and Maintenance Services	2	2	4	3	2
E6	Urban green corridors	11. Regulating and Maintenance Services	2	4	3	2	3
E7	Educational garden plots	12. Cultural services	3	3	1	3	3
E8	Heated pools with waste heat from power plants	12. Cultural services	3	1	2	1	2
E9	Green jobs and businesses	2. Human capital	2	4	4	4	3
E10	Public information service on climate action	2. Human capital	2	3	1	2	2
E11	Small scale production and consumption (prosumers)	3. Social capital	2	2	2	4	3
E12	Risk reporting platform	3. Social capital	3	2	4	4	1
E13	Energy storage systems	4. Natural capital	1	4	4	2	3
E14	Collection and storage of forest fuel loads	4. Natural capital	3	1	3	1	2
E15	SeaWater Air Conditioning (SWAC).	5. Physical capital	3	3	1	2	3
E16	Demand Side Mangement (DSM) of Energy	5. Physical capital	1	4	3	2	4
E17	Review building codes of the energy infrastructure	6. Managing long term risk	4	3	2	3	3
E18	Upgrade evaporative cooling systems	6. Managing long term risk	2	4	3	4	1
E19	Early Warning Systems (EWS)	7. Preparedness	3	1	2	3	2
E20	Grid reliability	7. Preparedness	2	3	3	1	2
E21	Study and develop energy grid connections	8. Response	3	2	4	3	1
E22	Energy-independent facilities (generators)	8. Response	2	3	4	1	3
E23	Energy recovery microgrids	9. Post disaster recovery and rehabilitation	2	1	3	2	4
E24	Local recovery energy outage capacity	9. Post disaster recovery and rehabilitation	2	4	1	1	2

Table 36 – Adaptation option characterization for Energy sector – Stakeholder 4

Options Characterization			Criteria				
ID	Name	Class of adaptation	Cost Efficiency	Environmental protection	Mitigation win-wins and trade-offs	Technical applicability	Social Acceptability
E1	Financial support for buildings with low energy needs	1. Financial capital	3	4	1	1	1
E2	Financial support for smart control of energy in houses and buildings	1. Financial capital	4	2	3	1	2
E3	Energy efficiency in urban water management	10. Provisioning services	3	2	4	1	1
E4	Underground tubes and piping in urban planning	10. Provisioning services	3	3	1	2	4
E5	Biomass power from household waste	11. Regulating and Maintenance Services	2	2	4	3	2
E6	Urban green corridors	11. Regulating and Maintenance Services	2	4	3	2	3
E7	Educational garden plots	12. Cultural services	3	3	1	2	3
E8	Heated pools with waste heat from power plants	12. Cultural services	3	1	2	1	2
E9	Green jobs and businesses	2. Human capital	2	3	1	2	3
E10	Public information service on climate action	2. Human capital	4	1	1	4	1
E11	Small scale production and consumption (prosumers)	3. Social capital	2	4	1	4	3
E12	Risk reporting platform	3. Social capital	3	2	4	4	1
E13	Energy storage systems	4. Natural capital	1	3	1	2	3
E14	Collection and storage of forest fuel loads	4. Natural capital	3	1	3	1	2
E15	SeaWater Air Conditioning (SWAC).	5. Physical capital	3	3	1	2	3
E16	Demand Side Mangement (DSM) of Energy	5. Physical capital	1	4	1	1	2
E17	Review building codes of the energy infrastructure	6. Managing long term risk	4	1	1	2	3
E18	Upgrade evaporative cooling systems	6. Managing long term risk	2	4	3	4	1
E19	Early Warning Systems (EWS)	7. Preparedness	3	4	1	3	2
E20	Grid reliability	7. Preparedness	2	3	3	1	2
E21	Study and develop energy grid connections	8. Response	3	2	4	1	1
E22	Energy-independent facilities (generators)	8. Response	2	3	1	2	3
E23	Energy recovery microgrids	9. Post disaster recovery and rehabilitation	4	3	1	4	1
E24	Local recovery energy outage capacity	9. Post disaster recovery and rehabilitation	2	3	1	2	2

Table 37 – Adaptation option characterization for Energy sector – Stakeholder 5

Options Characterization			Criteria				
ID	Name	Class of adaptation	Cost Efficiency	Environmental protection	Mitigation win-wins and trade-offs	Technical applicability	Social Acceptability
E1	Financial support for buildings with low energy needs	1. Financial capital	3	2	4	3	1
E2	Financial support for smart control of energy in houses and buildings	1. Financial capital	4	3	2	4	3
E3	Energy efficiency in urban water management	10. Provisioning services	3	2	3	2	1
E4	Underground tubes and piping in urban planning	10. Provisioning services	3	2	4	2	4
E5	Biomass power from household waste	11. Regulating and Maintenance Services	2	2	4	3	2
E6	Urban green corridors	11. Regulating and Maintenance Services	2	4	3	2	3
E7	Educational garden plots	12. Cultural services	3	3	1	2	3
E8	Heated pools with waste heat from power plants	12. Cultural services	3	1	3	1	2
E9	Green jobs and businesses	2. Human capital	2	3	3	2	3
E10	Public information service on climate action	2. Human capital	2	3	3	3	2
E11	Small scale production and consumption (prosumers)	3. Social capital	2	2	2	4	3
E12	Risk reporting platform	3. Social capital	3	2	4	4	1
E13	Energy storage systems	4. Natural capital	1	3	2	2	3
E14	Collection and storage of forest fuel loads	4. Natural capital	3	1	3	1	2
E15	SeaWater Air Conditioning (SWAC).	5. Physical capital	3	3	1	2	3
E16	Demand Side Mangement (DSM) of Energy	5. Physical capital	1	2	4	4	4
E17	Review building codes of the energy infrastructure	6. Managing long term risk	4	3	2	4	3
E18	Upgrade evaporative cooling systems	6. Managing long term risk	2	4	3	4	1
E19	Early Warning Systems (EWS)	7. Preparedness	3	1	3	2	2
E20	Grid reliability	7. Preparedness	2	3	3	1	2
E21	Study and develop energy grid connections	8. Response	3	2	3	2	1
E22	Energy-independent facilities (generators)	8. Response	2	3	2	1	3
E23	Energy recovery microgrids	9. Post disaster recovery and rehabilitation	4	3	2	4	4
E24	Local recovery energy outage capacity	9. Post disaster recovery and rehabilitation	2	4	3	2	2

Table 38 – Adaptation option characterization for Energy sector – Stakeholder 6

Options Characterization			Criteria				
ID	Name	Class of adaptation	Cost Efficiency	Environmental protection	Mitigation win-wins and trade-offs	Technical applicability	Social Acceptability
E1	Financial support for buildings with low energy needs	1. Financial capital	3	2	1	3	1
E2	Financial support for smart control of energy in houses and buildings	1. Financial capital	4	2	2	2	4
E3	Energy efficiency in urban water management	10. Provisioning services	3	2	2	2	3
E4	Underground tubes and piping in urban planning	10. Provisioning services	3	2	4	2	4
E5	Biomass power from household waste	11. Regulating and Maintenance Services	2	2	4	3	2
E6	Urban green corridors	11. Regulating and Maintenance Services	2	1	3	1	3
E7	Educational garden plots	12. Cultural services	3	2	2	4	3
E8	Heated pools with waste heat from power plants	12. Cultural services	3	2	2	3	2
E9	Green jobs and businesses	2. Human capital	2	4	4	4	3
E10	Public information service on climate action	2. Human capital	2	3	1	2	2
E11	Small scale production and consumption (prosumers)	3. Social capital	2	2	2	4	3
E12	Risk reporting platform	3. Social capital	1	3	1	4	1
E13	Energy storage systems	4. Natural capital	2	2	4	2	3
E14	Collection and storage of forest fuel loads	4. Natural capital	2	2	3	1	2
E15	SeaWater Air Conditioning (SWAC).	5. Physical capital	3	3	1	2	3
E16	Demand Side Mangement (DSM) of Energy	5. Physical capital	1	2	4	2	4
E17	Review building codes of the energy infrastructure	6. Managing long term risk	4	3	1	2	3
E18	Upgrade evaporative cooling systems	6. Managing long term risk	2	4	1	3	1
E19	Early Warning Systems (EWS)	7. Preparedness	3	1	2	2	4
E20	Grid reliability	7. Preparedness	2	3	2	2	3
E21	Study and develop energy grid connections	8. Response	3	2	4	4	2
E22	Energy-independent facilities (generators)	8. Response	1	3	1	1	3
E23	Energy recovery microgrids	9. Post disaster recovery and rehabilitation	2	2	4	2	4
E24	Local recovery energy outage capacity	9. Post disaster recovery and rehabilitation	2	2	3	1	2

Table 39 – Adaptation option characterization for Energy sector – Stakeholder 7

5.1.4 Aquaculture

Following are reported the values for the criteria for the adaptation option characterization setup by the by 6 expert island stakeholders.

Options Characterization			Criteria				
ID	Name	Class of adaptation	Cost Efficiency	Environmental protection	Mitigation win-wins and trade-offs	Technical applicability	Social Acceptability
A1	Financial schemes, insurance and loans	1. Financial capital	1	2	3	2	4
A2	Tax benefits and subsidies	1. Financial capital	2	3	2	4	1
A3	Feed production	10. Provisioning services	4	2	3	2	4
A4	Species selection	10. Provisioning services	2	3	1	1	2
A5	Selective breeding	11. Regulating and Maintenance Services	2	3	3	2	4
A6	Best Management Practices	11. Regulating and Maintenance Services	2	3	3	2	3
A7	Create educational visits	12. Cultural services	2	3	3	2	1
A8	Promote aquaculture cuisine	12. Cultural services	2	3	3	2	4
A9	Awareness campaigns for behavioural change	2. Human capital	1	4	2	2	2
A10	Efficient feed management	2. Human capital	2	3	3	2	4
A11	Addressing consumer and environmental concerns at the local level	3. Social capital	1	3	3	2	4
A12	Promote cooperation to local consumption	3. Social capital	2	1	3	1	2
A13	Integrated multi-trophic aquaculture (IMTA)	4. Natural capital	2	3	1	2	2
A14	Short-cycle aquaculture	4. Natural capital	2	3	2	2	4
A15	Recirculation Aquaculture Systems (RAS)	5. Physical capital	2	3	2	2	4
A16	Submersible cages	5. Physical capital	2	2	1	2	2
A17	Climate proof aquaculture activities	6. Managing long term risk	2	3	3	2	2
A18	Risk-based zoning and site selection	6. Managing long term risk	2	3	3	4	4
A19	Disease prevention methods	7. Preparedness	2	4	3	2	4
A20	Environmental monitoring and Early Warning Systems (EWS)	7. Preparedness	2	3	1	2	4
A21	Mainstreaming Disaster Risk Management (DRM)	8. Response	2	2	2	3	4
A22	Contingency for emergency management, early harvest and/or relocation	8. Response	4	3	2	1	3
A23	Recovery Post-Disaster plans	9. Post disaster recovery and rehabilitation	2	1	2	2	4
A24	Recovery Post-Disaster funds	9. Post disaster recovery and rehabilitation	3	1	3	2	4

Table 40 – Adaptation option characterization for Aquaculture sector – Stakeholder 1

Options Characterization			Criteria				
ID	Name	Class of adaptation	Cost Efficiency	Environmental protection	Mitigation win-wins and trade-offs	Technical applicability	Social Acceptability
A1	Financial schemes, insurance and loans	1. Financial capital	2	2	3	3	4
A2	Tax benefits and subsidies	1. Financial capital	2	3	2	4	1
A3	Feed production	10. Provisioning services	4	2	4	2	4
A4	Species selection	10. Provisioning services	2	4	2	1	4
A5	Selective breeding	11. Regulating and Maintenance Services	2	3	3	2	4
A6	Best Management Practices	11. Regulating and Maintenance Services	2	3	3	3	3
A7	Create educational visits	12. Cultural services	2	2	3	3	1
A8	Promote aquaculture cuisine	12. Cultural services	2	3	3	2	4
A9	Awareness campaigns for behavioural change	2. Human capital	1	4	2	2	2
A10	Efficient feed management	2. Human capital	2	3	3	3	4
A11	Addressing consumer and environmental concerns at the local level	3. Social capital	1	4	3	4	4
A12	Promote cooperation to local consumption	3. Social capital	2	1	3	1	2
A13	Integrated multi-trophic aquaculture (IMTA)	4. Natural capital	1	4	1	2	1
A14	Short-cycle aquaculture	4. Natural capital	2	3	2	4	4
A15	Recirculation Aquaculture Systems (RAS)	5. Physical capital	2	3	2	2	4
A16	Submersible cages	5. Physical capital	2	2	1	4	2
A17	Climate proof aquaculture activities	6. Managing long term risk	2	4	3	2	1
A18	Risk-based zoning and site selection	6. Managing long term risk	2	3	3	4	4
A19	Disease prevention methods	7. Preparedness	2	4	4	2	1
A20	Environmental monitoring and Early Warning Systems (EWS)	7. Preparedness	2	3	1	2	4
A21	Mainstreaming Disaster Risk Management (DRM)	8. Response	2	2	2	3	1
A22	Contingency for emergency management, early harvest and/or relocation	8. Response	4	3	2	4	3
A23	Recovery Post-Disaster plans	9. Post disaster recovery and rehabilitation	2	4	2	2	4
A24	Recovery Post-Disaster funds	9. Post disaster recovery and rehabilitation	3	1	3	4	4

Table 41 – Adaptation option characterization for Aquaculture sector – Stakeholder 2

Options Characterization			Criteria				
ID	Name	Class of adaptation	Cost Efficiency	Environmental protection	Mitigation win-wins and trade-offs	Technical applicability	Social Acceptability
A1	Financial schemes, insurance and loans	1. Financial capital	1	3	3	2	4
A2	Tax benefits and subsidies	1. Financial capital	2	3	2	3	4
A3	Feed production	10. Provisioning services	4	2	3	2	4
A4	Species selection	10. Provisioning services	2	3	3	1	2
A5	Selective breeding	11. Regulating and Maintenance Services	2	3	4	2	4
A6	Best Management Practices	11. Regulating and Maintenance Services	2	3	3	2	3
A7	Create educational visits	12. Cultural services	2	3	3	2	1
A8	Promote aquaculture cuisine	12. Cultural services	2	3	3	2	4
A9	Awareness campaigns for behavioural change	2. Human capital	1	3	2	2	3
A10	Efficient feed management	2. Human capital	2	3	3	2	4
A11	Addressing consumer and environmental concerns at the local level	3. Social capital	1	3	3	3	4
A12	Promote cooperation to local consumption	3. Social capital	2	1	3	3	2
A13	Integrated multi-trophic aquaculture (IMTA)	4. Natural capital	2	3	1	2	3
A14	Short-cycle aquaculture	4. Natural capital	2	3	4	2	4
A15	Recirculation Aquaculture Systems (RAS)	5. Physical capital	2	3	2	2	2
A16	Submersible cages	5. Physical capital	2	2	1	2	2
A17	Climate proof aquaculture activities	6. Managing long term risk	2	3	3	2	2
A18	Risk-based zoning and site selection	6. Managing long term risk	2	2	3	4	4
A19	Disease prevention methods	7. Preparedness	2	4	3	2	4
A20	Environmental monitoring and Early Warning Systems (EWS)	7. Preparedness	2	3	1	2	4
A21	Mainstreaming Disaster Risk Management (DRM)	8. Response	2	3	2	4	4
A22	Contingency for emergency management, early harvest and/or relocation	8. Response	4	3	2	1	3
A23	Recovery Post-Disaster plans	9. Post disaster recovery and rehabilitation	2	1	2	3	4
A24	Recovery Post-Disaster funds	9. Post disaster recovery and rehabilitation	3	4	3	2	4

