Long-term energy security in a national scale using LEAP. Application to de-carbonization scenarios in Andorra

Oriol Travesset-Baro[a,b], Eric Jover[a], Marti Rosas-Casals[b,c]

[a]Observatori de la Sostenibilitat d'Andorra, Sant Julià de Lòria, Andorra otravesset@obsa.ad

[b]Sustainability Measurement and Modeling Lab, Universitat Politècnica de Catalunya, Terrassa, Spain

[c]Research Institute in Science and Technology for Sustainability, Universitat Politècnica de Catalunya, Barcelona, Spain marti.rosas@upc.edu

INTRODUCTION

This poster analyses the long-term energy security in a national scale using Long-range Energy Alternatives Planning System (LEAP) modelling tool. It builds the LEAP-Andorra model, which forecasts energy demand and supply for the Principality of Andorra by 2050.

The model presented in this poster provides an initial estimate of energy demand in Andorra segregated into all sectors (residential, transport, secondary, tertiary and public administration) and charts a baseline scenario based on current policies and historical trends. Additional scenarios representing different policy strategies are built to explore the country's potential energy savings and the feasibility to achieve the Intended Nationally Determined Contribution (INDC). Current and future energy security is analysed in this study under baseline and de-carbonization scenarios.

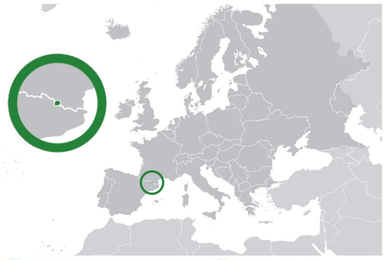

Fig. 1. Location of Andorra in Europe

Font: Wikipedia

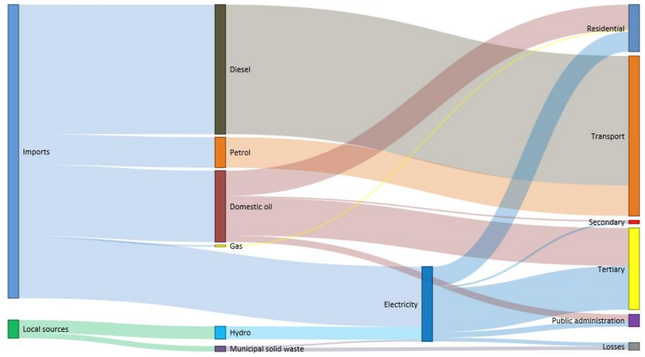

Fig. 2. Andorra's Sankey Diagram 2013. **Infographic:** Excel to Sankey (Bruce Mc Pherson)

MATERIALS AND METHODS

LEAP-Andorra model has a general bottom-up structure, where energy demand is driven by the technological composition of the sectors of the economy. The technological model is combined with a top-down econometric model to take into account macroeconomic trends.

Energy security issues are assessed in LEAP using the three perspectives on energy security framework (Cherp and Jewell 2011). The methodology developed by Jewell et al. 2014 to assess long-term energy security using integrated assessment models is applied in the present study to a national scale. Twelve indicators covering the three perspectives on energy security are identified and integrated to LEAP in order to quantify current and future vulnerability of Andorra's energy system.

The Reference scenario is analysed together with some demand and supply energy measures. Finally, three scenarios are built to examine the effects of combining different measures.

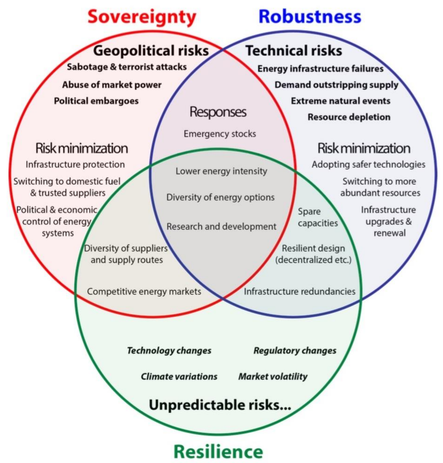

Fig. 3. The three perspectives on energy security have their roots in separate academic disciplines: political science (the sovereignty perspective), natural science and engineering (the robustness perspective) and economics (the resilience perspective). They differ with respect to their focus on different energy security threats and response strategies. The 'no-regrets' responses situated in the center of the diagram address the concerns of all three perspectives. **Font:** Cherp and Jewell 2011

RESULTS

CO_2 emissions savings and energy security improvement associated to different energy measures are shown in Fig. 4. Demand side strategies represent the implementation of technological and behavioural measures in the main sectors of activity. Supply side measures are based on the energy infrastructure plan presented in the national Energy White Paper (Andorra Government, 2012). Fig. 5 shows the combination of demand side measures (Efficient scenario), supply side measures (Electricity supply scenario) and the aggregation of both scenarios (Combined scenario).

