IEA WORK ON FUTURE ELECTRICITY SYSTEMS

Power grids, demand response and the low carbon transition

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IEA Overview

Founded in 1974

- Formed in wake of 1973 oil embargo with mission to promote member country energy security - autonomous agency of the Organisation for Economic Cooperation and Development (OECD)

29 member countries

- **Asia Pacific**: Australia, Japan, Republic of Korea and New Zealand
- **North America**: United States, Canada
- **Europe**: Austria, Belgium, Czech Rep, Denmark, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Luxembourg, Netherlands, Norway, Poland, Portugal, Slovak Republic, Spain, Sweden, Switzerland, Turkey and United Kingdom
- **European Commission** also participates in the work of the IEA

Decision-making body: Governing Board

- Consists of member country representatives
- Under the Governing Board, several committees are focusing on each area

Secretariat:

- **Staff of around 230**, mainly energy experts and statisticians from member countries
Where do we need to go?

Where are we today?

How do we get there?
Technology Collaboration Programmes

- TCPs are created or discontinued according to energy policy challenges
- Currently 39 TCPs
  - Cross-cutting activities
  - End use and energy efficiency
  - Fossil fuels
  - Fusion power
  - Renewable energy and hydrogen

- Close to 6,000 experts
- More than 1,900 topics to date
- More than 300 public or private organisations
- 51 countries
- 39 Technology Collaboration Programmes
- 9 regional or international organisations

This map is without prejudice to the status of sovereignty over any territory, to the delimitation of international frontiers and boundaries, and to the name of any territory, city or area. Experts from countries shown above participate in activities of the Technology Collaboration Programmes.
Power plays a critical role in the 21st century energy system

■ The important role of electricity
  ● Accounts for 40% of primary energy consumed in OECD countries
  ● Accounts for 42.5% of energy-related global CO2 emissions
  ● Growing pillar of energy security for electrified and digitalised economies

■ A transformation is already underway
  ● Demand declines or stagnates in all OECD Europe
  ● Wind and solar power represent 11.3% of capacity in IEA countries
  ● New technologies changing the power generation landscape

■ Competitive markets under-deliver
  ● Rapid deployment of renewables has been policy-driven
  ● Future of utilities in low-carbon power system

■ New technologies, market design initiatives and reforms
More than 45% of existing thermal capacity was built prior to 1990, and massive investments are needed in new power plants and networks.
The energy sector innovates slowly...

Data from Smil (2010) and IEA (2015), 2DS scenario
Power grids are a key enabler of a low carbon future

WEO: 8.4 trillion in grid investments by 2040, with half of all power transmission assets requiring replacement or upgrade
Alternative and distributed energy is accelerating

- Decentralised energy taking off
- Geography shifting
- Non-OECD countries overtake distributed PV in OECD in 4-5 years
- Global EV deployment close to on-track for two-degree pathway
Smart metering becoming mainstream, residential-scale batteries are next

Consumers increasingly looking for more control, insight on their energy use
Operating the system becomes more challenging as the technology mix shifts. Integrating variable renewables creates new challenges.

Short-term markets with a high temporal and geographic resolution can compensate for forecast errors and ensure flexible and secure system operations.
Demand response can bring many benefits

The different roles of demand response with high share of renewables (illustrative)

With new technologies, small consumers can contribute to flexibility and must be treated in a technology-neutral fashion.
In the European Union, demand response potential could exceed 150 gigawatts (GW) by 2050.
Large-scale deployment will increasingly require automated solutions.

Source of demand response in PJM (2014/15 delivery year)

Key technologies contributing to DR need to be identified; e.g. in PJM, manufacturing processes, HVAC, on-site generation and automated lighting systems form 97% of the source.
Most revenue for DR participants are from capacity mechanisms.

Emergency revenue, which includes capacity and emergency energy revenue, increased by 42.3%, from $475 million in 2013 to $675.7 million in 2014.
Short-term markets are pivotal to integrating wind and solar power and tapping the full potential of distributed resources and neighbouring markets.
Future demand for flexibility

**DR potential**

<table>
<thead>
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<th>Region</th>
<th>2020</th>
<th>2030</th>
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<tr>
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**DR vs everything else**

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<tr>
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</tr>
<tr>
<td>European Union</td>
<td>40</td>
<td>20</td>
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Thank you
In OECD Europe, new transmission investments needed will require modernising the regulatory framework and looking beyond local interests.