Table 42 – Adaptation option characterization for Aquaculture sector – Stakeholder 3

Options Characterization			Criteria				
ID	Name	Class of adaptation	Cost Efficiency	Environmental protection	Mitigation win-wins and trade-offs	Technical applicability	Social Acceptability
A1	Financial schemes, insurance and loans	1. Financial capital	1	3	3	2	4
A2	Tax benefits and subsidies	1. Financial capital	2	3	2	4	1
A3	Feed production	10. Provisioning services	4	2	3	3	4
A4	Species selection	10. Provisioning services	2	3	3	1	2
A5	Selective breeding	11. Regulating and Maintenance Services	2	3	3	3	4
A6	Best Management Practices	11. Regulating and Maintenance Services	2	3	3	2	3
A7	Create educational visits	12. Cultural services	2	2	3	2	1
A8	Promote aquaculture cuisine	12. Cultural services	2	3	2	2	3
A9	Awareness campaigns for behavioural change	2. Human capital	1	4	2	4	2
A10	Efficient feed management	2. Human capital	2	3	2	2	4
A11	Addressing consumer and environmental concerns at the local level	3. Social capital	1	4	3	2	4
A12	Promote cooperation to local consumption	3. Social capital	2	4	3	1	2
A13	Integrated multi-trophic aquaculture (IMTA)	4. Natural capital	2	3	1	4	2
A14	Short-cycle aquaculture	4. Natural capital	4	3	2	2	4
A15	Recirculation Aquaculture Systems (RAS)	5. Physical capital	2	3	4	2	4
A16	Submersible cages	5. Physical capital	2	2	4	2	2
A17	Climate proof aquaculture activities	6. Managing long term risk	2	4	3	2	2
A18	Risk-based zoning and site selection	6. Managing long term risk	2	3	3	2	4
A19	Disease prevention methods	7. Preparedness	2	3	3	4	2
A20	Environmental monitoring and Early Warning Systems (EWS)	7. Preparedness	2	3	1	2	4
A21	Mainstreaming Disaster Risk Management (DRM)	8. Response	3	2	2	3	4
A22	Contingency for emergency management, early harvest and/or relocation	8. Response	4	3	2	3	3
A23	Recovery Post-Disaster plans	9. Post disaster recovery and rehabilitation	2	1	2	2	4
A24	Recovery Post-Disaster funds	9. Post disaster recovery and rehabilitation	3	3	2	2	4

Table 43 – Adaptation option characterization for Aquaculture sector – Stakeholder 4

Options Characterization			Criteria				
ID	Name	Class of adaptation	Cost Efficiency	Environmental protection	Mitigation win-wins and trade-offs	Technical applicability	Social Acceptability
A1	Financial schemes, insurance and loans	1. Financial capital	1	3	4	2	4
A2	Tax benefits and subsidies	1. Financial capital	2	3	2	4	1
A3	Feed production	10. Provisioning services	4	3	3	2	4
A4	Species selection	10. Provisioning services	4	3	3	1	2
A5	Selective breeding	11. Regulating and Maintenance Services	2	3	3	2	4
A6	Best Management Practices	11. Regulating and Maintenance Services	2	3	3	3	3
A7	Create educational visits	12. Cultural services	2	3	4	3	1
A8	Promote aquaculture cuisine	12. Cultural services	2	3	3	3	4
A9	Awareness campaigns for behavioural change	2. Human capital	3	4	2	4	2
A10	Efficient feed management	2. Human capital	2	3	3	2	4
A11	Addressing consumer and environmental concerns at the local level	3. Social capital	1	3	3	4	3
A12	Promote cooperation to local consumption	3. Social capital	2	1	3	4	2
A13	Integrated multi-trophic aquaculture (IMTA)	4. Natural capital	2	3	1	2	2
A14	Short-cycle aquaculture	4. Natural capital	2	4	3	2	4
A15	Recirculation Aquaculture Systems (RAS)	5. Physical capital	2	3	4	3	4
A16	Submersible cages	5. Physical capital	2	2	1	3	2
A17	Climate proof aquaculture activities	6. Managing long term risk	2	3	4	4	2
A18	Risk-based zoning and site selection	6. Managing long term risk	2	3	3	4	4
A19	Disease prevention methods	7. Preparedness	2	4	3	4	3
A20	Environmental monitoring and Early Warning Systems (EWS)	7. Preparedness	2	4	3	2	4
A21	Mainstreaming Disaster Risk Management (DRM)	8. Response	2	2	2	3	4
A22	Contingency for emergency management, early harvest and/or relocation	8. Response	4	4	3	1	3
A23	Recovery Post-Disaster plans	9. Post disaster recovery and rehabilitation	2	1	2	3	4
A24	Recovery Post-Disaster funds	9. Post disaster recovery and rehabilitation	3	1	3	3	4

Table 44 – Adaptation option characterization for Aquaculture sector – Stakeholder 5

Options Characterization			Criteria				
ID	Name	Class of adaptation	Cost Efficiency	Environmental protection	Mitigation win-wins and trade-offs	Technical applicability	Social Acceptability
A1	Financial schemes, insurance and loans	1. Financial capital	1	3	3	2	4
A2	Tax benefits and subsidies	1. Financial capital	2	4	2	4	1
A3	Feed production	10. Provisioning services	4	2	4	2	4
A4	Species selection	10. Provisioning services	2	3	4	1	2
A5	Selective breeding	11. Regulating and Maintenance Services	2	3	3	4	4
A6	Best Management Practices	11. Regulating and Maintenance Services	2	4	3	2	3
A7	Create educational visits	12. Cultural services	2	3	3	4	1
A8	Promote aquaculture cuisine	12. Cultural services	2	3	4	2	4
A9	Awareness campaigns for behavioural change	2. Human capital	1	4	2	4	4
A10	Efficient feed management	2. Human capital	2	3	3	2	4
A11	Addressing consumer and environmental concerns at the local level	3. Social capital	1	3	4	2	4
A12	Promote cooperation to local consumption	3. Social capital	2	1	3	1	2
A13	Integrated multi-trophic aquaculture (IMTA)	4. Natural capital	2	4	4	2	2
A14	Short-cycle aquaculture	4. Natural capital	2	2	3	4	4
A15	Recirculation Aquaculture Systems (RAS)	5. Physical capital	2	3	2	2	4
A16	Submersible cages	5. Physical capital	2	2	1	3	3
A17	Climate proof aquaculture activities	6. Managing long term risk	2	3	2	2	2
A18	Risk-based zoning and site selection	6. Managing long term risk	2	3	3	4	4
A19	Disease prevention methods	7. Preparedness	2	3	2	2	3
A20	Environmental monitoring and Early Warning Systems (EWS)	7. Preparedness	2	3	1	2	4
A21	Mainstreaming Disaster Risk Management (DRM)	8. Response	2	3	2	3	4
A22	Contingency for emergency management, early harvest and/or relocation	8. Response	4	3	2	4	3
A23	Recovery Post-Disaster plans	9. Post disaster recovery and rehabilitation	2	1	2	4	4
A24	Recovery Post-Disaster funds	9. Post disaster recovery and rehabilitation	4	2	3	2	4

Table 45 – Adaptation option characterization for Aquaculture sector – Stakeholder 6

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SOCLIMPACT

Downscaling climate impacts and decarbonisation pathways in EU islands, and enhancing socioeconomic and non-market evaluation of Climate Change for Europe, for 2050 and beyond

SoClimPact project has received funding from the European Union's Horizon 2020 Research and Innovation Programme under Grant Agreement No 77661

SOCLIMPACT

This project has received funding from the European Union's Horizon 2020 research and innovation programme under Grant Agreement No776661

Work Package 7:

This is a result of Tasks 7.3. This deliverable will include the agendas, the list of participants, and the workshops outputs including the decisions taken.

Deliverable 7.3.

Workshop Report - Sicily

Island Focal Point:

Sicilia - OTIE - Giovanni Ruggieri; Patrizia Calò; Giacoma Brancato

This project has received funding from the European Union's Horizon 2020 research and innovation programme under Grant Agreement No776661

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1 Introduction

This document presents the results of the stakeholders' consultation process to design the **SOCLIMPACT Adaptation Pathways Workshops in Sicily**. This process is included in SOCLIMPACT Task 7.3 - Engage islands' stakeholders in the design of alternative pathways. According to the project Description of Action is expected that these online workshops use the background material prepared in Task 7.2/D7.2 and include the main results from previous WPs.

In the consultation process, the following objectives are expected to be covered:

22. **Identify and present the characterized packages of adaptation and risk management options** available for each archipelago/island.
23. **Develop detailed archipelago/island integrated adaptation pathways**, in three timeframes: Short term (up to 2030), Mid-century (up to 2050) and End-century (up to 2100).
24. **Evaluate** and rank pathways for Blue Economy sectors.

In Sicily, the consultation process was split into two online webinars. The original plan was to hold physical workshops in each archipelago. However, health and travel limitations due to Covid-19 forced changes to the original plan and partners decided to develop two shorter online sessions mixed with an online survey. The rationale was to make it as easier as possible for both **IFP** and **LWG** (stakeholders) to carry out the proposed work, without seriously compromising the **scientific quality** of the projects' outcomes.

The Sicilian LWG webinars were performed on the 8th of October 2020 and on the 17th of November 2020. All the sectors were involved in the process.

The workshops were performed taking into consideration the specific requirements of the region and the resources available. For Sicily different gaps in data were and substantially complemented with external sources (mostly local information).

The 24 options/measures available per sector were characterized by the IFP using the five criteria defined.

The report follows what was defined in the proposal by presenting the online workshop materials, namely: (1) decisions taken; (2) agendas and (3) list of participants.

The **Adaptation Pathways methodology applied in SOCPLIMPACT was based in the framework developed by Suckall et al.2018 and considered the three main strategic vectors for climate resilience: (1) vulnerability reduction -** Five capitals of Sustainable Livelihoods Approach (SLA)**; (2) Disaster Risk Reduction –** developed throughout Hyogo and Sendai Frameworks**; (3) Social-Ecological Resilience** – that emerge from the Millennium Ecosystem Assessment (MEA) and Common International Classification of Ecosystem Services (CICES).

The **Adaptation Pathways** aim to capture the policy preferences in time and the relevancy of the context traduced in investment and commitment (Suckall et al., 2018). These Adaptation Pathways Trajectories (APT) were delineated as a set of adaptation classes each one with two options/measures to choose from. Each individual stakeholder choices contribute to create a policy pathway together with the other choices made by different stakeholders. If most of the stakeholders chose one option, then that measure was incorporated in the island adaptation pathway for that specific class in each APT, per sector. The result of the series of choices in the three timeframes defines the pathway. If there is a tie between two options, then they will both be included and become part of the adaptation pathway in each time frame. The options

were included in the pathway when they were selected more than 50% in each time frame in each APT. Local Knowledge measures were included if they were chosen by at least 20% of all stakeholders.

Pathway options are grouped around three objectives: (1) actions to reduce socio-economic vulnerability; (2) actions that address disaster risk reduction; and (3) actions that affect social-ecological resilience. Adaptation policy under **vulnerability reduction**, **disaster risk reduction**, and **social-ecological resilience** were developed considering classes of adaptation (Figure 2) under which the participants decide which are the most relevant options for the Azores region.

For **vulnerability reduction** five classes were considered: (1) Financial capital; (2) Human capital; (3) Social capital; (4) Natural capital; and (5) Physical capital. For **Disaster Risk Reduction** four classes were considered: (6) managing long term risk; (7) preparedness; (8) response; (9) post disaster recovery and rehabilitation. For **Social-Ecological Resilience** three classes were considered: (10) Post disaster recovery and rehabilitation; (11) Provisioning services; and (12) Regulating and Maintenance Services (Figure 5 - The 12 classes of adaptation are structured in three broader objectives (Vulnerability reduction, Disaster Risk reduction and Ecosystem and social resilience) and linked to each APT narrative.Figure 5).

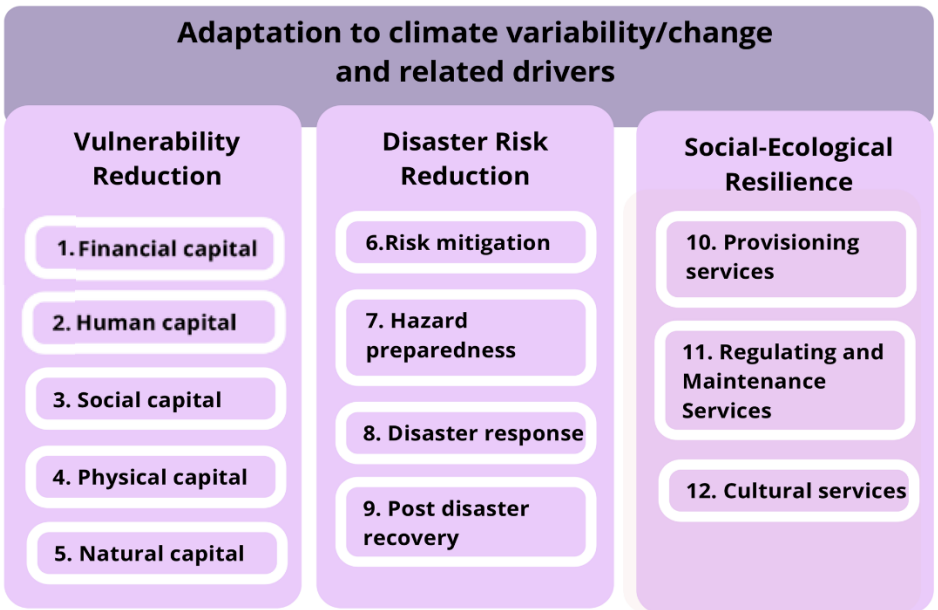

Figure 155 - The 12 classes of adaptation in the figure are structured in three broader objectives (Vulnerability reduction, Disaster Risk reduction and Ecosystem and social resilience).

The results of the Adaptation Pathways are presented in this report in two different outputs per sector: **(1) Selected Adaptation Pathways; and (2) Sustainability Performance.**

The (**1) Selected Adaptation Pathways** outputs aim to capture the acceptance of each adaptation option by calculating the options (number of times) selected within the maximum number of times they can be selected (Ratio – Selected/Maximum). This considers the number of times the option was selected by all stakeholders in all four APTs and three timeframes.

The **(2) Sustainability performance** outputs aim to characterize each pathway through the evaluation of the options chosen in each APT. The options selected in each APTs are evaluated considering a set of criteria: Cost Efficiency; Environmental protection; Mitigation (GHG emissions) win-wins and trade-offs; Technical applicability; Social acceptability (Table 3).

Table 46 – Description of the criteria used to evaluate the adaptation pathways performance.

