Overview

In order to assess the socio-economic impacts of biophysical changes for Madeira, the GEM-E3-ISL and GINFORS models have been used.
The former is multi-sectoral based on the principles of neo-classical theory, while the latter is a macro-econometric model based on the post-Keynesian theory.

Changes in the mean temperature, sea level and precipitation rates are expected to affect energy consumption, tourism flows and infrastructure developments. These impact-chains have been examined and quantified under two emission pathways: RCP2.6, which is compatible with a temperature increase well below 2C by the end of the century and RCP8.5, which is a high-emission scenario. The impacts on these three factors have been used as input in the economic models, which then assess the effects on GDP, consumption, investments, employment, etc.

Both models include 14 sectors of economic activity, with an emphasis on services and specifically on those composing the tourism industry. The GEM-E3-ISL model also has an endogenous representation of labour market and trade flows etc.

Overview

In total 18 scenarios have been quantified for Madeira. The scenarios can be classified in the following categories:

1.Tourism scenarios: these scenarios examine the reduction in tourism revenues due to changes in human comfort as captured by the hum-index, the degradation of marine environment, increased risk of forest fires and beach reduction

2.Energy scenarios: these scenarios examine the impacts of increased electricity consumption for cooling purposes and for water desalination

3.Infrastructure scenarios: these scenarios examine the impacts of port infrastructure damages

4.Aggregate scenarios: these scenarios examine the total impact of the previous-described changes in the economy

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Aggregate scenario - results

In this scenario we examine the impacts of a simultaneous change in electricity consumption, tourism revenues and infrastructure damages. The scenario specifications for the two climatic variants are presented below:

	Tourism revenues (% change from reference levels)	Electricity consumption (% change from reference levels)	Infrastructure damages (% of GDP)
RCP2.6 (2045-2060)	-14.35	1.7	-0.20
RCP2.6 (2080-2100)	-17.02	41.1	-0.25
RCP8.5 (2045-2060)	-23.25	3.2	-0.54
RCP8.5 (2080-2100)	-27.37	8.4	-0.69

The theoretical and structural differences of the two models mean that this study produces is a reasonable range of impacts, given the uncertainty embodied in economic analysis and especially in the long-term.

In GEM-E3-ISL, the economy is in equilibrium at each point in time. Prices adjust to ensure that supply equals demand (market clearing), capital is fully used; however, the allows for equilibrium unemployment.

The impacts are driven mainly by the supply side through changes in relative prices that determines competitiveness change, substitution effects, etc. The GEM-E3-ISL model assesses the impacts on the economy up to 2100.

The macro-econometric type of models, such as GINFORS, do not require that all markets are in equilibrium; idle capital and involuntary unemployment are some other features of this type of models where the results are driven mainly by adjustments in the demand side of the economy. The GINFORS assesses the impacts on the economy up to 2050.

