Energy Economics and Regulation

Skytte, Klaus

Publication date:
2017

Document Version
Publisher's PDF, also known as Version of record

Link back to DTU Orbit

Citation (APA):

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Energy Economics and Regulation
Systems Analysis Division, DTU Management Engineering

Klaus Skytte
Energy Economics and Regulation

December 2017
Tsinghua University
DTU Management Engineering
Systems Analysis division

• Energy Systems Analysis (ESY)
  – Global and regional energy system optimisation models (all sectors)
  – Integration of intermittent renewables in energy systems
  – GIS prepossessing tools
  – Quantitative scenario analysis

• Energy Economics and Regulation (EER)
  – Analyses of regulatory frameworks and market designs that facilitate the transition towards larger share of renewable energy in the energy system, energy savings, and climate change
  – Policy analysis and economic assessment
  – Economic and social aspects of wind integration, coupling of markets, and flexibility options
  – Demand behaviour based on technical/economic or econometric models

• Climate Change and Sustainable Development
  – Modelling of climate Change mitigation, renewable energy, and smart cities;
  – Decision making tools for climate change impacts and adaptation

• Transport Economics
Five research themes

1. **Energy system modelling**: Advanced tools and expertise supporting national and international energy policy making. Open access modelling. E.g. TIMES and Balmorel models.

2. **Energy economics, policy analysis and energy demand modelling**: E.g. design of energy markets with high share of variable renewable energy, economics of wind energy, and analysis of economic effects from energy and environmental policies and savings, demand forecast, and analysis of high-frequency individual energy demand data.

3. **Climate change impacts, risks and adaptation**

4. **Urban systems and green economy**: Research in connections between liveable cities, urban infrastructure, energy, water and local and global ecosystems in order to make cities smarter and more sustainable.

5. **Transport economics**: Assessment of the economic effect of transport policies, Analyses of travel demand and the relationships between the transport sector and the economy in general, especially the housing and labour markets.
The Future Energy System
Goals and RE-thinking of the Energy Policy Co-Operation

Current electricity system

The trichotomy of energy policy

Decarbonised energy systems

Centralised fossil-intensive supply

Market design

Sector coupling

Flexibility

Cost effectiveness

Reliability

Sustainability

Decentralised + Variable renewable energy + Phase-out of fossil peakers

System integration
Lessons learned from Denmark
Denmark - The Country of Wind and District Heating

Wind 42% share (2015).

Political targets:

• **2020**: 50% of traditional electricity consumption covered by wind power

• **2035**: All electricity and heat based on renewable energy (Obs. the previous governmental position)

• **2050**: The total* energy supply based on renewable energy
  *Total energy system incl. heat, gas, transport, industry, etc.

<table>
<thead>
<tr>
<th>District heating</th>
<th>share of heat supply</th>
<th>CHP share of DH</th>
<th>CHP share of electricity supply</th>
<th>Power-to-Heat share of DH</th>
</tr>
</thead>
<tbody>
<tr>
<td>Denmark</td>
<td>50%</td>
<td>69%</td>
<td>65%</td>
<td>&lt;1%</td>
</tr>
</tbody>
</table>
• develop a Baltic Grid concept (roadmap for offshore grid development) in a close dialogue with relevant industry and political stakeholders

Resources
• InterReg
• 2016 - 2019
• DTU Wind k€ 204 DTU Man: 192 k€
• DTU Wind, DTU Man, + Baltic/german/Polish partners
• WP3 Regulation & Policy + feasibility study
Cooperation on RES support auctions

**AURES: Auctions for Renewable Energy Support:**
**Effective use and efficient implementation options**

3-year H2020 project, 8 partners from 7 EU countries, 1.6mEUR, DTU is coordinator

**Cases on future RES support auction implementations**

- 5 cases
- 5-7 meetings per case
- 4 regional workshops
- Policy making support right where it happens
- Joint analysis on pressing issues
- Knowledge generation about processes
Iremb

Innovative re-making of markets and business models in a renewable energy system based on wind power

- **Content**
  - Market design that facilitates the uptake of renewable energy sources
  - WP on existing and new designs

- **Resources**
  - Approx 3 mio DKK
  - Three year – 2016-2018
  - 1 PhD to SYS
Flexibility for Variable Renewable Energy Integration in the Nordic Energy System

Integrating a high share of variable renewable energy through enhanced energy market interaction

Identify and assess regulatory and technical pathways towards coherent Nordic energy systems in 2050 based on strong interaction between different energy markets that ensure resilience, sustainability and efficiency.

Nordic Energy Research Flagship project September 2015 - March 2019
Flexibility Resources/Market Actors
Electrification/sector coupling - Finding ramping capabilities
Sector coupling
Electrification as source of flexibility

Distribution of EU energy consumption
(Source: EU Heating and Cooling strategy)

Large flexibility potentials in electrification of the energy sectors

Hindered by regulatory barriers

Remove barriers

From technical to realisable potentials

Framework conditions

Market design
Direct regulation
Fiscal policies
Support schemes
Grid regulation

Hindered by regulatory barriers

Remove barriers
Thank you for your interest

Klaus Skytte
Head of Energy Economics and Regulation
System Analysis Division
DTU Management Engineering
Technical University of Denmark

klsk@dtu.dk,
http://www.sys.man.dtu.dk/