



Energy Economics and Regulation

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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
Department of Management Engineering



DTU Management Engineering

Systems Analysis division



Poul Erik Morthorst



Kenneth Karlsson



Klaus Skytte



Simon Bolwig



Ninette Pilgaard

- Energy Systems Analysis (ESY)

- Global and regional energy system optimisation models (all sectors)
- Integration of intermittent renewables in energy systems
- GIS preprocessing 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

Sister departments

DTU Wind Energy
Department of Wind Energy

DTU Energy
Department of Energy Conversion and Storage

DTU Elektro
Institut for Elektroteknologi

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.

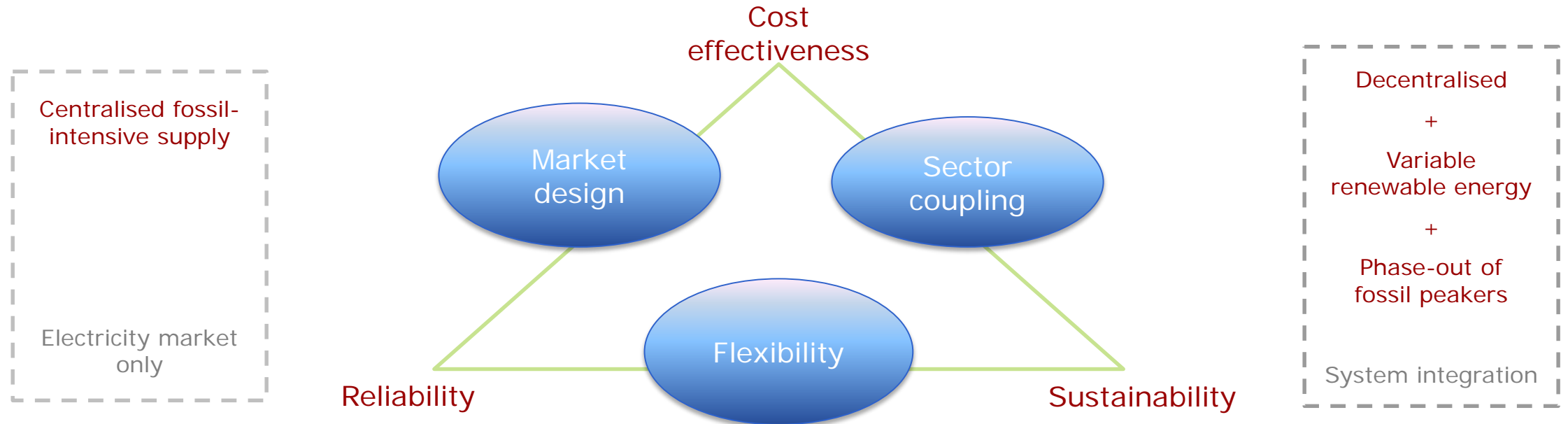
3. **Climate change impacts, risks and adaptation**