Results show the benefits of climate policies in terms of national energy security (in this poster only in the sovereignty perspective) and the difficulties for Andorra to achieving the de-carbonization target by 2030 (37%).

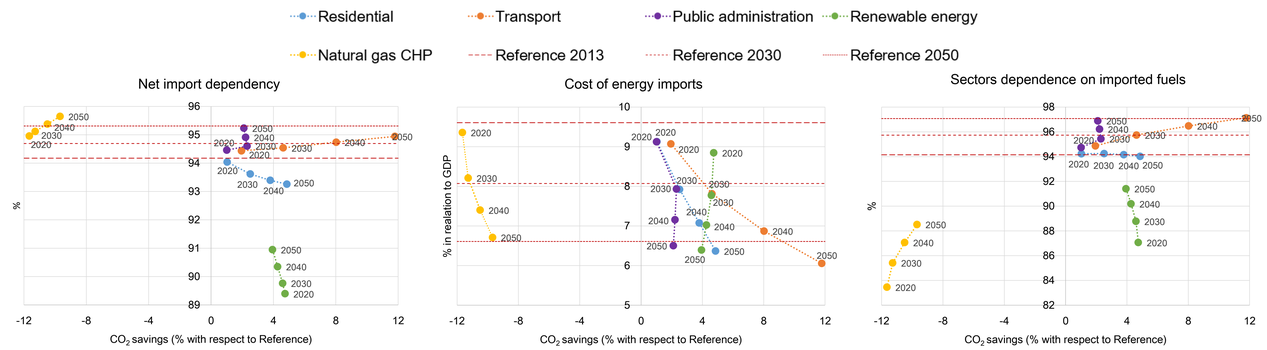

Fig. 4. Energy security and CO_2 emission savings of different energy strategies

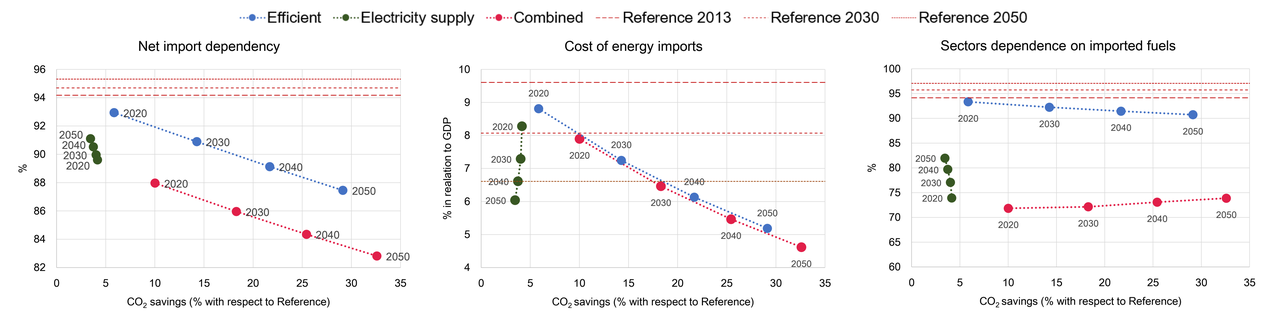

Fig. 5. Energy security and CO_2 emission savings of the combination of demand and supply side strategies

CONCLUSIONS

Andorra will need to do ambitious efforts in order to achieve its climatic agreement of reducing CO_2 emissions by 37% with respect to the Reference scenario. Particularly, supply side measures (i.e. renewable energy) should increase its expected contribution to reach the target.

Further work is focused on including the robustness and resilience perspectives in the current analysis to represent appropriately the three perspectives of energy security.

COLLABORATOR