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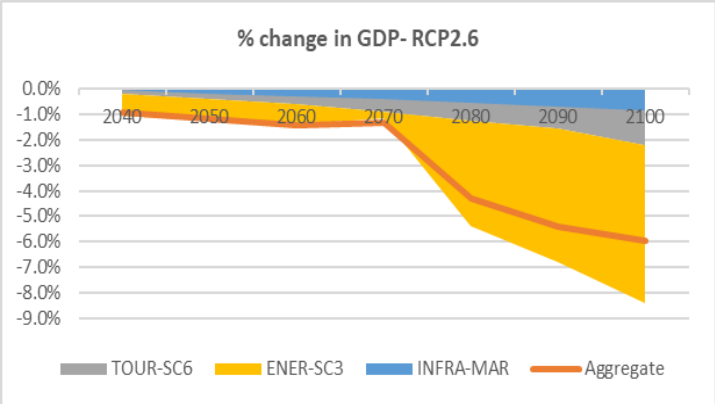
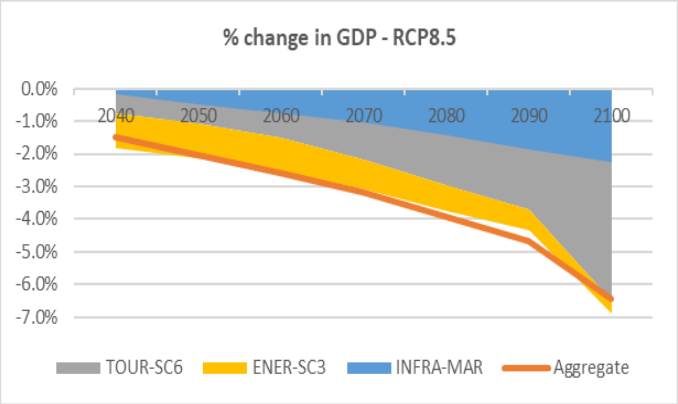
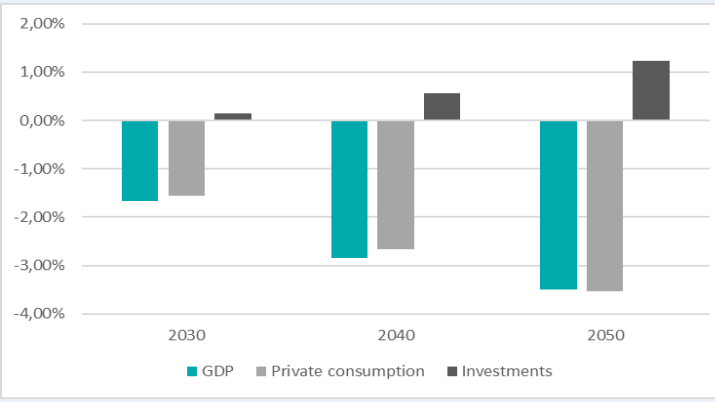
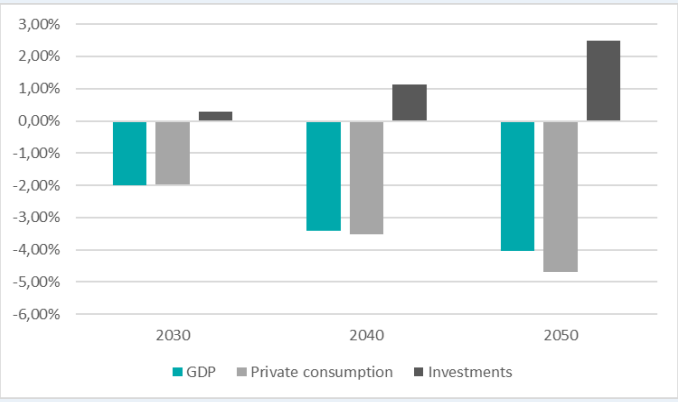




Source: GEM-E3-ISL





Source: GWS, own calculation.

Aggregate scenario results

With respect to GDP the estimated change compared to the reference case is between -1.2% and -3.5% in the RCP2.6 in 2050 and between -2% and -4.0% in the RCP8.5. The cumulative change over the period 2040-2100 is estimated (by GEM-E3-ISL) to be equal to -3.4% in the RCP2.6 and -3.7% in the RCP8.5.