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



Lessons learned from Denmark



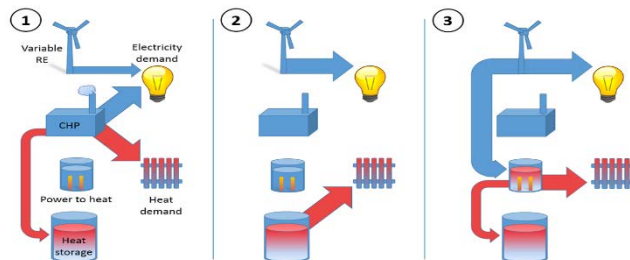
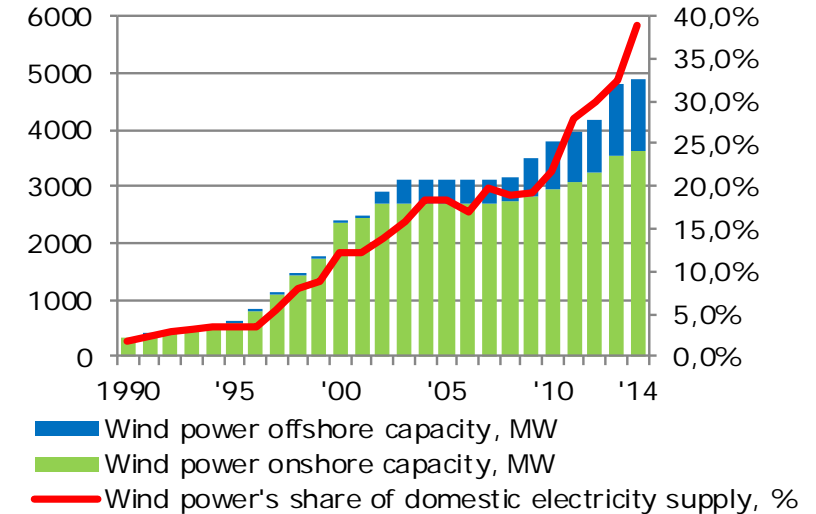


Denmark - The Country of Wind and District Heating

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.



	District heating			
	<i>share of heat supply</i>	<i>CHP share of DH</i>	<i>CHP share of electricity supply</i>	<i>Power-to-Heat share of DH</i>
Denmark	50%	69%	65%	<1%



- 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

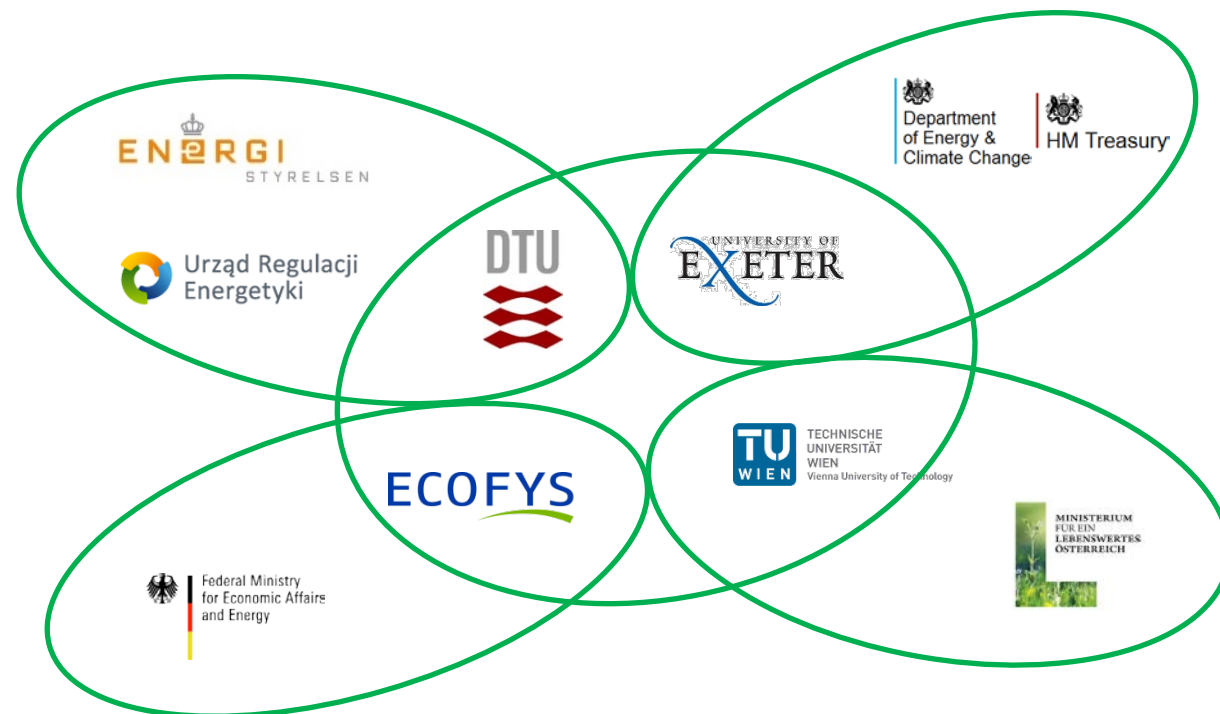
AURES: Auctions for Renewable Energy Support:

