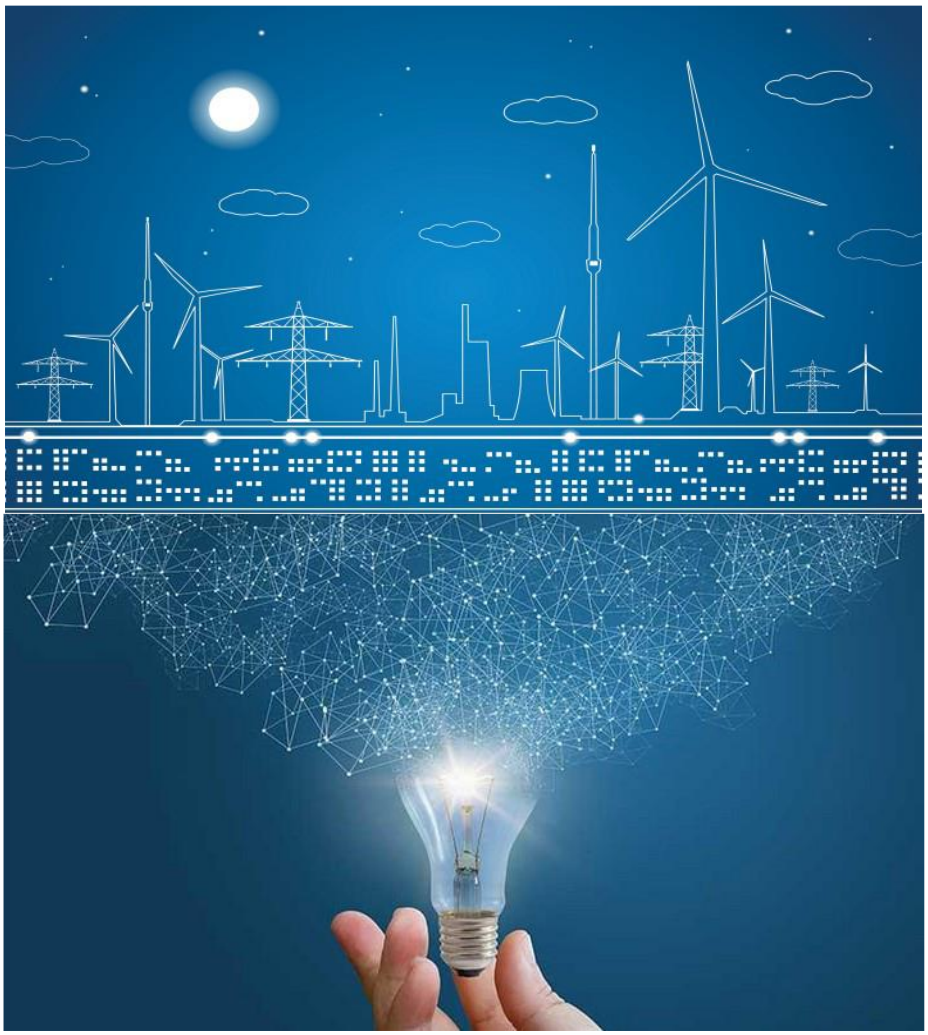
FUTURE ENERGY MARKET DESIGNS: RESEARCH AND INNOVATION NEEDS

SUMMARY REPORT



An event organised under the auspices of the

Experts' Group on R&D Priority Setting and Evaluation (EGRD)

22-23 October 2018

Berlin, Germany

International Energy Agency (IEA)

The IEA is an autonomous agency established in November 1974. Its mandate is two-fold: to promote energy security amongst its member countries through collective response to physical disruptions in oil supply and to advise member countries on sound energy policy. The IEA carries out a comprehensive programme of energy co-operation among 29 advanced economies[1]. The Agency aims to:

- Secure member countries' access to reliable and ample supplies of all forms of energy; in particular, through maintaining effective emergency response capabilities in case of oil supply disruptions.
- Promote sustainable energy policies that spur economic growth and environmental protection in a global context – particularly in terms of reducing greenhouse-gas emissions that contribute to climate change.
- Improve transparency of international markets through collection and analysis of energy data.
- Support global collaboration on energy technology to secure future energy supplies and mitigate their environmental impact, including through improved energy efficiency and development and deployment of low-carbon technologies.
- Find solutions to global energy challenges through engagement and dialogue with non-member countries, industry, international organisations, and other stakeholders.

Since the 1980s, the IEA has continued to build good working relationships with countries beyond its membership, in particular major energy consuming, producing and transit countries. Countries with which the IEA seeks enhanced engagement including Accession countries Chile and Mexico, Association countries China, India, Indonesia, Morocco, and Singapore. Co-operation with these and other partner countries cover a wide range of activities, from joint workshops to in-depth surveys of specific energy sectors or data exchange. Combined, the IEA co-operates with more than 69 countries worldwide.

IEA Energy Technology Network

The IEA Energy Technology Network is an ever-expanding, co-operative group of more than 6,000 experts that support and encourage global technology collaboration. At the head of this vast network is the Committee on Energy Research and Technology (CERT).