Criteria	Description	
Cost Efficiency	Ability to efficiently address current or future climate hazards/risks in the most economical way	Higher score = higher cost efficiency
- *Environmental protection*	Ability to protect the environment, now and in the future	Higher score = higher environmental protection
- *Mitigation (GHG emissions) win-wins and trade-offs*	Current ability to meet (win-win) or not (trade-off) the island/archipelago's mitigation objectives	Higher score = higher mitigation win-wins and lower trade-offs
- *Technical applicability*	Current ability to technically implement the option/measure in the island/archipelago	Higher score = higher technical applicability
- *Social acceptability*	Current social acceptability of the option/measure in the island/archipelago	Higher score = higher social acceptability

The results are presented in a spider diagram and is the average of all options chosen for the participants in each APT pathway.

2 Summary of Background Material

To support the decisions within the Online Survey Tool and to define the Adaptation Pathways, relevant information related with climate, socio-economy and adaptation were presented to stakeholders. The deliverable 7.2 (Background Materials) were the preferential source information but additional and tailored information was developed.

Table 47 – (under development) Summary of the information used support the decisions within the Online Survey Tool. All relevant information related with climate, socio-economy and adaptation is included.

Variable	Description
Sea level rise (SLR)	Produce by SOCLIMPACT
Sea level - Historical data	Mean sea level rise (in cm) with respect to the reference period (1986-2005). Ensemble mean of CMIP 5 simulations and scaling approximation for RCP2.6
Sea level rise – Estimations of increased cost in Ports	Under the high emissions scenario, it is expected that these costs could increase 3.6 million of euros per year until the end of the century. Produced by SOCLIMPACT: more info
Waves extremes - 99th percentile of significant wave height averaged	the 99th percentile of significant wave height averaged for the reference period and the relative change for the RCP8.5. MED-CORDEX and Global simulations produced by Hemer et al. (2013). Hazard developed in SOCLIMPACT: more info
Storm surge extremes	99th percentile of atmospherically forced sea level (in cm) averaged for the hindcast period, the near future (2046-2065) and the far future (2081-2100) under scenarios RCP2.6 (with scaling approximation) and RCP8.5. Produced by SOCLIMPACT: More info here
Wind extremes	Wind Extremity Index (NWIX98). Ensemble mean of EURO-CORDEX simulations. Produced by SOCLIMPACT: More info here
Thermal Stress	to identify and quantify the variations (future climate scenarios with respect to present climate) in the number and in the duration of events characterized by a Sea Surface Temperature (SST) exceeding a given threshold. The SST thresholds have been identified according to the farming and feeding necessities of several marine species, particularly relevant for the aquaculture sector in the Mediterranean Sea (MS)
Aquaculture production	Estimations of changes in aquaculture production (tons), due to increased sea surface temperature
Standardized Precipitation Evaporation Index (SPEI)	The SPEI is a multiscale drought index based on climatic data. It can be used for determining the onset, duration and magnitude of drought conditions with respect to normal conditions

	in a variety of natural and managed systems such as crops, ecosystems, rivers, water resources, etc. Under the high emission RCP8.5 pathway all European Islands are expected to face much drier conditions. The signal becomes stronger towards the end of the 21st century.
Wind energy productivity	All the scenarios in both 2046-2065 and 2081-2100 periods show a tendency to decreasing Wprod. However, the magnitude of the decreases varies.
PV energy productivity	The 2081-2100 period for RCP8.5 presents the largest negative changes. Over land, the decreases are lower than 2% the control productivity in spatial average over Sicily. The decreases are larger over the sea, particularly over the southern part of the domain. Productivity decreases are rather small for RCP2.6.
Temperature - Percentage of days when T > 98th percentile - T98p	The T98p is defined as the percentage of time where the mean daily temperature T is above the 98th percentile of mean daily temperature calculated for the reference period 1986-2005. For Sicily, N=195 grid cells were retained from the models domain. Hazard developed in SOCLIMPACT
Frequency and duration of low-productivity periods (energy droughts) as a measure of the variability of these sources	Wind droughts are remarkably more frequent over land than over the sea in the control period. Projected changes in the frequency of moderate PV droughts are small both in Malta and in Sicily. The combination of PV and wind energy is very positive in Sicily both for moderate and severe droughts in the control period.
Cooling Degree Days	Number of degrees and number of days that the outside air temperature at a specific location is higher than a specified base temperature, providing the severity of the heat in a specific time period taking into consideration outdoor temperature and average room. Produced by SOCLIMPACT
Energy demand	Estimations of increased energy demand for cooling in Sicily under different scenarios of climate change until 2100
Humidex	Number of Days with Humidex greater than 35°C was selected. Above 35°C describes conditions from discomfort to humans
Beach flooding - Sea level rise + higher wind waves	One of the consequences of an increase in the mean sea level will be the flooding of coastal areas. This includes sand beaches, which are the main asset for tourism activities in most of the European islands. Hazard developed in SOCLIMPACT Under mean conditions, at end of century, the total beach surface loss range from ~34% under scenario RCP2.6 to ~61% under scenario RCP8.5.16
Seagrass evolution (Posidonia Oceanica)	Seagrasses are the main habitat for coastal marine ecosystems. Therefore, the state of seagrasses is a convenient proxy for the state of coastal environment. 1 specie is located in the coasts of Sicily: Posidonia. The results of RCP8.5 projections indicate a loss of 28,3% at end of century.
Length of the window of opportunity for vector-borne diseases Vector Suitability Index for Aedes Albopictus (Asian Tiger Mosquito)	Habitat Suitability Index (HSI) values averaged over eight SOCLIMPACT islands and for each sub-period of analysis. Red colours indicate increases while blue colours indicate decreases in the future
Fire Weather Index (FWI)	FWI results include temperature, precipitation, relative humidity and wind. The FWI system provides numerical non-dimensional ratings of relative fire potential for a generalized fuel type (mature pine stands) based solely on weather observations. Hazard developed in SOCLIMPACT
Tourism – willingness to pay	Produced by SOCLIMPACT: more info

The background material was included in the excel tool provided to the stakeholders through different links to interactive *pdf* files containing the results for each sector and variable observed. Following the interface of the background material in the excel tool.

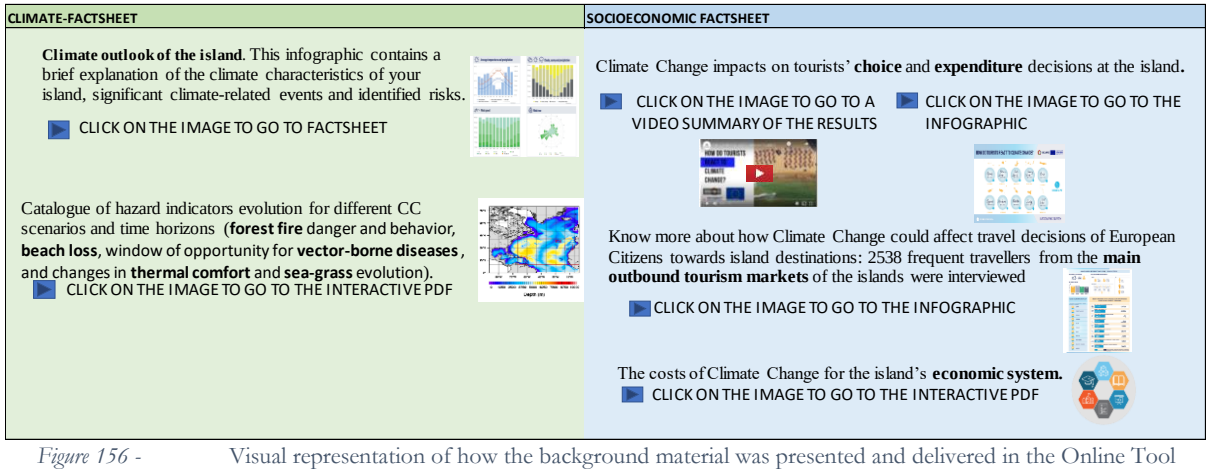

Figure 156 - Visual representation of how the background material was presented and delivered in the Online Tool Survey for Azores

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This project has received funding from the European Union's Horizon 2020 research and innovation programme under Grant Agreement No776661

3 Sector Adaptation Pathways

3.1 Tourism

Tourism pathways are based on choices made by 6 expert island stakeholders.

3.1.1 Selected Adaptation Pathways

ID	Name	Class number	Ratio
T7	Adaptive management of natural habitats	12	72%
T24	Pre-disaster early recovery planning	9	67%
T22	Health care delivery systems	8	67%
T6	River rehabilitation and restoration	11	64%
T4	Monitoring, modelling and forecasting systems	10	61%
T15	Beach nourishment	5	61%
T11	Local circular economy	3	61%
T13	Local sustainable fishing	4	58%
T9	Activity and product diversification	2	58%
T19	Mainstreaming Disaster Risk Management (DRM)	7	56%
T1	Economic Policy Instruments (EPIs)	1	56%
T18	Drought and water conservation plans	6	53%
T17	Coastal protection structures	6	47%
T2	Financial incentives to retreat from high-risk areas	1	44%
T20	Using water to cope with heat waves	7	44%
T10	Public awareness programmes	2	42%
T14	Water restrictions, consumption cuts and grey-water recycling	4	42%
T12	Tourist awareness campaigns	3	39%
T16	Desalination	5	39%
T3	Adaptation of groundwater management	10	39%
T5	Dune restoration and rehabilitation	11	36%
T21	Fire management plans	8	33%
T23	Post-Disaster recovery funds	9	33%
T8	Ocean pools	12	28%

ID	Name	Class number	Ratio	APT A			APT B			APT C			APT D		
				S	M	L	S	M	L	S	M	L	S	M	L
T1	Economic Policy Instruments (EPIs)	1	56%					B						D	
T2	Financial incentives to retreat from high-risk areas	1	44%					B						D	
T9	Activity and product diversification	2	58%		A			B			C			D	
T10	Public awareness programmes	2	42%		A			B			C			D	
T11	Local circular economy	3	61%								C				
T12	Tourist awareness campaigns	3	39%								C				
T13	Local sustainable fishing	4	58%								C			D	
T14	Water restrictions, consumption cuts and grey-water	4	42%								C			D	
T15	Beach nourishment	5	61%					B							
T16	Desalination	5	39%					B							
T18	Drought and water conservation plans	6	53%		A			B			C			D	
T17	Coastal protection structures	6	47%		A			B			C			D	
T19	Mainstreaming Disaster Risk Management (DRM)	7	56%								C				
T20	Using water to cope with heat waves	7	44%								C				
T22	Health care delivery systems	8	67%		A										
T21	Fire management plans	8	33%		A										
T24	Pre-disaster early recovery planning	9	67%		A									D	
T23	Post-Disaster recovery funds	9	33%		A									D	
T4	Monitoring, modelling and forecasting systems	10	61%		A			B			C			D	
T3	Adaptation of groundwater management	10	39%		A			B			C			D	
T6	River rehabilitation and restoration	11	64%					B			C				
T5	Dune restoration and rehabilitation	11	36%					B			C				
T7	Adaptive management of natural habitats	12	72%								C				
T8	Ocean pools	12	28%								C				

Figure 157 - Adaptation options for the tourism sector. Options are identified with an ID number, full name, and class of adaptation number. Adaptation objectives are identified in each option by colour: ***vulnerability reduction (red),*** *Disaster* ***Risk Reduction (blue); Social-Ecological Resilience (green);*** *Local Knowledge adaptation options (grey). Each ATP (APT A; APT B; APT C; APT D) is represented in three timeframes: S - Short term (up to 2030), M- Medium term (up to 2050), L - Long term (until 2100). Bold letters in each ATP indicate the option was available to be selected. Highlighted options indicate the measure was selected in each ATP and timeframe: ATP A (light blue); ATP B (light green); ATP C (Light orange) and ATP D (light purple). Space with colour: option was selected for the timeframe: Short term, Medium term, or Long term. Bold letter: option is available in the APT.*

Overall, the adaptation pathways for the Tourism sector in Sicily are characterized by a significant heterogeneity across the four potential adaptation policy trajectories (APTs) and across adaptation objectives.

The main measures selected to address **vulnerability reduction**, indicate that the region is initially centred on the development of sustainable approach both in short, medium and long term. Indeed, especially in APT C the goal is address a circular economy system and sustainable economic activities. But the priority is for the Natural, Social, Physical and Human Capital rather than the Financial one. This last one is considered residual in this class and mainly for the short and long term in APT B and D. The selection of the Financial incentives to retreat in the end of the century is related with the perception that the risks will continue or increase over time. To adapt via Human Capital (class 2), diversification of the activities and products in opposition to awareness campaigns should be implemented. Products and activities diversification is the desired option for all the time and all the APTs. It is the only option with this consideration.

For **Disaster Risk Reduction**, and to manage long term risk, the decisions need to be sensible to the level of investment and reflect the climate change risk identified for the region. Pre-disaster early recovery planning is a priority for the region in the opposite scenarios, that is APT A and D, for the medium and long term. In general, for this class the options are selected for the medium or long term and with a preference for the planning tools. This result highlights a great attention towards a better management with a long-term planning. In the other case a different combination of investment and commitment is considered in respect of the first two options.

In **Social-Ecological Resilience** is the most selected option, that is Adaptive management of natural habitats, included in the Cultural Services. This measure is in APT C for all the times, then is considered a priority, now and in the future, but only with low investments and a medium level of commitment in this direction. All the measures of this class are mainly selected for the medium and long term and with a certain combination of investment and commitment, then often for APT B and C. The actions concerning the rivers represent a priority in respect of those ones on the sea and there is a special attention to the planning and monitoring activities. This indicates that the need to prevent negative effects is considered as urgent.

