Project introduction

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IEA DSM Agreement Workshop
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Project consortium 2007-2009

ECN

Universidad Pontificia ICAI ICADE Comillas Madrid

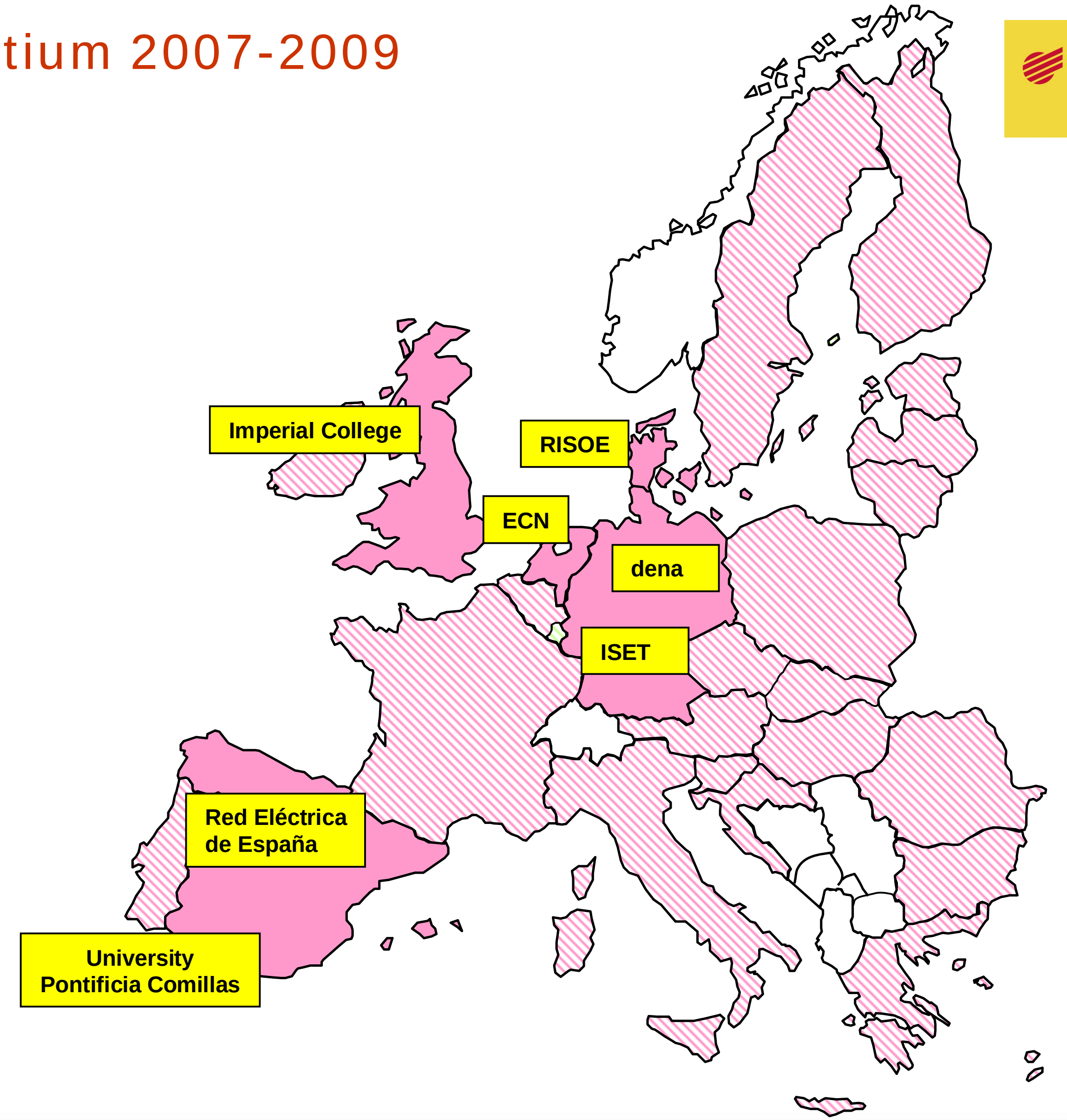
dena Deutsche Energie Agentur

Imperial College London

ISET

Red Eléctrica de España

RISØ



Objectives and main activities

Objective

- Identify, analyse and evaluate …"Economic efficient market-based Response options" to reduce the negative (increasing system costs) impacts of a strongly increasing penetration of intermittent RES-E and DG sources on the electricity system. This to meet EU RES targets for 2020;

Identify, analyse and assess…

- *response options* by market participants that support a more economic efficient integration of variable RES-E and DG in the electricity system.
- barriers and failures in *market competition and present regulation* that currently hinder these response options to be developed and implemented;
- *policy and regulatory instruments & conditions* to promote the application of these efficient response options by market parties in future.