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



I remb

Project example

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

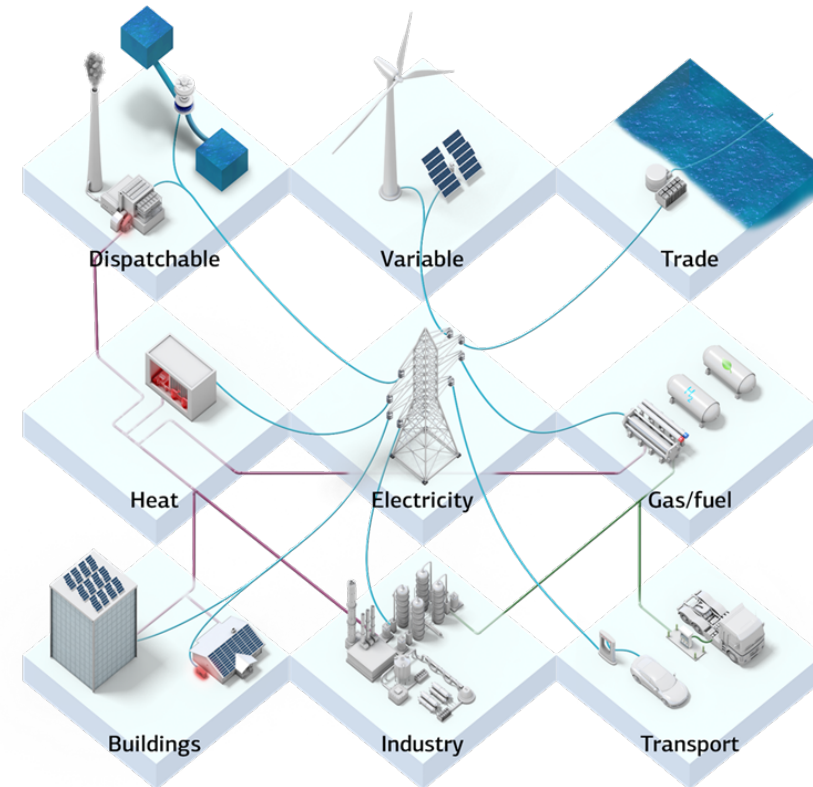
Integrating a high share of variable renewable energy through enhanced energy market interaction

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.

