MEDEAS

MODELING THE RENEWABLE ENERGY TRANSITION IN EUROPE

RESULTS AND CONCLUSIONS PROJECT MEDEAS

FINAL BROCHURE

INTRODUCTION TO THE PROJECT

It is clear today, that the climate is changing and will continue to change with uncertain consequences and impacts. Our society needs to act by reducing the amounts of greenhouse gas emissions through the process of decarbonisation. The transition to a low carbon economy with renewable energy sources is essential but it needs to satisfy multiple objectives including: socio-economic competitiveness, protection of the environment, creation of quality jobs, and social welfare. Policy-makers and other key stakeholders require holistic tools focusing on the energy sector and considering the implications of policies. Most modelling tools lack sufficient integration of these important areas, documentation, transparency and are mainly developed for a specialised audience, which makes validation and comparison of results more challenging. Thus, MEDEAS project aimed to develop a leading-edge policy-modelling tool:

The goal of the MEDEAS project – «Modelling the Energy Development under Environmental and Socioeconomic Constraints» – was to create a new computational model to represent the future of the energy system in Europe, taking into account physical as well as social constraints. An advanced modelling tool has been developed, with stakeholders' feedback, and tested with existing policies, to support the transition to a more sustainable European energy system based on renewable energy sources.

The MEDEAS model has a modular design, thus it allows for different levels and interests of stakeholders, with a high sectoral, temporal and spatial resolution. Finally, transparency is ensured through an open access freeware distribution of the model based on Python (open access programming language), providing a detailed user´s manual, and including free internet courses and learning materials.

The MEDEAS project has been developed during 2016–2019 by a consortium of eleven partners under the Horizon 2020 Research and Innovation Program of the European Union (GA 691287).

MODEL DESCRIPTION

The modelling tool developed within the project has three main objectives:

1) identify key physical parameters,

2) highlight existing challenges for the transition to a low-carbon economy,

3) suggest strategies to face such challenges.

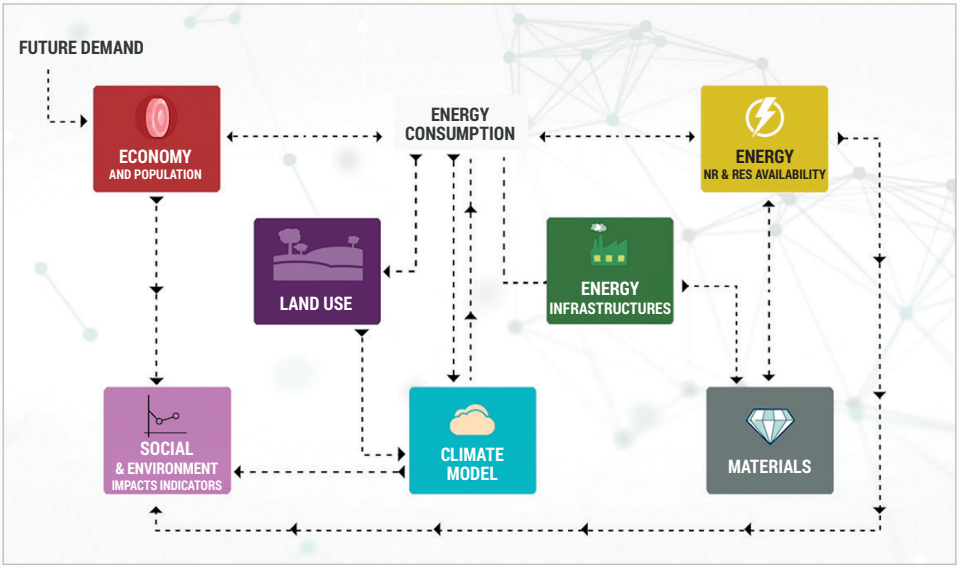
MEDEAS also provides scenario projections until 2050, analysing the challenges ahead each of them and the best policies for overcoming barriers.

MEDEAS-World model is a global, one region-aggregated economy-energy-environment model (or Integrated Assessment Model, IAM) which runs from 1995 to 2050 and includes more than 4,000 variables. It serves as a framework for the European model version, which is the core of the MEDEAS

project. Also, two country models have been created: Bulgaria and Austria. The model has been designed applying System Dynamics, which facilitates the integration of knowledge from different perspectives as well as the feedbacks from different subsystems.

The models, originally written in Vensim DSS proprietary software, are available in Python programming language (open source) at the MEDEAS webpage (https://www.medeas.eu/model/medeas-model).

The MEDEAS models consist of a modular and flexible structure, where each module can be expanded, simplified or replaced by another version or submodel. The models are structured into 7 submodules:



Thanks to the innovative approach, MEDEAS allows the users to model economic, environment and social indicators of the decisions made today and their impacts in the future in a wide range of areas. Thus, MEDEAS broadens the scientific toolbox to answer questions.

MEDEAS model has been developed with the help of the Board of Stakeholders to ensure better quality of the outcomes and maximize the range of potential users. A well-balanced mix of experts in different fields related to the project (i.e. model development, policy-making and model customization) were involved early in the process to enable them to follow the development and provide the consortium with feedback. Personal meetings were held annually and information on the progress has been sent to the Board continually.

MEDEAS PROJECT MAIN FINDINGS

The main findings of the research conducted in the MEDEAS project are summarized below:

- An **increasing amount of biophysical resources are required** for the renewable energy sources deployment.
- The **current implementation rates of renewable energy sources are not sufficient** for the EU to become a carbon free socio-economy by 2050.
- If the transition is delayed, the projections show huge negative impacts on employment, economic activities and planned GHG emissions reduction.
- Providing storage capacity will be key to counteracting the intermittency of renewable energies.
- Electrification of most economic sectors will be required to reduce the dependency on fossil fuels.

