IMPACT

ANALYSIS OF THE EUROPEAN ENERGY SYSTEM UNDER THE ASPECTS OF FLEXIBILITY AND TECHNOLOGICAL PROGRESS

REflex
Analysis of the European Energy System

http://reflex-project.eu/

Impact Objective

- REFLEX is analysing and evaluating the development towards a low carbon energy system with focus on flexibility options in the EU to support the implementation of the European Strategic Energy Technology Plan

Managing options for renewable energy integration

***Professor Dominik Möst** from **Technische Universität Dresden** is coordinating **REFLEX** (Analysis of the European energy system under the aspects of flexibility and technological progress), a project shaping the future European energy system. He talks about the expected impact from the project and sharing the knowledge gained*

The core objective of the REFLEX project is to analyse and evaluate the developments towards a low carbon energy system. Who do you anticipate will benefit from the project's findings?

REFLEX aims to create awareness to the solutions for shaping the future European energy system. One of the ways we will do this is through a decision making tool. This means the policy makers and stakeholders in the energy sector will benefit. These can be classified into three main categories: firstly, representatives from policy, such as politicians, ministries and agencies; secondly, industry and associations (like energy suppliers and the manufacturers of electric vehicles), and thirdly, the scientific community, particularly in the fields of experience curves and energy system modeling as well as social and environmental life cycle assessment.

What are some of the challenges that have come about so far and how have you dealt with these?

The biggest challenge in REFLEX so far has been combining the three research fields: technological learning, energy system modelling and life cycle assessment (LCA) in an adequate way and without exceeding the time schedule. This includes establishing a common database and coupling the miscellaneous models with their different approaches and assumptions. Thus, the combination of the knowledge of the different partners and the coordination of a common data set play an important role. To handle this challenge, we are developing and applying an innovative and comprehensive Energy Models System (EMS), which couples the models and tools from all of the REFLEX partners. The basis for the EMS builds a common database and scenario framework with the result that all models are based on identical assumptions.

How are you sharing the results?

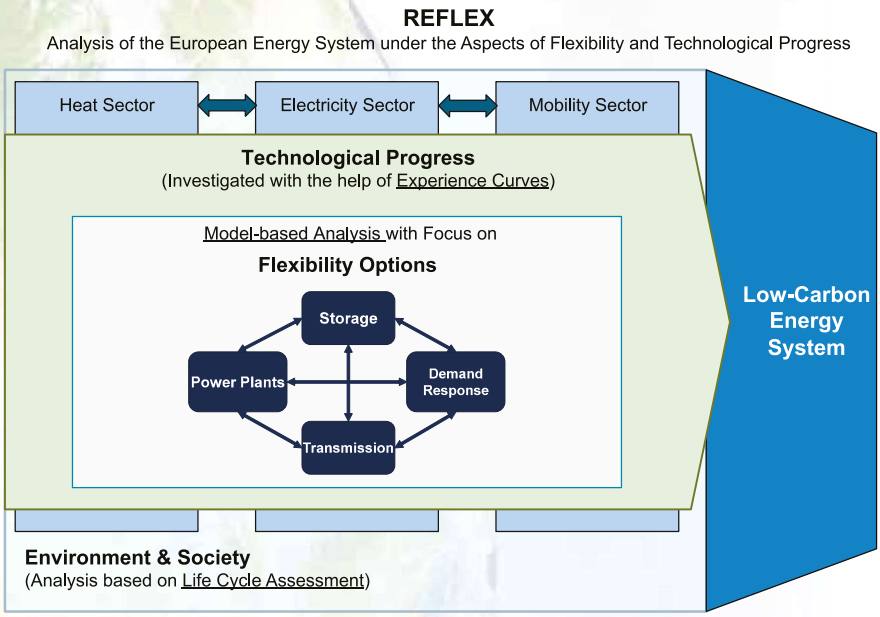
The first public workshop of REFLEX was held in November 2016 in Brussels where around 50 attendees from industry, policy and science intensively discussed about energy decarbonisation and flexibility needs. The workshop enabled representatives from these sectors to debate how we can efficiently balance the high shares of intermittent renewable energies. We also offered an expert workshop in May 2017 on social and environmental LCA of energy scenarios for the EU at the Society of Environmental Toxicology and Chemistry (SETAC) Europe Conference in Brussels. Energy scenarios produced by energy system modeling and used to support EU policy decisions are not assessed from a broad environmental or social perspective. For this reason the workshop consulted LCA experts, policy makers and others on a proposed framework methodology for the social and environmental LCA of future energy systems scenarios. First results from REFLEX were presented at the International Conference on the European Energy Market, which took place in June 2017 in Dresden, Germany. Results related to a comparison of techno-economic characteristics of different flexibility options in the European energy system are published in the IEEE Xplore conference proceedings.