3.1.2 Sustainability Performance

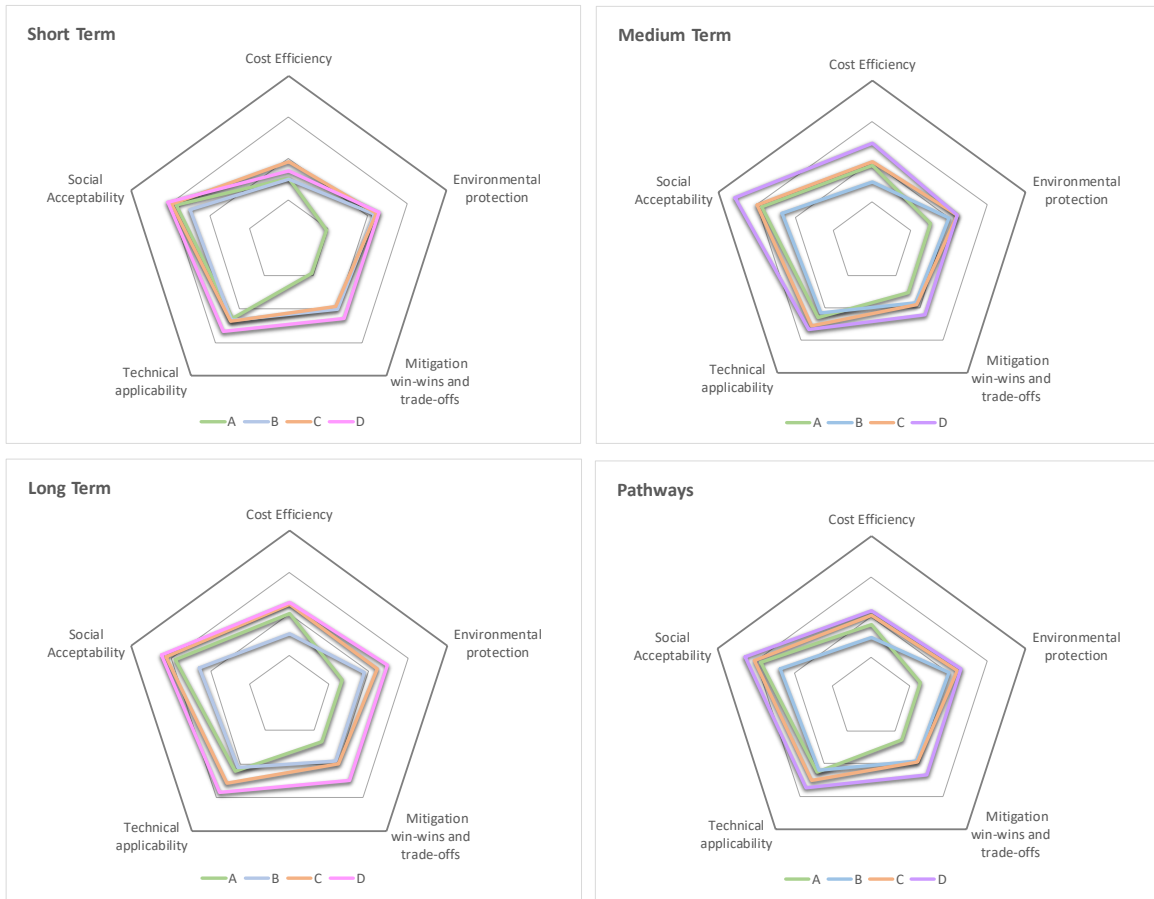

Figure 158 - Pathways evaluation for tourism sector considering: Cost Efficiency; Environmental protection; Mitigation (GHG emissions) win-wins and trade-offs; Technical applicability; Social acceptability. The policy pathways scenarios: APT A - Minimum Intervention; APT B - Economic Capacity Expansion (ECE); APT C- Efficiency Enhancement (EE); APT D - System Restructuring (SR), for different timeframes: short, medium, and long term

The performances of the four ATP scenarios for tourism sector are quite similar for the mid and long timeframes. In general, scenarios show a high level of social acceptability and technical applicability and a medium performance for the other variables, that is mitigation win-wins and trade-offs, cost efficiency and environmental protection.

In the short term, APT C has the best cost efficiency, APT D the best results in terms of environmental protection and mitigation as well as for social acceptability and technical applicability. In the medium and long timeframes, APT D (System Restructuring scenario) has the best combination for all the dimensions.

For all the timeframes, the social acceptability and technical applicability record the best results in all the APTs.

The minimum intervention scenario (APT A) tends to have socially acceptable options and adaptation solutions with technical applicability. However, in this scenario the pathway has a low performance on mitigation, environmental protection and cost efficiency. The scenarios B and C show balanced results for all the dimension in all the timeframes.

This project has received funding from the European Union's Horizon 2020 research and innovation programme under Grant Agreement No776661

3.2 Maritime Transport

Maritime transport pathways are based on choices made by 4 expert island stakeholders.

3.2.1 Selected Adaptation Pathways

ID	Name	Class number	Ratio
MT7	Integrate ports in urban tissue	12	83%
MT21	Inteligent Transport Systems (ITS)	8	75%
MT13	Refrigeration, cooling and ventilation systems	4	75%
MT11	Diversification of trade using climate resilient commodities	3	67%
MT10	Social dialogue for training in the port sector	2	67%
MT24	Post-Disaster recovery funds	9	58%
MT20	Early Warning Systems (EWS) and climate change monitoring	7	58%
MT16	Increase operational speed and flexibility in ports	5	58%
MT4	Combined protection and wave energy infrastructures	10	56%
MT6	Coastal protection structures	11	54%
MT17	Climate proof ports and port activities	6	50%
MT18	Consider expansion/retreat of ports in urban planning	6	50%
MT1	Insurance mechanisms for ports	1	50%
MT2	Financial incentives to retreat from high-risk areas	1	50%
MT5	Hybrid and full electric ship propulsion	11	46%
MT3	Marine life friendly coastal protection structures	10	44%
MT15	Sturdiness improvement of vessels	5	42%
MT19	Reinforcement of inspection, repair and maintenance of	7	42%
MT23	Backup routes and infrastructures during extreme weather	9	42%
MT9	Awareness campaigns for behavioural change	2	33%
MT12	Climate resilient economy and jobs	3	33%
MT14	Restrict development and settlement in low-lying areas	4	25%
MT22	Prepare for service delays or cancellations	8	25%
MT8	Ocean pools	12	17%

ID	Name	Class number	Ratio	APT A			APT B			APT C			APT D		
				S	M	L	S	M	L	S	M	L	S	M	L
MT1	Insurance mechanisms for ports	1	50%					B						D	
MT2	Financial incentives to retreat from high-risk areas	1	50%					B						D	
MT10	Social dialogue for training in the port sector	2	67%		A			B			C			D	
MT9	Awareness campaigns for behavioural change	2	33%		A			B			C			D	
MT11	Diversification of trade using climate resilient commodities	3	67%								C				
MT12	Climate resilient economy and jobs	3	33%								C				
MT13	Refrigeration, cooling and ventilation systems	4	75%								C			D	
MT14	Restrict development and settlement in low-lying areas	4	25%								C			D	
MT16	Increase operational speed and flexibility in ports	5	58%					B							
MT15	Sturdiness improvement of vessels	5	42%					B							
MT17	Climate proof ports and port activities	6	50%		A			B			C			D	
MT18	Consider expansion/retreat of ports in urban planning	6	50%		A			B			C			D	
MT20	Early Warning Systems (EWS) and climate change monitoring	7	58%								C				
MT19	Reinforcement of inspection, repair and maintenance of	7	42%								C				
MT21	Inteligent Transport Systems (ITS)	8	75%		A										
MT22	Prepare for service delays or cancellations	8	25%		A										
MT24	Post-Disaster recovery funds	9	58%		A									D	
MT23	Backup routes and infrastructures during extreme weather	9	42%		A									D	
MT4	Combined protection and wave energy infrastructures	10	56%		A			B			C			D	
MT3	Marine life friendly coastal protection structures	10	44%		A			B			C			D	
MT6	Coastal protection structures	11	54%					B			C				
MT5	Hybrid and full electric ship propulsion	11	46%					B			C				
MT7	Integrate ports in urban tissue	12	83%								C				
MT8	Ocean pools	12	17%								C				

Figure 159 - Adaptation options for the Maritime Transport sector. Options are identified with an ID number, full name, and class of adaptation number. Adaptation objectives are identified in each option by colour: ***vulnerability reduction (red),*** *Disaster* ***Risk Reduction (blue); Social-Ecological Resilience (green);*** *Local Knowledge adaptation options (grey). Each ATP (APT A; APT B; APT C; APT D) is represented in three timeframes: S - Short term (up to 2030), M- Medium term (up to 2050), L - Long term (until 2100). Bold letters in each ATP indicate the option was available to be selected. Highlighted options indicate the measure was selected in each ATP and timeframe: ATP A (light*

blue); ATP B (light green); ATP C (Light orange) and ATP D (light purple). Space with colour: option was selected for the timeframe: Short term, Medium term, or Long term. Bold letter: option is available in the APT.

The Sicilian maritime transport sector adaptation pathways are characterized by a significant heterogeneity across the four potential adaptation policy trajectories (APTs). In general, a certain combination of investment and commitment, then a certain level of concrete involvement emerge for this sector.

As in the Tourism sector, the most selected option for Maritime Transport is in the class of the **Social-Ecological Resilience** and it is considered the best for all the timeframes and with a combination of medium investment and commitment (APT B and C). For this class there is a certain availability in investment for the medium and long term, mainly concerning the coastal protection, which represent a priority also in respect of alternative and sustainable propulsions for ships. These ones are selected as long-term option in APT B and C. Ocean pools are not considered a measure to implement in Sicily. The orientation is toward the improvement of the infrastructures with medium long-term strategies and investments.

In the context of **Risk Reduction** class of adaptation, the selection of the different measures is different both in terms of timeframes and in terms of combination among investments and commitment. The most selected measures concern the creation of an Intelligent Transport System but in APT A, then with low investment and low commitment. The other options are the post disaster recovery (APT A low investment and commitment) to react to the impacts and the prevention systems to avoid negative effects (APT C – low investments and medium commitment). The two risk mitigation options are considered equally desired. Prepare for service delays or cancellations, instead, is not considered as a priority and could be a strategy only in the short time under APT C and D.

For the **vulnerability reduction** the Physical, Social and Human capital represent a priority option in the mid-long term for APT C and D. Particularly, all these three options are considered in APT C, then with a low level of investment and medium commitment, at least for the mid and long term. The financial instruments are equally preferred. Specifically, the insurance mechanisms fit well in the mid and long term, while the financial incentives are useful in the short term, in APT B and D. For almost all the measure included in this class of adaptation, the orientation is towards a certain combination of investment and commitment, then a certain level of involvement. Only for the Human Capital option the choice is for APT A.

3.2.2 Sustainability Performance

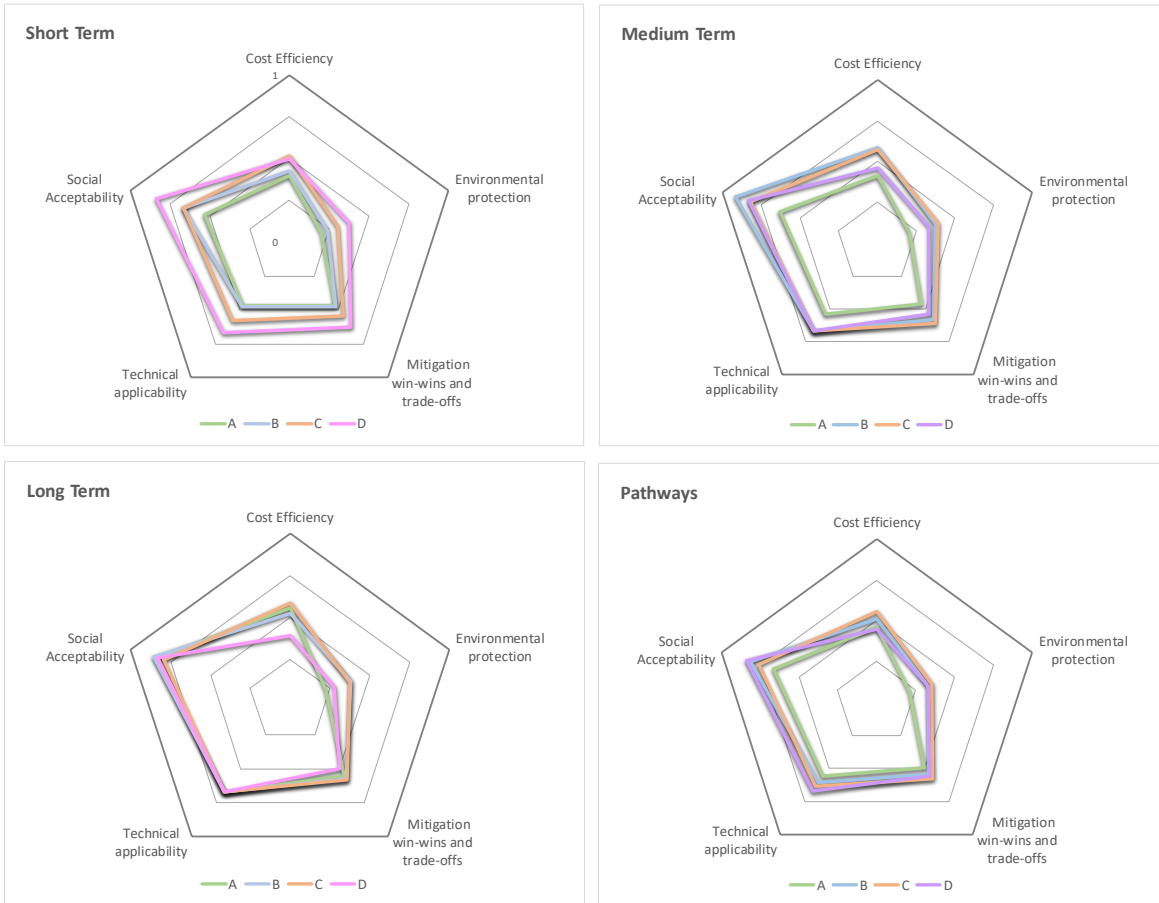

Figure 160 - Pathways evaluation for Maritime Transport sector considering: Cost Efficiency; Environmental protection; Mitigation (GHG emissions) win-wins and trade-offs; Technical applicability; Social acceptability. The policy pathways scenarios: APT A - Minimum Intervention; APT B - Economic Capacity Expansion (ECE); APT C- Efficiency Enhancement (EE); APT D - System Restructuring (SR), for different timeframes: short, medium, long term

All four adaptation pathways for the maritime transport sector reveal a similar structure in terms of their sustainability performance, especially from 2050 up to 2100. These pathways are comprised of measures that have a relatively high social acceptability and technical acceptability, medium level for mitigation objectives and cost-efficiency. These sector pathways will not perform in terms of future environmental protection.

More specifically, APT C has the best general performances in terms of cost efficiency, environmental protection and mitigation. APT D has the best results for social acceptability and technical applicability. Considering the different timeframes, in the short term, APT D has the best combination except than for the cost efficiency aspect. In the medium and long timeframes, the APT B shows the better mix for all the dimension.

All the pathways are characterised by a high degree of social acceptability, especially in the mid-long time.

This project has received funding from the European Union's Horizon 2020 research and innovation programme under Grant Agreement No776661

3.3 Energy

Energy pathways are based on choices made by 3 expert island stakeholders.