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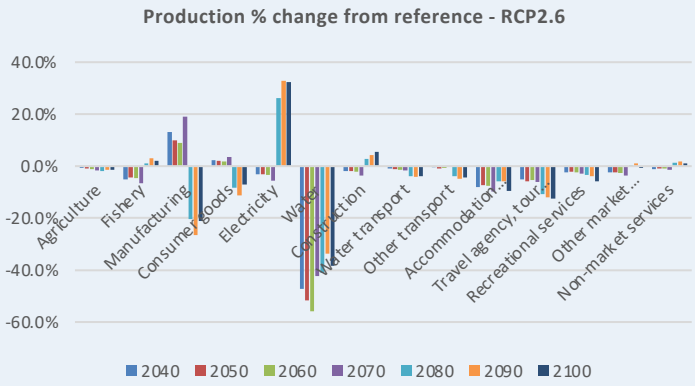
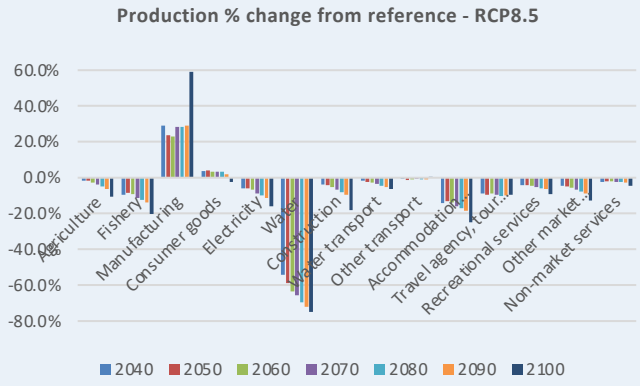
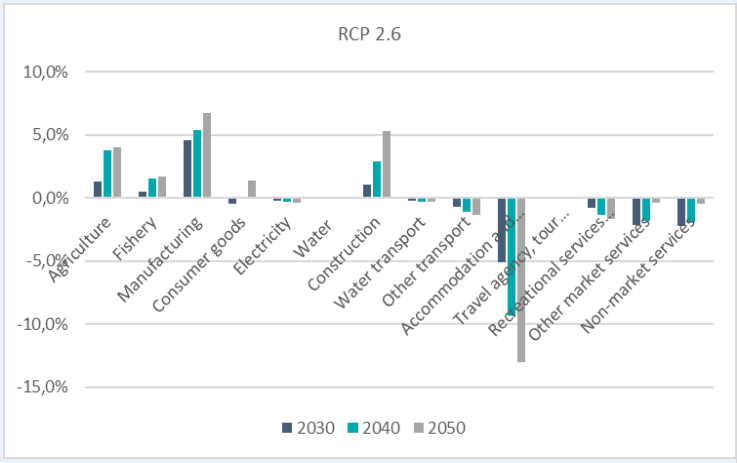
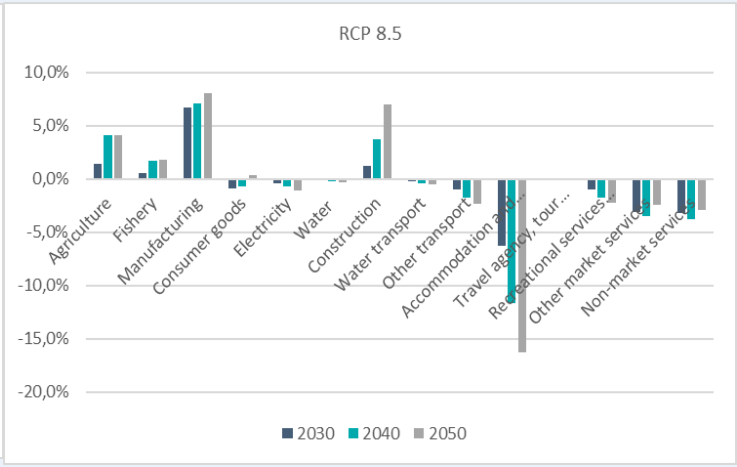




Source: GEM-E3-ISL





Source: GWS, own calculation.

Aggregate scenario results

With respect to sectorial impacts both models show a significant decrease in the activity of tourism related sectors and an increase in the activity of the manufacturing sector in both models. The GINFORS also foresees increased activity in the primary production sectors and consumer goods while in the GEM-E3-ISL primary production increases only in the RCP2.6 while in the RCP8.5 the magnitude of changes leads to a decrease in their activity levels.