Committee on Energy Research and Technology (CERT)

Comprised of senior experts from IEA member governments, the Committee on Energy Research and Technology (CERT) considers effective energy technology and policies to improve energy security, encourage environmental protection and maintain economic growth. Under the guidance of the IEA Governing Board, the CERT oversees the technology forecasting, analyses and the research, development, demonstration and deployment (RDD&D) strategies of the IEA Secretariat, notably through its flagship publication, *Energy Technology Perspectives*, and the series of energy technology roadmaps. The CERT also provides guidance to its working parties and experts' groups to examine topics that address current energy technology, or technology policy, issues. The CERT is supported in its work through four topical working parties, including the EGRD.

Experts' Group on R&D Priority-Setting and Evaluation (EGRD)

The EGRD examines analytical approaches to energy technologies, policies, and R&D on targeted, timely topics. The results and recommendations support the Committee on Energy Research and Technology (CERT), feed into IEA analysis, enabling a broad perspective of energy technology issues.

Executive Summary

Introduction

On 22-23 October 2018, the IEA Experts' Group on R&D Priority Setting (EGRD) held a workshop in Berlin to gain further understandings on research and innovation needs associated with future energy market designs. Technology experts from research entities and leading agencies across the world offered a wide range of perspectives and insights. The event was hosted by Project Management Jülich.

Rationale and Background

The increase in weather dependent renewable energy sources (RES) in the electricity grid has changed the way electricity is generated and transmitted. So to balance supply and demand in real-time, energy storage and demand-side management will play a crucial role. Also managing electricity to and from other energy sectors such as transport, heating, or industries will play a much more important role in the future power system. This technological transition is accompanied by a diversification of the stakeholders leading to a large number of "prosumers" entering the market.

To handle a more complex, dynamic and interdependent energy system requires a legal framework that allows for a more flexible supply. Governments need to focus on a number of policy challenges linked to system integration and market design over the next years. However, there is also important actions government should take related to Research&Development and below the EGRD list some of those.

Key areas for enhanced R&D efforts

Providing flexibility options

To reach the global goals in CO_2-reduction defined in the Paris Agreement a strong effort in the development and deployment of most carbon-neutral energy technologies is needed. A key ingredient are energy technologies that provide flexibility such as energy storage, intelligent grids and demand response technologies.

Efforts must be taken to provide a market value to flexibility which is not always the case in contemporary energy markets. A thorough understanding of possible energy market designs is needed to accelerate worldwide energy transitions.

Towards better markets: price signals, new technologies and services

A well designed electricity market needs to provide the right price signals. Increasingly dominant issues like intermittency, frequency stability and congestion need to be approached by both the supply and demand sides. Getting price signals right helps markets to adapt or push for new solutions. Research is needed to understand the possible impact of different pricing schemes.

Peer-to-Peer technologies such as distributed ledger and blockchain provide a new perspective on energy-trading since transaction costs are low. These create new business opportunities for companies outside the traditional energy supply chain. More research is needed to fully understand the impact of such technologies on energy market designs. To make peer-to-peer energy trading viable, new financial instruments are needed.

Many energy technologies are available on the market, though a number of new technologies are not on track. In particular, more knowledge on cost-efficient installation, implementation, system

integration and sector coupling is needed, not least regarding impact on congestion and stability. The perspective is slowly **shifting from "energy" as the main good on the market towards "energy services"**. This will have long-reaching consequences to the market design as well as to the players on the market.

Future energy systems will rely strongly on digital technology. Since large amounts of often personal data are needed in the process, **data security** becomes an important point to consider. Data security should be given high priority in new market designs.

Living Labs for in-depth policy learning

Living labs and showcase regions provide an ideal opportunity to test different aspects of future energy markets, partially by allowing for regulatory exemptions from the existing legal framework in a "sandbox" setting. These allow evaluating the impact for both technologies and frameworks before rolling out regulatory schemes for the whole country. The living labs currently in place worldwide provide a great chance for in-depth policy learning and can be fed back into decision-making for new regulatory frameworks and business models.

Mission oriented RD&D

R&D funding should focus on solution-oriented transition pathways and be mission-driven, providing solutions to the energy transition. Multiple disciplines and multiple stakeholders will necessarily be involved in the process. An important and challenging task is to ensure a high level of security of supply while allowing for new, possibly disruptive, structures in the energy markets.

Recommendations
• A thorough understanding of possible energy market designs will accelerate worldwide energy transitions and should be considered an integral part of future R&D programmes. • Flexible demand is likely to be one of the lowest cost sources of flexibility. A better understanding how to set the right price signals for flexible demand in any energy market is needed. • Distributed ledger technologies can have a high impact on the energy market and can serve as an instrument to provide flexibility on small scales. Block chain and peer to peer technologies should be considered as a possible alternative to traditional market schemes. • Data security should be given high priority in new market designs due to the large amounts of (often personal) data generated across multiple levels and interfaces. • Living labs are needed to test regulatory schemes in a "sandbox" setting and allow for the active participation of consumers. Future R&D programmes should allow for temporary exceptions from current regulatory frameworks to analyze their impact. • Lessons learned from showcase regions provide valuable insights for in-depth policy learning and should be fed back into into decision-making for new regulatory frameworks and business model. • RD&D should be mission driven, providing solutions to the energy transition. Multiple disciplines and multiple stakeholders will necessarily be involved in the process.

To access the full report please contact Birte Holst Jørgensen (bhjq@dtu.dk) or Johannes Tambornino (j.tambornino@fz-juelich.de).