3.3.1 Selected Adaptation Pathways

ID	Name	Class number	Ratio
E13	Energy storage systems	4	78%
E9	Green jobs and businesses	2	69%
E8	Heated pools with waste heat from power plants	12	67%
E20	Grid reliability	7	67%
E11	Small scale production and consumption (prosumers)	3	67%
E4	Underground tubes and piping in urban planning	10	56%
E23	Energy recovery microgrids	9	56%
E21	Study and develop energy grid connections	8	56%
E17	Review building codes of the energy infrastructure	6	56%
E16	Demand Side Mangement (DSM) of Energy	5	56%
E2	Financial support for smart control of energy in houses and	1	56%
E5	Biomass power from household waste	11	50%
E6	Urban green corridors	11	50%
E1	Financial support for buildings with low energy needs	1	44%
E15	SeaWater Air Conditioning (SWAC).	5	44%
E18	Upgrade evaporative cooling systems	6	44%
E22	Energy-independent facilities (generators)	8	44%
E24	Local recovery energy outage capacity	9	44%
E3	Energy efficiency in urban water management	10	44%
E12	Risk reporting platform	3	33%
E19	Early Warning Systems (EWS)	7	33%
E7	Educational garden plots	12	33%
E10	Public information service on climate action	2	31%
E14	Collection and storage of forest fuel loads	4	22%

ID	Name	Class number	Ratio	APT A			APT B			APT C			APT D		
				S	M	L	S	M	L	S	M	L	S	M	L
E2	Financial support for smart control of energy in houses and	1	56%					**B**						**D**	
E1	Financial support for buildings with low energy needs	1	44%					**B**						**D**	
E9	Green jobs and businesses	2	69%		**A**			**B**			**C**			**D**	
E10	Public information service on climate action	2	31%		**A**			**B**			**C**			**D**	
E11	Small scale production and consumption (prosumers)	3	67%								**C**				
E12	Risk reporting platform	3	33%								**C**				
E13	Energy storage systems	4	78%								**C**			**D**	
E14	Collection and storage of forest fuel loads	4	22%								**C**			**D**	
E16	Demand Side Mangement (DSM) of Energy	5	56%					**B**							
E15	SeaWater Air Conditioning (SWAC).	5	44%					**B**							
E17	Review building codes of the energy infrastructure	6	56%		**A**			**B**			**C**			**D**	
E18	Upgrade evaporative cooling systems	6	44%		**A**			**B**			**C**			**D**	
E20	Grid reliability	7	67%								**C**				
E19	Early Warning Systems (EWS)	7	33%								**C**				
E21	Study and develop energy grid connections	8	56%		**A**										
E22	Energy-independent facilities (generators)	8	44%		**A**										
E23	Energy recovery microgrids	9	56%		**A**									**D**	
E24	Local recovery energy outage capacity	9	44%		**A**									**D**	
E4	Underground tubes and piping in urban planning	10	56%		**A**			**B**			**C**			**D**	
E3	Energy efficiency in urban water management	10	44%		**A**			**B**			**C**			**D**	
E5	Biomass power from household waste	11	50%					**B**			**C**				
E6	Urban green corridors	11	50%					**B**			**C**				
E8	Heated pools with waste heat from power plants	12	67%								**C**				
E7	Educational garden plots	12	33%								**C**				

Figure 161 - Adaptation options for the Energy sector. Options are identified with an ID number, full name, and class of adaptation number. Adaptation objectives are identified in each option by colour: ***vulnerability reduction (red),*** *Disaster* ***Risk Reduction (blue); Social-Ecological Resilience (green);*** *Local Knowledge adaptation options (grey). Each ATP (APT A; APT B; APT C; APT D) is represented in three timeframes: S - Short term (up to 2030), M- Medium term (up to 2050), L - Long term (until 2100). Bold letters in each ATP indicate the option was available to be selected. Highlighted options indicate the measure was selected in each ATP and timeframe: ATP A (light blue); ATP B (light green); ATP C (Light orange) and ATP D (light purple). Space with colour: option was selected for the timeframe: Short term, Medium term, or Long term. Bold letter: option is available in the APT.*

In general, the energy sector in Sicily is characterized by heterogeneity concerning the selection of adaptation options in all adaptation policy trajectories (APTs). APT C is the prevailing combination of investment and commitment, highlighting as there is a wide awareness about the need to do something concretely improving the medium- and long-term scenarios.

Across all ATPs, for **vulnerability reduction**, pathways mainly rely on energy storage systems (Physical capital; ATP C and D) and green jobs (Human capital; all ATPs). Both the options are considered at least for the mid and long time. In contrast, public information on climate action (also Human capital; APT B and C) is not a priority since it is assumed that there is and will be a sufficient level public information in the island for it to pursue climate action. At the same way, the collection of forest fuel loads is part of pathways D for the short term, but it relies as last option. The Natural capital and the Financial one are considered always of equal importance in the context of vulnerability reduction. Moreover, the Financial capital is considered necessary, almost with equal intensity, and with a certain combination of investment and commitment, in APT B and D.

For **Disaster Risk Reduction**, the Grid reliability is the most selected option in APT C, for the mid and long term. On the opposite, the Early Warning System is not a priority, chosen only in APT C as a short-term measure. The options within the classes Risk mitigation, Disaster response and Post disaster recovery have the same distribution of preference. Particularly, the options with the higher percentage (56%) are valid for the short and the long term, instead the remaining ones are chosen for the medium timeframe. Moreover, Review building codes and Generators are present in all the APTs for all the timeframes.

Regarding **Social-Ecological Resilience**, Heated pools with waste heat from power plants is considered a priority in all the timeframes of APT C. Except that for underground tubes and piping in urban planning, chosen for all the APTs, the other measures are characterized by a certain degree of investment and commitment (APT B and C). The options in the Regulating and Maintenance Services class are considered equally relevant and with the same degree of priority. The educational gardens are not a priority, then it seems that there is enough awareness and knowledge about climate implication in Energy Sector.

3.3.2 Sustainability Performance

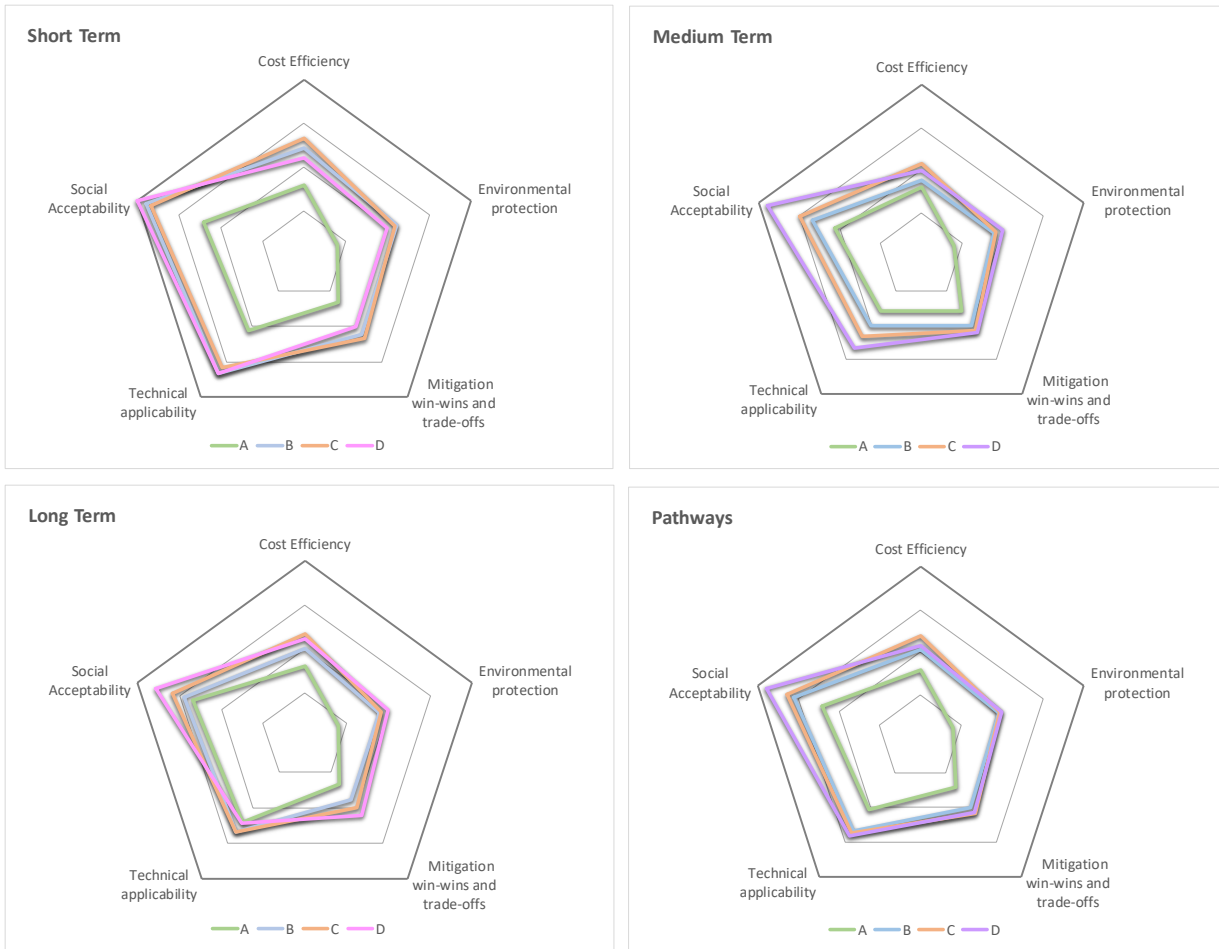

Figure 162 - Pathways evaluation for Energy sector considering: Cost Efficiency; Environmental protection; Mitigation (GHG emissions) win-wins and trade-offs; Technical applicability; Social acceptability. The policy pathways scenarios: APT A - Minimum Intervention; APT B - Economic Capacity Expansion (ECE); APT C- Efficiency Enhancement (EE); APT D - System Restructuring (SR), for different timeframes: short, medium, long term

In general, the best performance in term of cost efficiency is in APT C, while the APT D has the higher results for the other dimensions. APT A shows the worst results in all the dimensions, especially in cost efficiency, mitigation and environ mental protection.

In the short timeframe, APT B provides the best environmental protection, the APT C the best combination of cost efficiency and mitigation, the APT D the best performances in terms of technical applicability and social acceptability. In the medium time, cost efficiency has the best results in APT C, instead APT D prevails in the other dimensions. In the long term, APT C has the best combination for cost efficiency and technical applicability, while APT D in the other dimensions.

Also, in this case social acceptability shows the higher results in all the APTs and all the timeframes.

SOCLIMPACT

This project has received funding from the European Union's Horizon 2020 research and innovation programme under Grant Agreement No776661

3.4 Aquaculture

Aquaculture pathways are based on choices made by 4 expert island stakeholders.

3.4.1 Selected Adaptation Pathways

ID	Name	Class number	Ratio
A15	Recirculation Aquaculture Systems (RAS)	5	75%
A13	Integrated multi-trophic aquaculture (IMTA)	4	71%
A8	Promote aquaculture cuisine	12	67%
A6	Best Management Practices	11	67%
A3	Feed production	10	60%
A20	Environmental monitoring and Early Warning Systems (EWS)	7	58%
A18	Risk-based zoning and site selection	6	58%
A12	Promote cooperation to local consumption	3	58%
A10	Efficient feed management	2	58%
A23	Recovery Post-Disaster plans	9	54%
A21	Mainstreaming Disaster Risk Management (DRM)	8	50%
A22	Contingency for emergency management, early	8	50%
A1	Financial schemes, insurance and loans	1	50%
A2	Tax benefits and subsidies	1	50%
A24	Recovery Post-Disaster funds	9	46%
A19	Disease prevention methods	7	42%
A17	Climate proof aquaculture activities	6	42%
A11	Addressing consumer and environmental concerns at the	3	42%
A9	Awareness campaigns for behavioural change	2	42%
A4	Species selection	10	40%
A7	Create educational visits	12	33%
A5	Selective breeding	11	33%
A14	Short-cycle aquaculture	4	29%
A16	Submersible cages	5	25%

ID	Name	Class number	Ratio	APT A			APT B			APT C			APT D		
				S	M	L	S	M	L	S	M	L	S	M	L
A1	Financial schemes, insurance and loans	1	50%		A			**B**			C			**D**	
A2	Tax benefits and subsidies	1	50%		A			**B**			C			**D**	
A10	Efficient feed management	2	58%		**A**			**B**			**C**			**D**	
A9	Awareness campaigns for behavioural change	2	42%		**A**			**B**			**C**			**D**	
A12	Promote cooperation to local consumption	3	58%		A			B			**C**			D	
A11	Addressing consumer and environmental concerns at the	3	42%		A			B			**C**			D	
A13	Integrated multi-trophic aquaculture (IMTA)	4	71%		A			B			**C**			**D**	
A14	Short-cycle aquaculture	4	29%		A			B			**C**			**D**	
A15	Recirculation Aquaculture Systems (RAS)	5	75%		A			**B**			C			D	
A16	Submersible cages	5	25%		A			**B**			C			D	
A18	Risk-based zoning and site selection	6	58%		**A**			**B**			**C**			**D**	
A17	Climate proof aquaculture activities	6	42%		**A**			**B**			**C**			**D**	
A20	Environmental monitoring and Early Warning Systems (EWS)	7	58%		A			B			**C**			D	
A19	Disease prevention methods	7	42%		A			B			**C**			D	
A21	Mainstreaming Disaster Risk Management (DRM)	8	50%		**A**			B			C			D	
A22	Contingency for emergency management, early	8	50%		**A**			B			C			D	
A23	Recovery Post-Disaster plans	9	54%		**A**			B			C			**D**	
A24	Recovery Post-Disaster funds	9	46%		**A**			B			C			**D**	
A3	Feed production	10	60%		**A**			**B**			**C**			**D**	
A4	Species selection	10	40%		**A**			**B**			**C**			**D**	
A6	Best Management Practices	11	67%		A			**B**			**C**			D	
A5	Selective breeding	11	33%		A			**B**			**C**			D	
A8	Promote aquaculture cuisine	12	67%		A			B			**C**			D	
A7	Create educational visits	12	33%		A			B			**C**			D	

Figure 9 - Adaptation options for the Aquaculture sector. Options are identified with an ID number, full name, and class of adaptation number. Adaptation objectives are identified in each option by colour: ***vulnerability reduction (red),*** *Disaster* ***Risk Reduction (blue); Social-Ecological Resilience (green);*** *Local Knowledge adaptation options (grey). Each ATP (APT A; APT B; APT C; APT D) is represented in three timeframes: S - Short term (up to 2030), M- Medium term (up to 2050), L - Long term (until 2100). Bold letters in each ATP indicate the option was available to be selected. Highlighted options indicate the measure was selected in each ATP and timeframe: ATP A (light blue); ATP B (light green); ATP C (Light orange) and ATP D (light purple). Space with colour: option was selected for the timeframe: Short term, Medium term, or Long term. Bold letter: option is available in the APT.*

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In general, the Aquaculture sector in Sicily is characterized by a heterogeneous selection of adaptation options in all adaptation policy trajectories (APTs). APT A prevails in Disaster Risk Reduction class of adaptation, APT B and C are the prevalent choice in Social Ecological Resilience measures, while the vulnerability reduction is characterized by a certain combination of APT B, C and D. This show the degree of commitment and investment associated to each class.

The most selected measures concern **vulnerability reduction**, that is Recirculation Aquaculture Systems and Integrated multi-trophic aquaculture. These options are selected for all the timeframes respectively in APT B for the first one and APT C and D for the other one. Since they are perceived as urgent, a priority, there is a certain degree of investment and commitment towards them. The measures concerning Human and Social Capital are selected for all the ATPs and different timeframes and show the same share of preference within each class. The instruments within the Financial capital measures are considered of equal importance, so the choice among the two options is indifferent. Short cycle aquaculture and Submersible cages are the less selected then they don't represent a priority.

For **Disaster Risk Reduction**, the Disaster response measures are considered of equal relevance, then the choice among the two options is indifferent. The monitoring and the implementation of a warning plan are considered a priority option, showing that the prevention measures and tools are fundamental. All the measures included in this category of class of adaptation have a certain level of relevance for local experts, indeed they are in all the APTs and in all the timeframes

Regarding **Social-Ecological Resilience**, the measures with the higher score are considered for all the timeframes within the single ATP in which they are selected. Promote aquaculture and Best management practices consider a different combination of investment and commitment (ATP B and C) but they are considered valid in the short, medium and long term. The feed production is the option universally selected for all the ATPs and the times. In this field the need for measure addressing different aspect emerges.