During the MEDEAS project, transition scenarios towards a low-carbon economy have been developed on the available global carbon budget in order to limit global warming below 2°C and the EU target to reduce absolute annual emissions by 80%. Three scenarios are run with the model:

- **Business as Usual (BAU):** extrapolating current trends. In this scenario all the variables follow the historical trends (from 1995), e.g. annual growth of wind onshore: 8.7%, wind offshore: 25%, solar PV: 9.5%, CSP: 3.6%.
- **Optimal Level Transition (Green Growth):** moderate increase of RES. Annual growth of wind onshore: 17.4%, wind offshore: 25%, solar PV: 19%, CSP: 7.2%.
- **TRANS (-ition):** maximum effort to increase RES starting in 2020 with the aim of drastically reducing GHG emissions by 2050. Annual growth: wind onshore: 80%, wind offshore: 80%, solar PV: 60%, CSP: 50%.

The main conclusions that come out of the MEDEAS model include:

- BAU scenario shows increasing emissions and permanent recession after 2035-2040.
- OLT scenario assures GDP to grow but is not able to bring a satisfactory reduction of GHG emissions (and therefore is not compliant with the Paris Agreement).
- TRANS scenario stabilizes the economy, reduces energy and materials demand, and shows a drastic reduction of emissions.

Model projections show that, if no new RES technologies (storage and PtX) are rapidly developed, then economic stabilization (no-growth) will be a potential option for decarbonizing economy whilst maintaining social welfare.

To conclude, MEDEAS has confirmed that the upcoming decades will become one of the most challenging times of our civilisation. Thus, it will require structural changes that go beyond purely technological aspects and tackle the social (e.g. cultural and political) aspects as well. Also, we will have to put forward new solutions which will help us to overcome the limits of resources (fossil fuels and raw materials) and will transform the economic system in a way that enables the necessary transition.

The risks of doing nothing (Business as Usual) or delaying the transition are too big to

even consider. The more we wait to make the necessary changes, the more energy costs we will incur and the higher risks we will have to assume for both, future generations, and all the ecosystems of the planet.

White Book for policy makers

The MEDEAS White Book highlights the relevance of the issues addressed in the areas of electricity grid upgrade, transport electrification, the role of natural gas, energy efficiency, energy costs, financing of cross-border energy infrastructure, price regulation, raw materials and re-cycling, environmental impacts, social and behavioural adaptations, economic development and climate change adaptation. On the basis of the analysis conducted during the project, it derives recommendations for long-term policy and policy modelling, which are pertinent to the achievement of EU energy and climate targets and the implementation of the Clean Planet for All Strategy. The starting point for the scenario design was the available global carbon budget in order to limit global warming to 2°C, a target agreed by participating countries at the 21st Conference of Partners in Paris (COP21, United Nations, Paris Agreement, 2015).

MEDEAS PROJECT RESULTS

MEDEAS database
https://www.medeas.eu

Analysis of the key variables/parameters, main relationships between them and the definition of necessary variables for model comparison, sensitivity analysis and model cross-comparison.

MEDEAS models in python
https://www.medeas.eu/model/medeas-model

The open-source versions of the model are available at three geographical levels: World, EU and Austria.

MEDEAS video guides
https://www.youtube.com/channel/UCI7_M85yAFst5YixTdtDMCw?view_as=subscriber

Five short videos have been released to guide users through the installation and use of the pymedeas models.

MEDEAS documentary
https://www.medeas.eu

The short 20-minute documentary describes the project. The film presents the main project aims and the key results in a synthetized non-technical language for a general audience. It includes the point of view on energy matters of the general public, industry and stakeholders; the state of the art of renewable primary energy production systems; and the transition scenarios with simulation results and the role played by the meetings with stakeholders.

MEDEAS massive online open course (MOOC)
https://www.medeas.eu/model/mooc-course

The duration of the course is six weeks with an estimated 5-hour workload per week. There are two short videos, about 10 minutes long for each topic, reference documentation for the topic, auxiliary materials, tasks for the student and a self-assessment questionnaire. The MOOC is oriented to describe the IAM MEDEAS modules, their structure and use. The ultimate goal of the course is to encourage students to use this free tool in order to explore the best pathways for the transition to a low carbon society.

MEDEAS lead the organization of Energy Modelling Platform for Europe (EMP-E) 2019
http://www.energymodellingplatform.eu

MEDEAS, lead the 2019 edition as part of the H2020 Energy modelling group, which consists of ten Horizon 2020 projects funded by the European Commission's Research and Innovation Programme. The Energy Modelling Platform for Europe (EMP-E) is an annual conference, bringing together scientists and policy makers on current and innovative energy modelling issues. Due to the active involvement of EC representatives and leading researchers, the aim is to bridge the gap between modelling and policy making at European, regional and local level.

MEDEAS publications

The partners in the consortium wrote a number of interesting publications during their work on the MEDEAS project. They have been listed on the MEDEAS website and can also be found on ResearchGate, referenced to the project https://www.researchgate.net/project/MEDEAS.

DOCUMENT INFO SHEET

Lead Beneficiary : Hnutí DUHA

WP : WP8 - Outreach, dissemination and exploitation of results

Task : 8.5.c Outreach activities Reports on general audience outreach activities

Authors : Romana Kaclíková, Myrto Theofilidi, Teresa Madurell

Dissemination level : Public

PROJECT MEDEAS CONSORTIUM

www.icm.csic.es | www.energyagency.at | www.anglia.ac.uk | www.blue4you.be | www.bserc.eu

www.cres.gr | www.hnutiduha.cz | www.iiasa.ac.at | www.instm.it | www.humenv.fss.muni.cz | www.uva.es

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