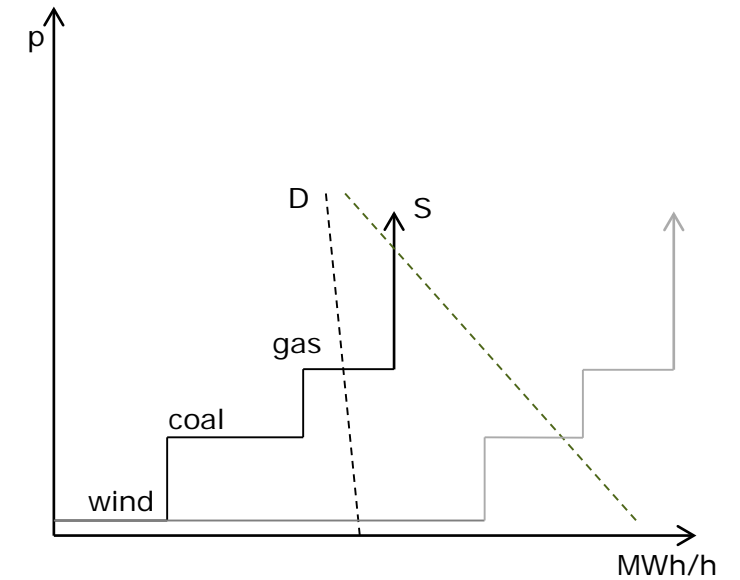
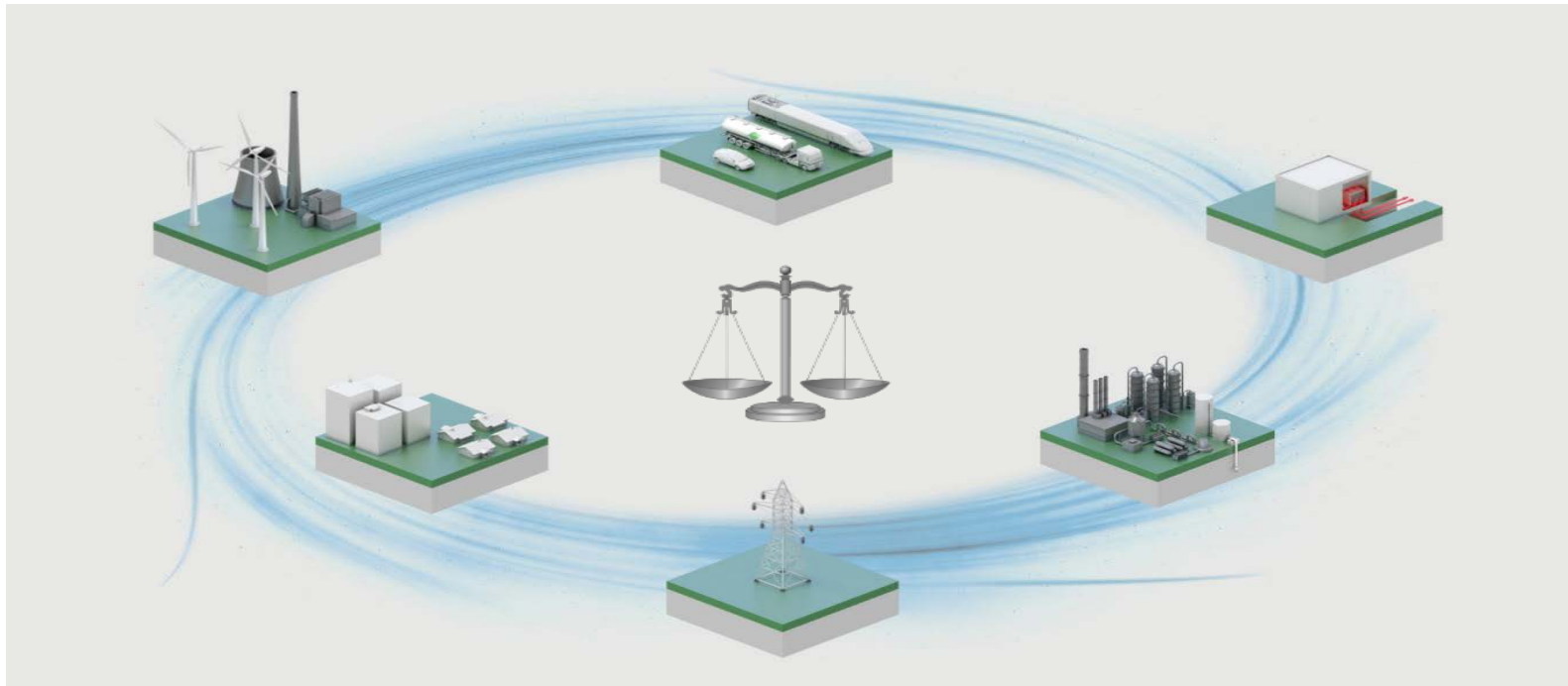
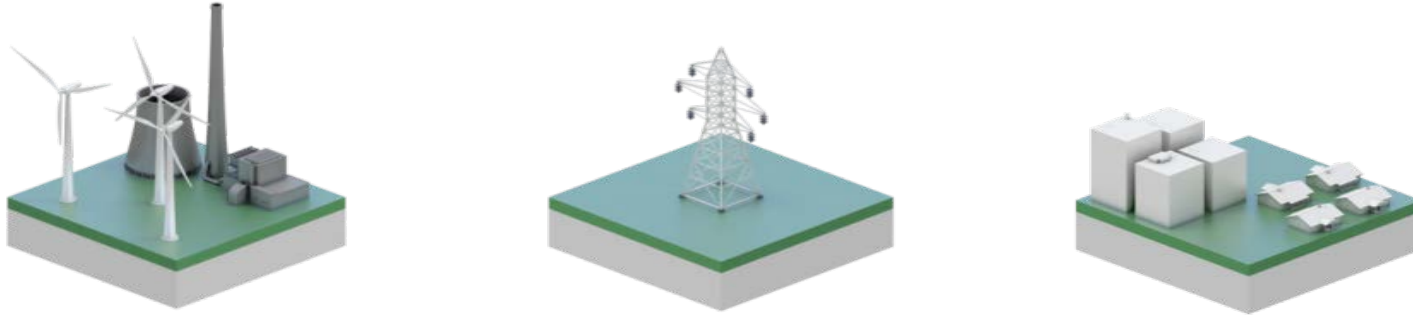