3.4.2 Sustainability Performance

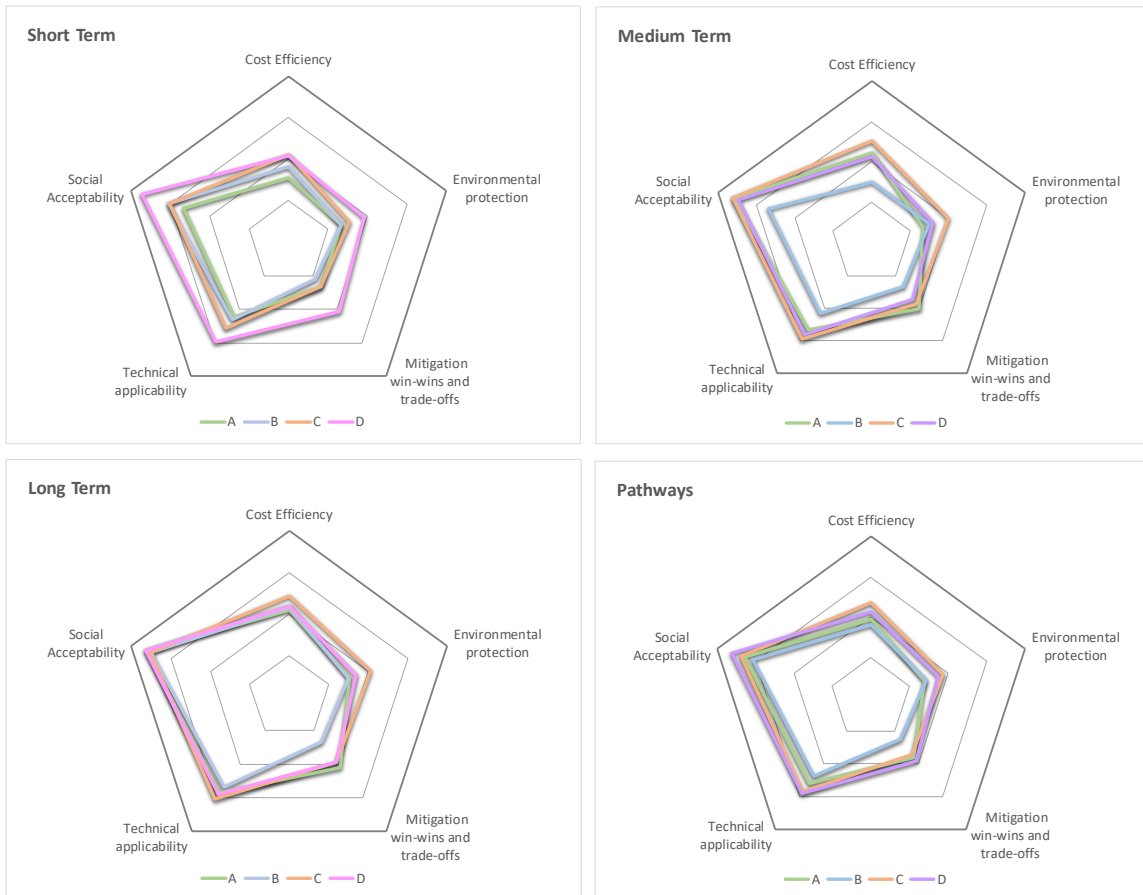

Figure 10 - Pathways evaluation for Energy sector considering: Cost Efficiency; Environmental protection; Mitigation (GHG emissions) win-wins and trade-offs; Technical applicability; Social acceptability. The policy pathways scenarios: APT A - Minimum Intervention; APT B - Economic Capacity Expansion (ECE); APT C- Efficiency Enhancement (EE); APT D - System Restructuring (SR), for different timeframes: short, medium, long term

All the pathways in the Energy sector have a similar evaluation across all timeframes, in general terms.

The APT B has the worst results in terms of cost efficiency, mitigation and environmental protection. APT D the best mix in all the dimensions except for the environmental protection for which the APT C has a higher score.

More specifically, APT D has the best performances in the short period, the APT C in the medium and long timeframe.

In general, the dimension with the best results are the social and technical ones, especially in mid-long time. Environmental protection and mitigation record the worst results in all the timeframes and almost in all the APTs.

4 Webinars

4.1 1st Webinar

4.1.1 Objectives

1. The context of the Project: Sectors, Models and Outputs

2. Background material to support your decisions.

3. Present the Online Survey Tool – Design of adaptation pathways for Sicily.

   - Adaptation options up to 2030, 2050 and until the end of the century

   - How to fill in and submit the Online Survey Tool

4.1.2 Agenda

Workshop Regionale On Line

Giovedì, 8 Ottobre 2020
15:30 – 17:30

Sviluppo di percorsi di adattamento climatico nei settori della Blue Economy in Sicilia

Programma

15:30 - 15:40 (10 Minuti)	Saluti • Dott. Marcelo Mautone *SOCLIMPACT Project Manager* • Prof. Giovanni Ruggieri *Presidente dell'Osservatorio sul Turismo nelle Isole Europee - OTIE*
15:40 – 15:45 (5 minuti)	Introduzione al progetto SOCLIMPACT
15:45 – 16:00 (15 Minuti)	Principali evidenze per la Sicilia – Progetto SOCLIMPACT • Dott. ssa Patrizia Calò - *Osservatorio sul Turismo nelle Isole Europee - OTIE*
16:00 – 16:40 (Esperti locali - 40 minuti)	• Dott. Marco Mineo – *Presidente Assohotel Palermo* • Prof. Giuseppe Salvo - *Professore Associato di Tecnica ed Economia dei Trasporti – DICAM - UNIPA* • Dott. Vincenzo Maccarrone - *Gestione Integrata della fascia costiera e pianificazione dello spazio marittimo – CNR* • Dott. Alfonso Milano - *Dirigente Servizio 2 Pesca e acquacoltura Dipartimento della Pesca Mediterranea - Regione Siciliana*

16:40 – 17:00 (20 Minuti)	Sviluppo dei percorsi di adattamento - Presentazione dello strumento di indagine
17:00 – 17:10 (10 Minuti)	Dibattito/Domande e risposte
17:10 – 17:15 (5 Minuti)	Conclusione e ulteriori sviluppi

4.3 2nd Webinar

4.3.1 Objectives

- Present the final *Pathways Adaptation* for Sicily

- Discuss the *Pathways Adaptation* results

4.3.2 Agenda

II Workshop Regionale On Line

Martedì, 17 Novembre 2020
11:00 – 13:00

Sviluppo di percorsi di adattamento climatico nei settori della Blue Economy in Sicilia

Programma

11:00 - 11:10 (10 Minuti) Saluti

- Prof. Giovanni Ruggieri
  Presidente dell'Osservatorio sul Turismo nelle Isole Europee – OTIE

11:10 – 11:20 (10 minuti) Progetto SOCLIMPACT

- Dott.ssa Patrizia Calò
  Osservatorio sul Turismo nelle Isole Europee - OTIE

11:20 – 11:35 (15 Minuti) Partecipazione locale ed influenza sul *Policy Decision Making*

- Dott. Alessandro Pernice
  ARCES Collegio Universitario di Merito

11:35 – 12:00 (25 Minuti) Sviluppo dei percorsi di adattamento - Presentazione dell'indagine e dei risultati

- Dott.ssa Patrizia Calò
  Osservatorio sul Turismo nelle Isole Europee - OTIE

12:00 – 12:20 (20 Minuti) Assessing Socioeconomic Impacts of Climate Change Scenarios with the GEM-E3-ISL model – Sicily

- Dr Ioannis Charalampidis
  E3-Modelling

12:20 – 12:30 (10 Minuti)	Dibattito
12:30 – 12:40 (10 Minuti)	Conclusione e ulteriori sviluppi

4.4 List of participants

1st Webinar

Nome	Cognome	Ente
Vincenzo	Maccarrone	CNR
Olga	Annibale	Unci agroalimentare
Domenico	Santacolomba	Regione Siciliana - Dipartimento dell'Energia
Assonautica		Assonautica Associazione Prov. per la Nautica da Diporto - Palermo
Andrea	Fabris	Associazione Piscicoltori Italiani
Angelo	Sciacca	Edinburgh Napier University
Stefania	Valentini	FEDERPESCA
Federico	Gallas	FEDERPESCA
Alessandro	Gibertini	Università degli Studi di Milano Bicocca
GIOVANNI	VACANTE	AGENZIA REGIONALE PER LA PROTEZIONE DELL'AMBIENTE
Giovanni	Basciano	AGCI AGRITAL
Marco	Platania	Università degli Studi di Catania
Giuseppe	Salvo	Università di Palermo
Luigi	Neri	Regione Siciliana - Servizio Informativo agrometeoroligico Siciliano
ALFONSO	MILANO	REGIONE SICILIANA - DIP. PESCA MEDITERRANEA
Andrea	Santulli	Università di palermo
Sebastiano	Calvo	Universitá di Palermo
Agostino	Tomasello	Università degli Studi di Palermo DiSTeM
Giuseppe	Ciraolo	Università di Palermo
Giovanni	Ruggieri	OTIE
Filippo	Grasso	Università degli studi di Messina
Sara	Di Salvo	Climate KIC Pioneer/ Aquabiotech
Marco	Mineo	Assohotel Confesercenti Palermo
Franco	Andaloro	Stazione zoologica Anton dhorn

2nd Webinar

Nome	Cognome	Ente
Alessandro	Pernice	Collegio Universitario di Merito ARCES
Alessandro	Gibertini	Università degli Studi di Milano Bicocca
vincenzo	maccarrone	IRBIM-CNR

Federica	Terranova	Legambiente
Teresa	Caltabiano	Università degli Studi di Catania
Giuseppe	Di Natalee	Forum Terzo Settore Sicilia
Demetrio	Milea	Università degli Studi di Messina
Giovanni	Basciano	AGI Agrital
Tiziana	Fiscella	Consorzio Acquacoltura Sicilia
Tiziana	Fiscella	Mediterranea pallet srl
Marco	Platania	università degli studi di catania
Giovanni	Ruggieri	OTIE - UNIPA

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5 Annexes - Sicily

5.1 Adaptation Options Evaluation

5.1.1 Tourism

Table 48 – Adaptation option characterization for Tourism sector

Options Characterization				Criteria				
ID	Name	Description	Class of adaptation	Cost Efficiency	Environmental protection	Mitigation (GHG emissions) win-wins and trade-offs	Technical applicability	Social Acceptability
T1	**Economic Policy Instruments (EPIs)**	Economic Policy Instruments (EPIs) are incentives designed and implemented with the purpose of adapting individual decisions to collectively agreed goals. Diferent type of instruments can be aplied, like: pricing (e.g. water tariffs), environmental taxes and charges, subsidies; trading (e.g tradable permit for pollution or water abstraction, compensation mechanisms, payments for environmental services); and voluntary agreements and risk management schemes such as insurances.	1. Financial capital	2	3	3	3	3
T2	**Financial incentives to retreat from high-risk areas**	Financial incentives to retreat from high-risk areas refers to the creation of financial incentives to retreat or relocate settlements, infrastructure and productive activities from the original location due to their high exposure to risks such as flood, sea-level rise and storm surges.	1. Financial capital	2	2	2	3	3
T3	**Adaptation of groundwater management**	Adaptation of groundwater management can be used to (1) conserve groundwater reservoirs, limiting water use and optimizing water reuse, and (2) restore or increase natural infiltration capacity. Both contribute to adaptation in circumstances of reduced precipitation and sea saltwater intrusion aggravated with groundwater over-exploitation. Different packages of interventions usually inlcude: freshwater injection, modifying pumping practice, delayed inflow, artificial recharge or efficient use of freshwater.	10. Provisioning services	2	3	3	3	3
T4	**Monitoring, modelling and forecasting systems**	Monitoring, modelling and forecasting systems are information system that provide timely and reliable climate information, as well as up-to-date data on the occurrence and severity of extreme events, possible impacts and their duration. Different systems can be implemented to respond to different climate hazards, such as drought-related, water quality monitoring, water resources management and predicting and managing flood risks.	10. Provisioning services	3	3	3	3	3
T5	**Dune restoration and rehabilitation**	Dune restoration and rehabilitation refers to the strengthening of the flood safety and sand reservoir functions of dunes. Dune erosion happens as a result of wind action, marine erosion, human activities and Sea Level Rise (SLR). Possible technics examples include: grass planting, thatching and fencing.	11. Regulating and Maintenance Services	3	3	3	3	4

T6	**River rehabilitation and restoration**	River rehabilitation and restoration are measures that emphasise the natural functions of rivers and create vegetated buffer zones alongside watercourses. This contributes to the improvement of micro-climatic conditions, reduces run-off and erosion, and increases groundwater recharge. For Tourism, this option also increases available leisure areas, increases thermal comfort areas and the availability of water.	11. Regulating and Maintenance Services	3	3	3	3	3
T7	**Adaptive management of natural habitats**	Adaptive management of natural habitats refers to the preservation of ecosystem services which are essential for human well-being. Human activities induce pressure and impacts on biodiversity and ecosystems that tend to be aggravated by climate change. Adaptive management measures include: understanding species response; make space for the development of rivers and coasts; aid gene flow; species translocation; targets and conservation mechanisms/plans.	12. Cultural services	3	3	2	3	3
T8	**Ocean pools**	Ocean pools are seawater pools located by the sea where waves can wash into the pool. The width, length and depth of ocean pools varies and often depends on their location on the coastline. These recreational structures are useful on SLR context, doubling as an additional protection of the coast and creating alternatives to beach leisure areas.	12. Cultural services	3	3	3	3	3
T9	**Activity and product diversification**	Activity and product diversification include actions to diversify the tourism activities and products and aim to reduce seasonality and overload in infrastructures and ecosystems. Shifting the dependency from 'sun, sea and sand' products to alternative leisure activities can reduce the impacts of heat waves, coastal erosion or ecosystem degradation, and thus help to maintain destination attractiveness.	2. Human capital	3	3	3	3	4
T10	**Public awareness programmes**	Public awareness programmes establish targeted programmes that raise awareness about climate change (specific values and protection needs) among guides, site managers and local communities.	2. Human capital	3	3	3	4	4
T11	**Local circular economy**	Local circular economy is an economic system aimed at eliminating waste and the continual use of resources that offers a valuable framework for reduced carbon emissions from materials (decarbonization) and increased resilience to climate change and its impacts.	3. Social capital	3	3	3	3	4
T12	**Tourist awareness campaigns**	Tourist awareness campaigns target behavioural change of visitors and aim to increase tourists (individuals and organisations) knowledge about climate change and the risk faced by tourism destinations. These campaigns can be targeted to regions affected by a particular climate threat, specific groups of visitors or the general tourism sector as a whole.	3. Social capital	3	3	2	4	4
T13	**Local sustainable fishing**	Local sustainable fishing refers to the promotion of fishing zones/rights for local small-scale fishers maintaining stocks and using sustainable methods. This option aims to add value to local resources and products, protect ecosystems services and decrease external dependency.	4. Natural capital	3	3	3	3	4
T14	**Water restrictions, consumption cuts and grey-water recycling**	Restrictions can be applied to allow water administration services to cope with water crises. Restriction (or rationing) of certain uses of water such as irrigation of lawns, car washing, filling swimming pools or hosing down pavement areas may be necessary during these times. Grey-water recycling (or reclamation) is the reuse of non-drinkable water (usually treated waste water) to cover water use needs that don't demand such a high-quality standard.	4. Natural capital	2	3	3	3	2
T15	**Beach nourishment**	Beach nourishment (or replenishment) is the artificial placement of sand to compensate for erosion. Beach nourishment also often aims at maintaining beach width (for tourism and recreational purposes). Several beach nourishment	5. Physical capital	2	3	3	3	3