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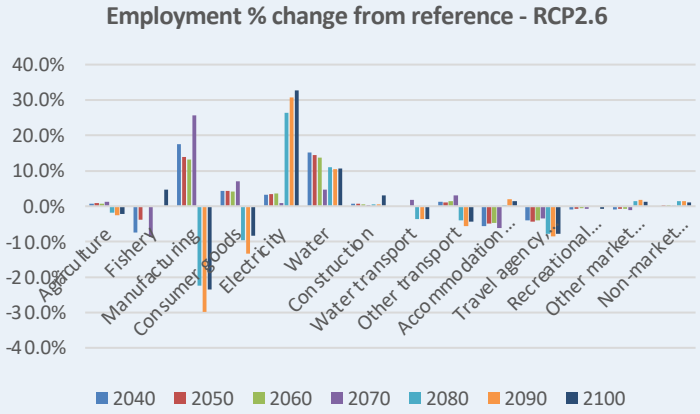
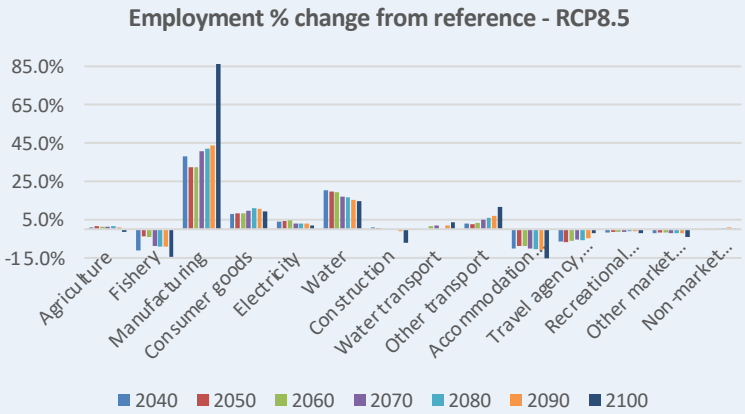
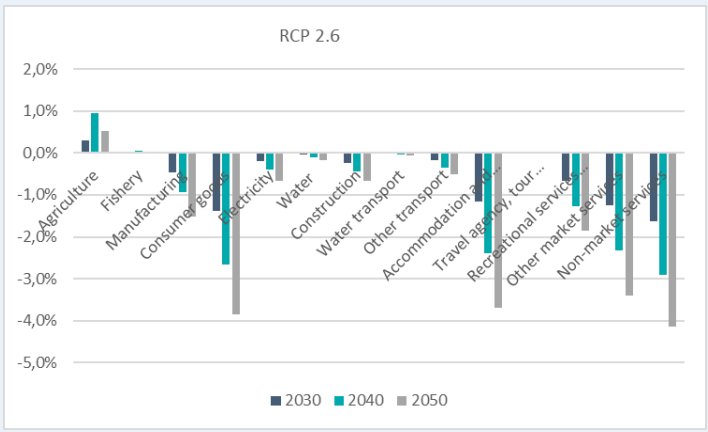
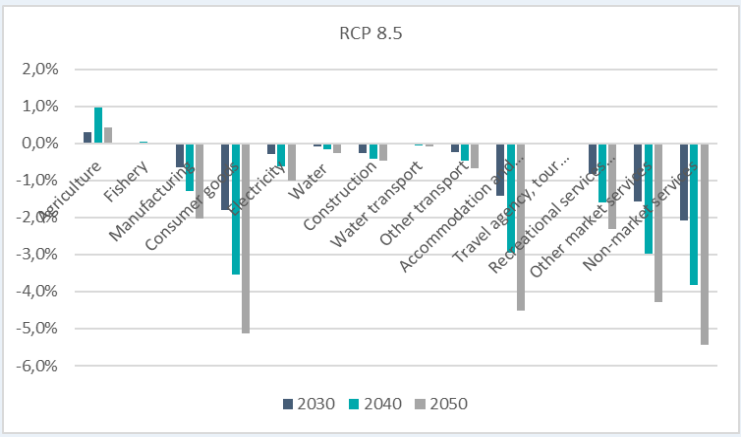




Source: GEM-E3-ISL





Source: GWS, own calculation.

Aggregate scenario results

Overall employment falls in the economy and especially in tourism related sectors following the slowdown in domestic activity. In GEM-E3-ISL increases in employment in non-tourism related activities are related to labor costs reductions (as wages fall and their competitiveness increases) and a consequent substitution of capital with labor in other sectors. Employment falls on average by 0.2% in the RCP2.6 and by 0.6% in the RCP8.5.

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Madeira