Final results…

- A concise set of economic efficient policy responses and the policy & regulatory framework to facilitate its implementation by regulators & policy makers
- *awareness among market parties,* stakeholders & policy makers of these economic efficient market-based response options by workshops, articles etc

Project progress so far

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Impact analysis of increasing intermittent RES-E and DG penetration

- Development of RES (intermittency) scenarios of the electricity system
- Impacts on generation, demand, trade and balancing system
- Impacts on transmission and distribution networks, respectively
- Crude overview of negative (increasing system costs) impacts

Identification and analysis of response options in generation, balancing/trade, networks and demand

- Response options in: generation, demand response and power trade
- Response options by: distribution and transmission system operators
- Reviews on relevance in several partner countries of these options

Assessment of barriers (current system conditions)
for implementation of these (market) response options→ on-going now

Assessment of regulatory & policy measures/improvements
to implement response options→ October08 till May09

Presentation of some results and findings regarding DSO & Demand side options

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- Introduction of the background of increasing impacts by intermittent RES-E generation
- Overview of response options that would reduce the negative (system costs increasing) impacts
- Some conclusions
- Main sources:
  - Response options for generation, trade and demand by Henrik Jacobsen, Risoe
  - Response options for the DSO including DSM by Adriaan van der Welle, ECN

Drivers for DER (RES&DG) penetration

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Greenhouse gas emission reduction

- EU Kyoto target : -8% reduction in 2008-2012 compared to 1990 emissions
- CO_2 emission reduction in 2020: -20%

Renewable electricity

- 2010 target: 21% electricity demand in EU from renewable sources
- 2020 target: share of RES 30-50% in electricity and 20% in total primary energy supply

Energy efficiency

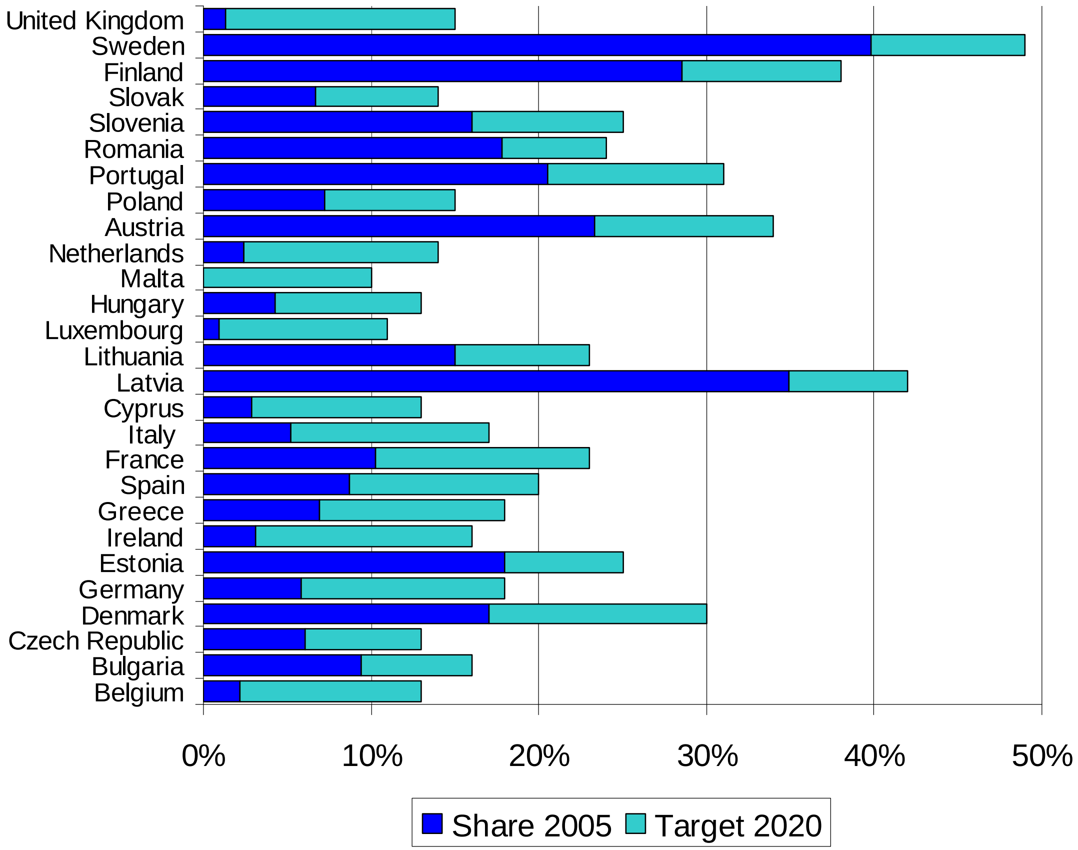
- EU directive for Combined Heat and Power (CHP)
- EU Action Plan for Energy efficiency: 20% energy saving by 2020 compared to baseline