		techniques can be used including beach, backshore and shoreface nourishment, and large scale coastal nourishment (e.g. using sand motors).						
T16	**Desalination**	Desalination is the process of removing salt from sea or brackish water to make it useable for a range of purposes including drinking, and can contribute to adaptation in circumstances of current or future water scarcity problems. Technological examples include electrically driven technologies, like reverse osmosis, and thermally driven technologies, based mainly on vapor distillation processes.	5. Physical capital	2	3	3	3	3
T17	**Coastal protection structures**	Coastal protection structures such as groynes, breakwaters, artificial reefs and seawalls are different types of artificial structures, built in the shoreline (or rivers), which are designed to protect the coast from SLR or storms. Those structures can be used to, for example, drift and trap sediments, protect from erosion, absorb wave energy, or allow navigation.	6. Managing long term risk	2	3	2	3	3
T18	**Drought and water conservation plans**	Drought and water conservation plans refer to tourism-lead adaptation and/or involvement in drought management plans with the aim to reduce the economic, social, and environmental consequences of drought and water scarcity, and to reduce the loss of water and improve efficiency in the sector.	6. Managing long term risk	3	3	3	3	4
T19	**Mainstreaming Disaster Risk Management (DRM)**	Mainstreaming Disaster Risk Management (DRM) aims to plan and organize DRM along five stages including prevention, protection, preparedness, and response, recovery and review. Examples include interventions to limit urban development in flood prone areas; identify natural hazard prone areas; develop strategies, arrangements, and procedures to address crises; and post-emergency recovery activities.	7. Preparedness	3	3	3	3	4
T20	**Using water to cope with heat waves**	Water use to cope with heat waves in cities are a set of investments in water supply services and infrastructures that aim to increase urban resilience regarding heat waves. Different packages of grey interventions are usually applied, as for example: creating and/or repairing fountains for drinking water and cooling; water spray fountains; and wetting streets.	7. Preparedness	2	2	2	3	4
T21	**Fire management plans**	Fire management plans are management actions have wide range of application such as early warning detection, with escape routes and advice to local citizens and tourists, mobilization and suppression of unwanted and damaging fires, or use of fire to manage fuel. Additionally, these plans help to increase the understanding of the interactions of climate change with vegetation cover and fire regimes.	8. Response	3	1	1	3	4
T22	**Health care delivery systems**	Health care delivery systems are pre-emptive actions and adjustments that need to be made to health care systems, namely reinforcing less prepared aspects of its operation and/or logistics, in order to guarantee effectiveness and efficiency during, for example, high temperature and heat-wave situations.	8. Response	3	1	1	3	4
T23	**Post-Disaster recovery funds**	Post-Disaster recovery funds is the creation of recovery funds for the Tourism sector to recover after disasters, through initiatives that get the economy up and running quickly while building-back-better (e.g. rebuild damaged critical infrastructures such as ports and roads or recorver the landscape from fires). The aim is to minimize the economic and social impacts (which may include future loss of the touristic destination attractiveness) that can occur in a post-disaster context.	9. Post disaster recovery and rehabilitation	2	1	2	3	4
T24	**Pre-disaster early recovery planning**	Pre-disaster early recovery planning processes include the development of knowledge, good practices and objectives that aim to improve the living conditions of the affected communities, while facilitating the adjustments necessary to reduce the risk of future disasters. Examples of good practices are	9. Post disaster recovery and rehabilitation	3	2	2	3	4

		may include identifying critical ecosystems (goods and services) that require immediate restoration after a disaster or particularly vulnerable communities.						

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5.1.2 Maritime Transport

Table 49 – Adaptation option characterization for Maritime Transport sector

Options Characterization				Criteria				
ID	Name	Description	Class of adaptation	Cost Efficiency	Environmental protection	Mitigation (GHG emissions) win-wins and trade-offs	Technical applicability	Social Acceptability
MT1	**Insurance mechanisms for ports**	Insurance mechanisms for ports include risk-sharing schemes that aim to assist port operators in responding to the climate risks they are enabled to reduce. Insurance outsources the risks to a third party in exchange for a regular financial compensation.	1. Financial capital	2	1	2	3	4
MT2	**Financial incentives to retreat from high-risk areas**	Financial incentives to retreat from high-risk areas refers to the creation of financial incentives to retreat or relocate settlements, infrastructure and productive activities from the original location due to their high exposure to risks such as flood, sea-level rise and storm surges.	1. Financial capital	3	2	3	3	4
MT3	**Marine life friendly coastal protection structures**	Marine life friendly coastal protection structures are coastal protection structures constructed with materials that maximize the fixation of marine organisms. This option reduces climate change impacts on local ecosystems, provides water waste depuration (made by marine organisms) and water quality bio-indicators inside the ports.	10. Provisioning services	3	3	3	3	4
MT4	**Combined protection and wave energy infrastructures**	Combined protection and wave energy infrastructures is an energy measure that combines sea protection structures with wave energy production. This can create economies of scale, increase coastal protection and further decrease wave propagation inside the port during normal operations.	10. Provisioning services	3	3	3	3	4
MT5	**Hybrid and full electric ship propulsion**	Hybrid and full electric ship propulsion is environmentally friendly for marine life, decreases carbon emissions and can increase ship manoeuvrability which is useful in small ports and under difficult weather conditions. Low speed manoeuvring with conventional engines creates air and water pollution, noise and fuel consumption. Electrically driven propulsion can address these issues while increasing manoeuvrability using for instance azimuth thrusters.	11. Regulating and Maintenance Services	3	3	3	3	4
MT6	**Coastal protection structures**	Coastal protection structures such as groynes, breakwaters, artificial reefs and seawalls are different types of artificial structures, built in the shoreline (or rivers), which are designed to protect the coast from SLR or storms. Those structures can be used to, for example, drift and trap sediments, protect from erosion, absorb wave energy, or allow navigation.	11. Regulating and Maintenance Services	3	2	3	3	4
MT7	**Integrate ports in urban tissue**	Integrate ports into the urban tissue opening port areas to other activities, namely cultural, while gaining room in the urban landscape. This allows some port activities to be pooled from low-laying areas while leisure and cultural activities can access more waterfront space.	12. Cultural services	3	1	2	3	4

MT8	**Ocean pools**	Ocean pools are situated by the sea where waves can wash into the pool. The width, length and depth of ocean pools varies and often depends on their location on the coastline. These recreational structures are a response to SLR, protect the coast and create alternatives to beach leisure areas.	12. Cultural services	3	3	3	3	4
MT9	**Awareness campaigns for behavioural change**	Awareness campaigns for behavioural change aim to increase individuals and organisations' knowledge about climate change and the risk faced by the maritime transport sector. These campaigns can be targeted to regions affected by a particular climate threat, specific groups of infrastructures or the general transport sector as a whole.	2. Human capital	2	2	3	3	4
MT10	**Social dialogue for training in the port sector**	Social dialogue for training in the port sector refers to social and educational issues related with the gender equality and attracting the young to the sector, while tackling climate change. It relies on social dialogue between workers and employees to define common guidelines for training. It considers key challenges that ports are facing and how the industry is adapting to change and preparing for the future.	2. Human capital	2	2	2	3	3
MT11	**Diversification of trade using climate resilient commodities**	Diversification of trade using climate resilient commodities aims to reduce dependency on trade of perishable goods and critical services, create larger stocks of goods that are climate resilient and consider were changing trading systems to endure changes in climate is economically feasible, strategically justifiable and equitable.	3. Social capital	3	2	3	3	3
MT12	**Climate resilient economy and jobs**	Climate resilient economy and jobs aims to shift the economy and jobs towards a more climate resilient society. Perishable goods and some critical services rely heavily on the marine transport which can be affected by unpredictable extreme weather events. To address this the economy needs to adapt by shifting to products and services that depend less on Just In Time (JIT) operations, using for instance larger stocks.	3. Social capital	3	2	3	3	3
MT13	**Refrigeration, cooling and ventilation systems**	Improve the efficiency of refrigeration, cooling and ventilation systems in order to reduce costs in warmer weather and maintain operations during heat waves. Human thermal comfort provided by efficient ventilation and cooling is relevant to ensure the health and safety of passengers and port workers. Refrigeration is relevant for managing goods that need low temperatures.	4. Natural capital	2	2	3	3	3
MT14	**Restrict development and settlement in low-lying areas**	Restrict development and settlement in low-lying areas means to assure that ports are not further developed in low-laying areas exposed to SLR. Planning must consider the long-term potential risks.	4. Natural capital	3	3	3	3	3
MT15	**Sturdiness improvement of vessels**	Improve the strength of vessels to sea storms while decreasing the noise and increasing efficiency. Wave-induced loads on the ship structures are a major concern in hull design process. Ship owners should prefer designs that allow for more demanding wave regimes (for instance including the survivability to rouge waves).	5. Physical capital	2	1	2	2	3
MT16	**Increase operational speed and flexibility in ports**	Increase operational speed and flexibility in ports aims to increase the attractiveness of ship transport in order to capture more freight and passenger movement. This can promote a modal shift towards shipping and create new opportunities including those related with exports and tourism. Faster operations also reduce the effects of heat waves on goods and people as well as decarbonise the economy.	5. Physical capital	3	2	3	3	4
MT17	**Climate proof ports and port activities**	Climate-proof ports and port activities refers to investments that consider specific climate change projections to manage future risks in port infrastructures and improve operational safety conditions. These can include retrofitting or reconfiguring breakwaters and other port structures to avoid overtops and	6. Managing long term risk	2	2	3	3	3

		flooding due to storm surges, heavy precipitation, extreme heat, strong winds events and extreme swell conditions. The Copernicus Emergency Management Services (EMS) services can provide regarding climate change and disaster risk reduction.						
MT18	**Consider expansion/retreat of ports in urban planning**	Consider expansion/retreat of ports in urban planning means to consider the expansion or reallocation of areas for future maritime transport infrastructures due to climate change risks. The urban planning and expansion should consider the potential requirements for port expansion/retreat options.	6. Managing long term risk	3	2	3	3	3
MT19	**Reinforcement of inspection, repair and maintenance of infrastructures**	A continuous reinforcement of inspection, repair and maintenance of infrastructures aims to adapt monitoring to a new climate context. Changes in the frequency and/or intensity of storms, SLR or temperature, for example, may have impacts in infrastructure, increasing degradation of the materials and requiring new maintenance plans.	7. Preparedness	3	2	3	3	3
MT20	**Early Warning Systems (EWS) and climate change monitoring**	Early Warning Systems (EWS) is an information system with several components that assesses climate risks and relays that information to decision makers, companies utilities and the general public in real time. Transport operators should integrate this tool in procedures in order to protect the safety of people and goods. The collected data can also be used to study the evolution of climate impacts as time progresses, for instance the impact of heat waves and storms in operations.	7. Preparedness	3	2	3	3	3
MT21	**Inteligent Transport Systems (ITS)**	Inteligent Transport Systems (ITS) are technologies that relay automated and taylored data and safety-related messages to ships, regarding climate hazards and other relevant information. ITS use communication and information standards that are uniform and widely accepted by other ports that the island is linked to.	8. Response	3	1	3	3	3
MT22	**Prepare for service delays or cancellations**	Prepare for service delays or cancellations aims to promote the creation of new procedures, alternative options and channels to sell goods and transport passengers, as well as better communication to deal with delays or cancellations. Dealing with more frequency and/or intensity of storms (which will happen in some regions) improves port reputation and customer preferences.	8. Response	3	1	3	3	4
MT23	**Backup routes and infrastructures during extreme weather**	Backup routes and infrastructures during extreme weather aims to creates a post disaster response that ensures available alternatives when the main ports are damaged or inaccessible due to extreme weather events. It considers alternative ports and access roads. Alternative ports can be smaller in size, simpler and be used for other purposes, but should have a different location and orientation from the main ones.	9. Post disaster recovery and rehabilitation	3	2	3	3	3
MT24	**Post-Disaster recovery funds**	Post-Disaster recovery funds is the creation of recovery funds for the maritime transport sector to recover after disasters, through initiatives that get the economy up and running quickly while building-back-better (e.g. rebuild damaged critical infrastructures such as ports and roads). The aim is to minimize the economic and social impacts that can occur in a post-disaster context.	9. Post disaster recovery and rehabilitation	2	1	2	3	4

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5.1.3 Energy

Table 50 – Adaptation option characterization for Energy sector

Options Characterization				Criteria				
ID	Name	Description	Class of adaptation	Cost Efficiency	Environmental protection	Mitigation (GHG emissions) win-wins and trade-offs	Technical applicability	Social Acceptability
E1	**Financial support for buildings with low energy needs**	Financial schemes in the form of loans, subsidies or tax reliefs are ways to support the reduction of energy needs of new or existing buildings, making them address climate change in a more efficient manner. For example, architecture and construction materials that rely on passive thermal comfort reduce the use of energy for human comfort, so less air-conditioning is necessary in the cooling season.	1. Financial capital	2	3	3	3	4
E2	**Financial support for smart control of energy in houses and buildings**	The support of smart control of energy in houses and buildings allows for an efficient and automated use of energy that enables savings and creates synergies with utilities. For example, such a system could coordinate the automated opening vents with the air conditioning operation, avoiding energy consumption when possible. This will allow for the adaptation of buildings at a controlled cost, while complying with mitigation goals.	1. Financial capital	2	3	3	3	4
E3	**Energy efficiency in urban water management**	Energy efficiency in urban water management is the adaptation of urban design and construction for water conservation that avoids energy use under scarcity scenarios. For instance, Water Sensitive Urban Design (WSUD) aims to plan water conservation and storm water storage with integration with elements of urban design. This both to minimises hydrological impacts on the environment and the associated energy use of water supply.	10. Provisioning services	3	3	3	4	4
E4	**Underground tubes and piping in urban planning**	Underground tubes and piping are used for space heating/cooling across the globe and are more resilient to climate change. These systems can be Earth Air Heat Exchanger (EAHE) and Ground Source Heat Pump (GSHP) types. Both systems use tubes or pipes that usually need to be buried beyond the footprint of the building or house. The measure considers this need, and both allows and encourages the use of such space in urban planning.	10. Provisioning services	3	3	3	3	3
E5	**Biomass power from household waste**	Biomass power plants burn household waste, waste from parks and public gardens and sludge generated by sewage treatment plants. Towns and cities can also realise urban production and recreational woods, which can be used for producing biomass for co-generation (Combine Heat and Power) as well as tri-generation (Combined Cold Heat and Power) plants.	11. Regulating and Maintenance Services	3	3	3	3	4
E6	**Urban green corridors**	Urban green areas decrease the air temperature in a city and thus decrease energy needs. Warm air tends to transport pollution and particulate matter to higher layers of atmosphere, causing a cloud of smog. Creating green corridors also promotes biodiversity, increases the touristic value and decreases water run-off during storms.	11. Regulating and Maintenance Services	4	3	3	4	4