The team is also providing short policy briefs to publish scientifically-based findings on topics of importance to energy policy and short reports that focus on distilling some of the key information, as well as publishing scientific articles in relevant journals. We have some exemplary conferences and events coming up where we are planning to discuss results from REFLEX, including the EU Sustainable Energy Week 2018 - which is Europe's leading conference on sustainable energy policy. In addition, our project website is an important tool for sharing results and information - http://reflex-project.eu/.

A collaborative approach to Europe's energy future

*With Europe increasingly focusing on a renewable energy future, the **REFLEX** project has been established to analyse and evaluate the region's progress towards a low carbon energy system*

There is currently a great deal of effort around the world to decarbonise energy. Europe's response was the establishment of the European Strategic Energy Technology Plan (SET-Plan) in 2007. Its main aim is to accelerate the development and deployment of low carbon technologies and, by coordinating national research efforts and helping to finance projects, improve new technologies and bring down costs.



EFFECTIVE COMBINATIONS, MODELS AND SYSTEMS

As fossil fuel-based technologies are still an inherent part of the provision of energy, it is essential that the existing system by which Europe is powered is transformed to a more sustainable one. This will necessitate complementing as well as replacing fossil fuel-based technologies with competitive renewable energy sources (RES), but most can only be considered as intermittent electricity sources. Coupled with the limitations of these sources, means flexibility options are required; supply and demand must be continuously balanced to guarantee supply. Furthermore these flexibility options must be cost-efficient and competitive in a liberalised market.

The SET-Plan initiative stretches across the EU and the target is to reduce emission by 80 to 95 per cent compared to 1990 levels by 2050, which brings significant complexities and challenges. Coordinating all the stakeholders involved requires extraordinary attention to detail and it is essential that progress is charted. To support this, the 3-year EU-funded REFLEX project was established in May 2016. Led by Professor Dominik Möst from Technische Universität Dresden (TUD), REFLEX brings the comprehensive expertise and competences of known European experts from six different European countries together. In doing so, the initiative combines three separate, but complementary, research fields: techno-economic learning, fundamental energy system modelling, and environmental and social life cycle assessment (E-LCA and S-LCA).

The core objective of the REFLEX project is to analyse and evaluate the development towards a low carbon energy system. With a focus on flexibility options in the EU up to 2050, the researchers will support the SET-Plan's integration of RES. 'REFLEX is delivering a unique compilation of sectoral bottom-up energy system models to provide robust findings regarding potential energy transformation paths', Möst explains. 'In doing so, we are strengthening the knowledge base for the implementation of the SET-Plan.'

The project has 8 work packages (WP) which Möst says are linked by research focus: WP1 is developing the overall scenario framework; WP2 is setting up a common database and the effective energy models system; experience curves are being determined in WP3; WP4 and WP5 will use this experience curve to model and assess options and pathway to transformation; impacts on society and the environment from these pathways will be assessed in WP6; WP7 delivers the dissemination; and WP 8 provides the overall coordination of this work with a collaborative framework.

THE VALUE OF EXPERT PARTNERS

A collaborative partnership with industry and academic institutions is essential for the success of this project. TUD is coordinating the project as well as providing knowledge in modelling the European electricity system including sector coupling. Analysis of different design options of electricity markets and their impact on the integration of flexible technologies is being completed by experts from Karlsruhe Institute of Technology (KIT).

KTH Royal Institute of Technology (KTH) is coordinating the sustainability assessment work and also providing expertise into the social Life-Cycle Assessment of energy systems. Modelling and analysis of the EU heat sector is being delivered by the AGH-University of Science and Technology (AGH-UST). Sustainability is one of the core themes of research at Utrecht University and they are bringing this expertise into the REFLEX project by providing assessments for novel technologies and products by determining experience curves at both early- and in-development stages.