Nordic Energy Research
Flagship project
September 2015 - March 2019



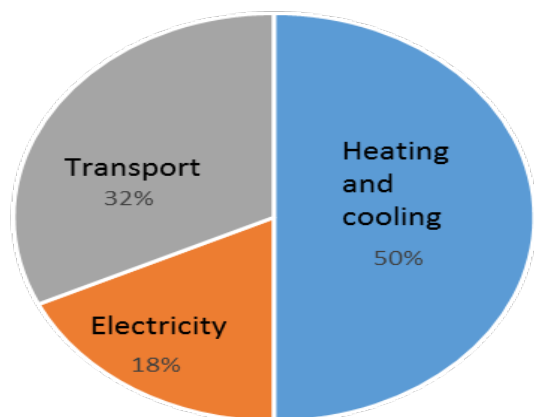
Flexibility Resources/Market Actors

Electrification/sector coupling - Finding ramping capabilities



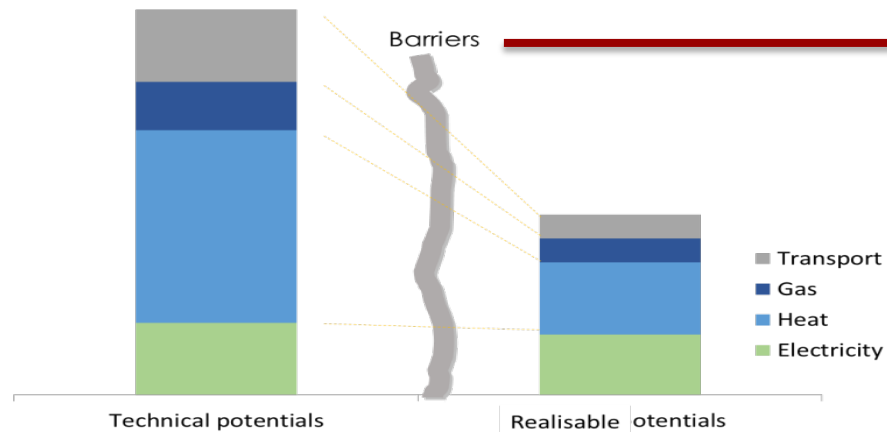
Sector coupling

Electrification as source of flexibility



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

From technical to realisable potentials



Framework conditions

- Market design
- Direct regulation
- Fiscal policies
- Support schemes
- Grid regulation

Large flexibility potentials in electrification of the energy sectors

Hindered by regulatory barriers

Remove barriers



Flex4RES

Flexible Nordic Energy Systems

www.Flex4RES.org

Funded by:



Nordic Energy Research
Nordic Council of Ministers

Thank you for your interest



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