E7	**Educational garden plots**	Educational garden plots are sites where people, especially children, can garden with volunteers one afternoon a week after school. The harvest can be taken home. This creates well-being while having local fresh produce reduces the energy consumption and pollution. These garden plots can be further exploring to educate people about other climate action measures, directly and indirectly related with energy such as waste to energy, composting, water retention and green corridors.	12. Cultural services	4	3	3	4	4
E8	**Heated pools with waste heat from power plants**	Power plants need cooling and their waste heat can be used in swimming pools for public use and tourism. This creates an attractive leisure activity in off-peak winter times which diversifies the touristic offer and promote community well-being. This type of heat recovery design is called Combined Heat and Power (CHP). Pools provide a heat sink for the power plants which increases efficiency and is useful during heat waves.	12. Cultural services	3	3	3	3	4
E9	**Green jobs and businesses**	The promotion of green jobs and businesses consists in training people and supporting green businesses to implement energy solutions across the economy, both in mitigation and adaptation. One example can be the support of research projects to help businesses deal with new technologies relevant to climate action.	2. Human capital	3	3	2	3	4
E10	**Public information service on climate action**	Public information service on climate action aims to provide the general public with information about adaptation and mitigation options available for their activities and businesses. This includes information dissemination and counselling about available solutions and the public support. This type of information is relevant, for example, to support dwellings, hotels or commerce to adapt to climate change.	2. Human capital	3	2	2	3	3
E11	**Small scale production and consumption (prosumers)**	Small scale production and consumption (prosumers) aims to promote cooperation by creating economies of scale both in the production and consumption of energy. This allows for a greater use of local renewable resources and waste energy recovery which allow for a better resilience when dealing with climate change events such as heat waves.	3. Social capital	3	3	3	4	4
E12	**Risk reporting platform**	Risk reporting platform intends to promote the communication between the general public and the administration bodies concerning the risks related with climate change. It is a platform were the general public reports directly the risks as they become aware of. These can be for example related with cliff instability, trees falling over energy lines, uncleared bushes that can be ignited by power lines or unstable structures that may fall due to strong winds.	3. Social capital	3	2	2	3	3
E13	**Energy storage systems**	The development of energy storage systems can provide an alternative when the main power sources fail and need time to recover. This allows for a more resilient energy grid while enabling decarbonization and peak levelling at a controlled cost. This includes not only electric batteries (like those in cars and buses), but also other forms of energy storage such as thermal tanks (heat), ice banks (cold) or water height (reversed pumping).	4. Natural capital	3	3	3	3	4
E14	**Collection and storage of forest fuel loads**	Collection and storage of forest fuel loads intend to promote and regulate the collection and storage of wood and combustible material to reduce wildfire hazard. Actions may include: clearing of small trees out of dense areas, reduce the amount of fuel on the ground and increasing the spacing between trees. Materials collected can be used in energy to waste applications such as pellets, biogas or other energy solutions.	4. Natural capital	3	3	3	4	4

E15	**SeaWater Air Conditioning (SWAC).**	The Seawater Air Conditioning (SWAC) measure is an alternate-energy system design that uses cold water from the deep ocean to provide more efficient, decarbonized and reliable cooling. The sweater is piped to heat exchangers for process cooling or to provide condensation water in air conditioning systems. It replaces air cooling units or fresh water evaporative cooling towers which performances degrades in heat waves. Other subsequent or parallel seawater uses can be combined, like for swimming pools or desalinisation.	5. Physical capital	3	3	3	3	4
E16	**Demand Side Mangement (DSM) of Energy**	Demand Side Management (DSM) of energy is an operational strategy that better coordinates producers and consumers of energy. More renewable energy use is possible while ensuring the energy service reliability and controlled costs. DMS balances off-peak and peak demand using peek shaving, which is important, for example, during heat waves.	5. Physical capital	3	3	3	4	4
E17	**Review building codes of the energy infrastructure**	Review energy infrastructure building codes aims to climate-proof the energy system by reviewing regulatory codes and infrastructures considering the spatial distribution of climate risks. This should include establishment of new procedures, maintenance practices, operational changes, retrofitting and the use of climate and mapping services such as those produced by the Copernicus Emergency Management Service (EMS).	6. Managing long term risk	3	2	2	4	4
E18	**Upgrade evaporative cooling systems**	Upgrade of evaporative cooling systems that rely on a given range of air temperature and water availability is necessary given that this type of cooling systems are a technology that can be affected by climate change and become compromised due to heat waves and water scarcity.	6. Managing long term risk	2	2	3	2	3
E19	**Early Warning Systems (EWS)**	Early Warning Systems (EWS) is an information system that assesses climate risks and provides real time information to decision makers, companies, utilities and the general public. Climate data used to control and monitor the energy infrastructure can be relayed to the EWS. Using this data to monitor the evolution of climate related impacts in the energy sector increases the knowledge necessary to make long term climate adaptation decisions.	7. Preparedness	3	2	3	3	3
E20	**Grid reliability**	Grid reliability improvement aims to find and upgrade critical components and to enhance the energy system resilience to climate risks. This may include redundant circuitry or components that provide alternative dispatch of energy, equipment upgrades (e.g. better cooling to cope with heat waves) or power downrating (e.g. decrease power output of energy transformers so that they do not overheat during heat waves).	7. Preparedness	3	2	3	3	4
E21	**Study and develop energy grid connections**	Energy grid connections aims to develop interconnections between islands and/or with the mainland allowing for the creation of economies of scale, energy system reliability improvements and more Renewable Energy Sources (RES) penetration.	8. Response	2	2	3	3	3
E22	**Energy-independent facilities (generators)**	Energy-independent facilities (generators) make it possible for buildings to temporarily create their own energy supply. In case of an energy supply failure (power outage), essential amenities remain functional and can be optimized with Combined Heat and Power (CHP) designs and other decentralised energy generation solutions.	8. Response	3	2	3	3	3
E23	**Energy recovery microgrids**	Energy recovery microgrids are operational elements of the energy grids that rely on distributed generation to restore systems from power outages and to stabilize the grid. This allows for a flexible and swifter recovery from power outages caused by knock-out events (e.g. tree falls on energy lines), excess demand (e.g. during heat waves) or other causes.	9. Post disaster recovery and rehabilitation	3	1	2	3	4

E24	**Local recovery energy outage capacity**	Local recovery energy outage capacity consists in increasing and improving the ability of the islands to recover from energy outages caused by or worsen by climate extreme events, like severe sea or windstorms that can lead to island isolation and exacerbate logistical hurdles. To facilitate a swift recovery, it's useful to have more mobile backup power, power line replacements and other grid components, logistics, supplies and personnel.	9. Post disaster recovery and rehabilitation	2	1	2	3	4

5.1.4 Aquaculture

Options Characterization				Criteria				
ID	**Name**	**Description**	**Class of adaptation**	**Cost Efficiency**	**Environmental protection**	**Mitigation (GHG emissions) win-wins and trade-offs**	**Technical applicability**	**Social Acceptability**
A1	**Financial schemes, insurance and loans**	Financial schemes, insurance and loans are public or private risk-sharing mechanisms that aim to support farmers to respond to loss of production and infrastructures damages due to extreme weather, such as strong winds, heavy rains, floods or tidal surges. Additionally, it can provide capital to farm relocation, infrastructure and equipment upgrade, repair or replacement required.	1. Financial capital	2	1	1	3	4
A2	**Tax benefits and subsidies**	Tax benefits and subsidies consists in financial public policy instruments to promote or benefit economic or aquaculture sustainable practices and operator's overall resilience to climate change.	1. Financial capital	2	3	3	3	4
A3	**Feed production**	An important indirect impact to aquaculture is the change in fisheries production due to climate change. Aquaculture of finfish is highly dependent on fisheries for feed ingredients. This already a current problem with many fisheries overexploited and will only intensify in the future. Therefore, alternative feed ingredients are being developed such as insect meal and algae.	10. Provisioning services	2	2	3	2	3
A4	**Species selection**	Species selection consists of selecting species that are less sensitive to changes in the environment, less prone to diseases and less dependent on fish meal and oil. For example, choosing non-carnivorous species reduces food dependence and stocking larger hatchery fingerlings reduces the culture cycle and expusure to diseases.	10. Provisioning services	3	2	1	3	3
A5	**Selective breeding**	Selective breeding consists of genetic selection of species or strains with a focus on developing strains with a higher tolerance to changes in temperature, that grow faster, and which are more resilient to diseases. This is done by selecting and mating only the fish with desirable traits	11. Regulating and Maintenance Services	3	2	1	3	3

		as broodfish. For example, choosing species with a wider temperature tolerance range may reduce the risk of future mortality.						
A6	**Best Management Practices**	Implementing Best Management Practices at farms which focus on food safety, fish health, environmental impact (including climate change) and social responsibility. These practices improve the farms capacity to participate in value chains with the aim of improving the overall resilience of the farm. For example, increasing hygiene will improve resilience of species to diseases.	11. Regulating and Maintenance Services	3	3	2	3	4
A7	**Create educational visits**	Students, schools, institutes and organisations can organise visits to the fish farms to learn about aquaculture and the interactions between aquaculture and the environment. These visits can also increase knowledge on different impacts on aquaculture including man-made and climate impacts. Biosecurity should be strictly observed.	12. Cultural services	3	2	2	3	4
A8	**Promote aquaculture cuisine**	This measure promotes aquaculture via online information and uses local restaurants. Aquaculture itself can be seen as an adaptation measure to climate change as an alternative to wild fisheries, which production and yield will reduce due to climate change. Therefore, promoting aquaculture species in restaurants or setting up specific 'aquaculture' restaurants will provide both a cultural experience and promote farmed products. The online tool highlights the initiative, provides recipes and aggregates information.	12. Cultural services	3	3	3	4	4
A9	**Awareness campaigns for behavioural change**	Awareness campaigns aim to increase the knowledge of individuals and organisations, it could also be relevant in a region affected by a particular climate threat, groups of stakeholders, and the general public.	2. Human capital	3	3	3	4	4
A10	**Efficient feed management**	Efficient feed management practices that reduce the Food Conversion Ratio by using technology or practices to feed more efficient helps to reduce the cost of production and increase environmental standards.	2. Human capital	3	3	3	3	4
A11	**Addressing consumer and environmental concerns at the local level**	This option aims to promote economy and jobs to address the future challenges of climate change. The major challenges need to be underlined and linked to the key concerns and impacts on the aquaculture sector.	3. Social capital	2	2	2	3	3
A12	**Promote cooperation to local consumption**	Cooperation to promote local consumption of aquaculture produced fish specially in tourist sector will reduce the cost of distribution and will improve the creation of add value in local products or by-products in innovative industries.	3. Social capital	3	3	3	4	4
A13	**Integrated multi-trophic aquaculture (IMTA)**	Integrated multi-trophic aquaculture (IMTA) is an ecosystem-based approach to culture species from different trophic levels (fish, shellfish, seaweeds) in an integrated farm to create balanced systems for environmental sustainability. IMTA can increase resilience due to its tolerance to wider ranges of climatic factors such as temperature and salinity.	4. Natural capital	3	3	3	3	3
A14	**Short-cycle aquaculture**	Short-cycle aquaculture shortens the farming period and the time in marine cages by stocking larger fingerlings in the nursery stage (land-based) or selecting species with a shorter culture cycle.	4. Natural capital	3	2	2	3	3

A15	**Recirculation Aquaculture Systems (RAS)**	Recirculation Aquaculture Systems (RAS) are land-based indoor fish farms with closed containment rearing systems where filtration is applied to purify and regulate water parameters and remove toxic metabolic wastes of fish. Since RAS is land-based and indoor it limits the risk of infrastructure destruction due to extreme events in the ocean.	5. Physical capital	2	2	2	3	3
A16	**Submersible cages**	Submersible cages are oceanic depth-adjustable and can be moved up and down in the sea to escape the worst effects of storms, parasite outbreaks, surface algal blooms and to keep species at an optimal temperature.	5. Physical capital	2	3	3	3	3
A17	**Climate proof aquaculture activities**	Climate-proof activities refer to investments that consider climate change projections to manage future risks to infrastructures and improve operational safety conditions. E.g. strengthening mooring systems, cage structures and nets.	6. Managing long term risk	3	2	2	3	4
A18	**Risk-based zoning and site selection**	Risk-based zoning and site selection consists of taking into consideration climate change scenarios when planning and selecting a site for a farm. For example, marine cage operations should not select a site that is (or is expected to be) exposed to high waves or strong currents, and pond farming operations should select sites with low risk of flooding. Zone management can facilitate effective sharing of space and resources with other users, taking into account the carrying capacity of the site.	6. Managing long term risk	3	2	2	4	4
A19	**Disease prevention methods**	Disease prevention methods are preventive health measures such as vaccines, stronger fingerlings, probiotics, ensuring optimal water quality and implementing stricter hygiene procedures with the aim of reducing the risk of diseases now and in the future.	7. Preparedness	3	2	2	3	4
A20	**Environmental monitoring and Early Warning Systems (EWS)**	Environmental monitoring and Early Warning Systems (EWS) systematically collects and provides information to fish farmers with the aim of supporting climate risk management decision-making. Monitoring and early warning can facilitate adaptation actions, such as early harvesting or relocation of fish net pens from sites of intense harmful algae blooms. Dynamic vulnerability maps, remote sensing and GIS are typically applied in the development of this type of measures.	7. Preparedness	3	3	3	4	4
A21	**Mainstreaming Disaster Risk Management (DRM)**	This measure aims to plan and organize DRM considering climate change along five stages including prevention, protection, preparedness, and response, recovery and review in the aquaculture decision making and management frameworks. Examples include interventions to limit farm development in natural hazard areas; review safety engineering standards for farms; study the interactions of climate change in local ecosystems and appropriately develop strategies, arrangements, and procedures to address crises; and post-emergency recovery activities.	8. Response	3	3	3	4	4
A22	**Contingency for emergency management, early harvest and/or relocation**	These plans consist in moving produce or activities to sites with more suitable characteristics to protect them against climate hazards such as storms, high waves, temperature changes or water quality degradation. Relocation can mean moving activities within the same environment	8. Response	2	2	3	3	3

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		(ocean-ocean; land-land) or between environments (ocean to land). It also includes protocols emergency harvesting to reduce the stock loss.						
A23	**Recovery Post-Disaster plans**	Establish early recovery good practices and objectives. This option will allow to reduce socio-economic and environmental consequences of the disaster. Examples of good practices are: Identify goods and services (support facilities like boats and docks as well as farm infrastructure) that require restoration.	9. Post disaster recovery and rehabilitation	**2**	**3**	**3**	**4**	**4**
A24	**Recovery Post-Disaster funds**	Create recovery funds and plans for Post-Disaster in Aquaculture with Initiatives to get the economy running quickly, e.g. rebuild damaged critical infrastructures such boats, docks, and farm infrastructure. This option minimizes the economic and social impacts that can occur in a post-disaster context.	9. Post disaster recovery and rehabilitation	**3**	**1**	**2**	**3**	**4**

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