Fraunhofer Institute for Systems and Innovation Research (Fraunhofer-ISI) is working on energy demand modelling for all sectors, together with TEP Energy GmbH. In addition, they collect valuable data, undertake a Demand Side Management (DSM) survey and analyse the contribution of DSM to the integration of renewables. 'Additional to the demand modelling activities, Fraunhofer ISI is analysing the development in the transport sector and simulating the diffusion of alternative fuel technologies and efficiency measures. The competences in mobility and transport are complemented by the Karlsruhe Institute of Technology, which explores key impacts of future car technology market developments and give insights on an international perspective, as well as the private company TRT Trasporti e Territorio (TRT), which is able to provide analysis of the long term impacts of transport policies. The complementary competences of all partners are coordinated in REFLEX and the valuable support and expertise of our partners is helping us to work collectively towards a common goal to develop an integrated energy system model', Möst says. Within this project Energy Systems Analysis Associates – ESA² is playing a key role in data preparation, model coupling and supporting the other partners in their work.

A COMPREHENSIVE ENERGY MODELS SYSTEM

To successfully combine techno-economic learning, fundamental energy system modelling and LCA, a comprehensive Energy Models System (EMS) is being developed. The EMS is based on a common database scenario framework and connects the models and tools from all REFLEX partners. All the models are presented on the REFLEX website (www.reflex-project.eu). In total, the system combines 10 different models and tools the majority of which cover all EU Member States. These can be applied for long-term scenario analyses until the year 2050. Once the results from each of the 10 models and tools have been gathered, they will be consolidated and further assessed by a significant Indicator Set. This includes the different perspectives of sustainability development, such as economic, environmental and social.

'The assessments and results from the REFLEX-EMS help to understand the complex links, interactions and interdependencies between the different actors and different sectors. By doing so, the available technologies and sector coupling, as well as the impact of the different interventions on all levels from the individual to the whole energy system are addressed,' Möst says. 'In this way, the knowledge base for decision-making concerning feasibility, effectiveness, costs and sustainability impacts of different policy measures are being strengthened, which supports the implementation of the SET-Plan.'

The dissemination of the results to the appropriate target audience is a key consideration, and the professional networks of all involved partners will be used to ensure this is achieved. Four main fields for dissemination have been identified: establishing a REFLEX website, publishing collected and a selection of generated data, organising workshops, and preparing articles for journals. Within these fields, specific dissemination activities have been developed to directly address certain stakeholder groups as well as the general public. First publications are already available at the project website.

The results of REFLEX will assist policymakers across Europe, enabling them to derive strategies that help achieve the EU's emission reduction targets. By understanding different market designs and their specific effects on flexibility measures, policy recommendations can be derived to enable individuals and policymaking organisations to make the best, most informed choices. There are several aspects to consider when establishing the best technologies, such as environmental impact, cost, integration capabilities, and flexibility, that a systematic method of ascertaining this information is essential.

'The knowledge derived on the interrelationship between energy transformation processes and the development of energy technologies under different frames could also be used by companies or industrial stakeholders,' Möst points out. 'In this way, REFLEX offers knowledge that can be used by European utilities, service and technology providers to enhance their competitiveness in the global energy market.' In addition, the partners involved in REFLEX will disseminate the results via literature and seminars, thereby supporting the education of young academics who, over the years, will be called on to lead aspects of future research and analyses.

Project Insights

FUNDING

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement number 691685.

PARTNERS

Technische Universität Dresden (Germany) • AGH University of Science and Technology (Krakow, Poland) • Energy Systems Analysis Associates – ESA² GmbH (Karlsruhe, Germany) • Fraunhofer Institute for Systems and Innovation Research (Karlsruhe, Germany) • Karlsruhe Institute of Technology (Germany) • KTH Royal Institute of Technology (Stockholm, Sweden) • TEP Energy GmbH (Zurich, Switzerland) • TRT Trasporti e Territorio Srl (Milan, Italy) • Utrecht University (Netherlands)

CONTACT

Dominik Möst
Project Coordinator

T: +49 35146333297
E: Dominik.Moest@tu-dresden.de
W: http://reflex-project.eu/

SCIENTIFIC COORDINATOR BIO

Professor Dominik Möst has been a Professor of Energy Economics at Technische Universität Dresden (TUD) since 2010 and Vice Dean of Faculty of Business and Economics at TUD since 2013. He studied Industrial Engineering and Business Administration at the University of Karlsruhe (TH). Möst's research topics of interest are energy system and market modelling, energy market design, long-range development of energy markets and price forecasts (especially gas, electricity and emission allowance markets), renewable energies and energy efficiency.

REflex
Analysis of the European Energy System

This project is funded by the European Union