Enhancing supply security/reducing fuel dependency

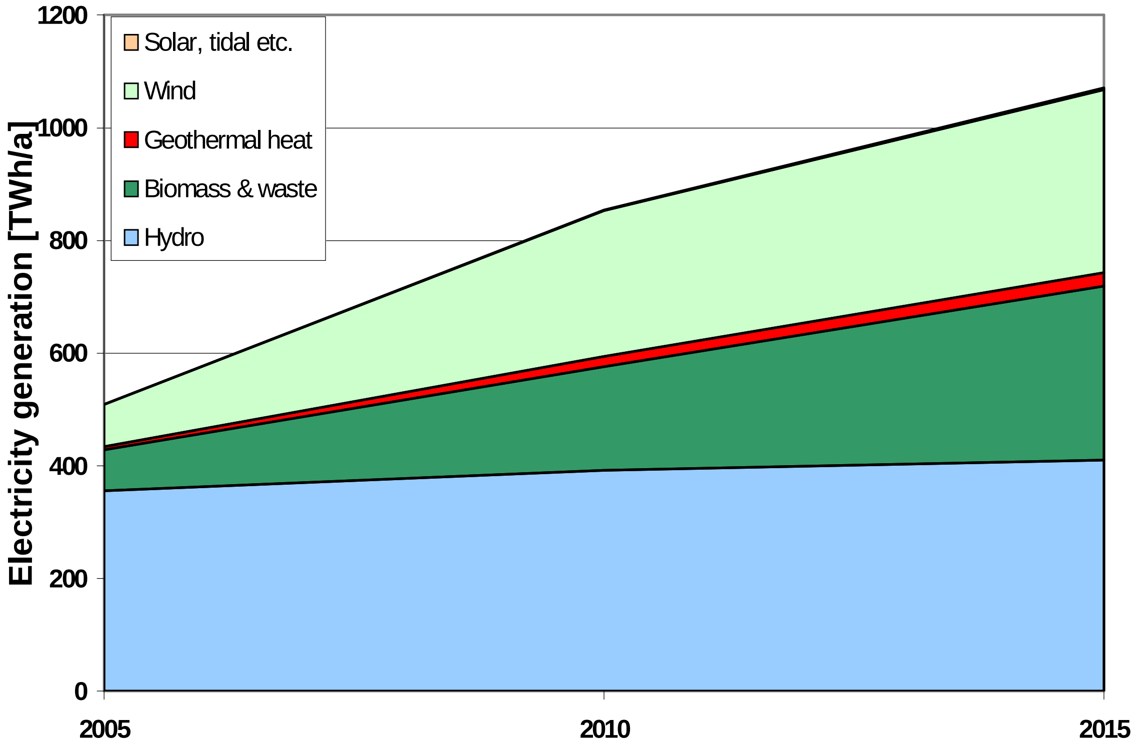
→ Via Support Schemes in Member States

National RES targets 2020 EU

source: Draft Directive EC (2008)



Scenario of RES-E generation in the EU 27



- The largest part additional RES generation by offshore and onshore wind (9%) and biomass (9%)

source: Dena

Electricity generation and installed capacities in the EU 27 for 2005 & 2015

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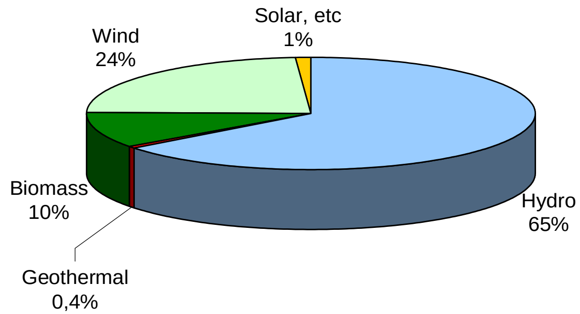

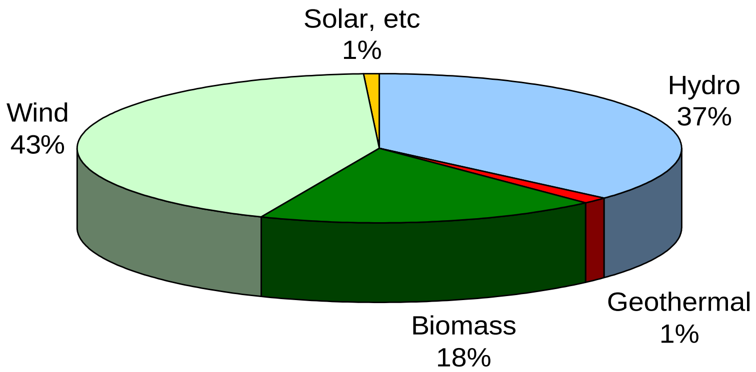

Source: Dena

- Wind contributes for largest part to the increase of RES.
- Onshore and offshore wind will become the dominant renewable energy source with a share of 43% of all installed RES capacities in 2015.

Main negative impacts of large intermittent RES-E (wind, PV, micro-CHP) supply

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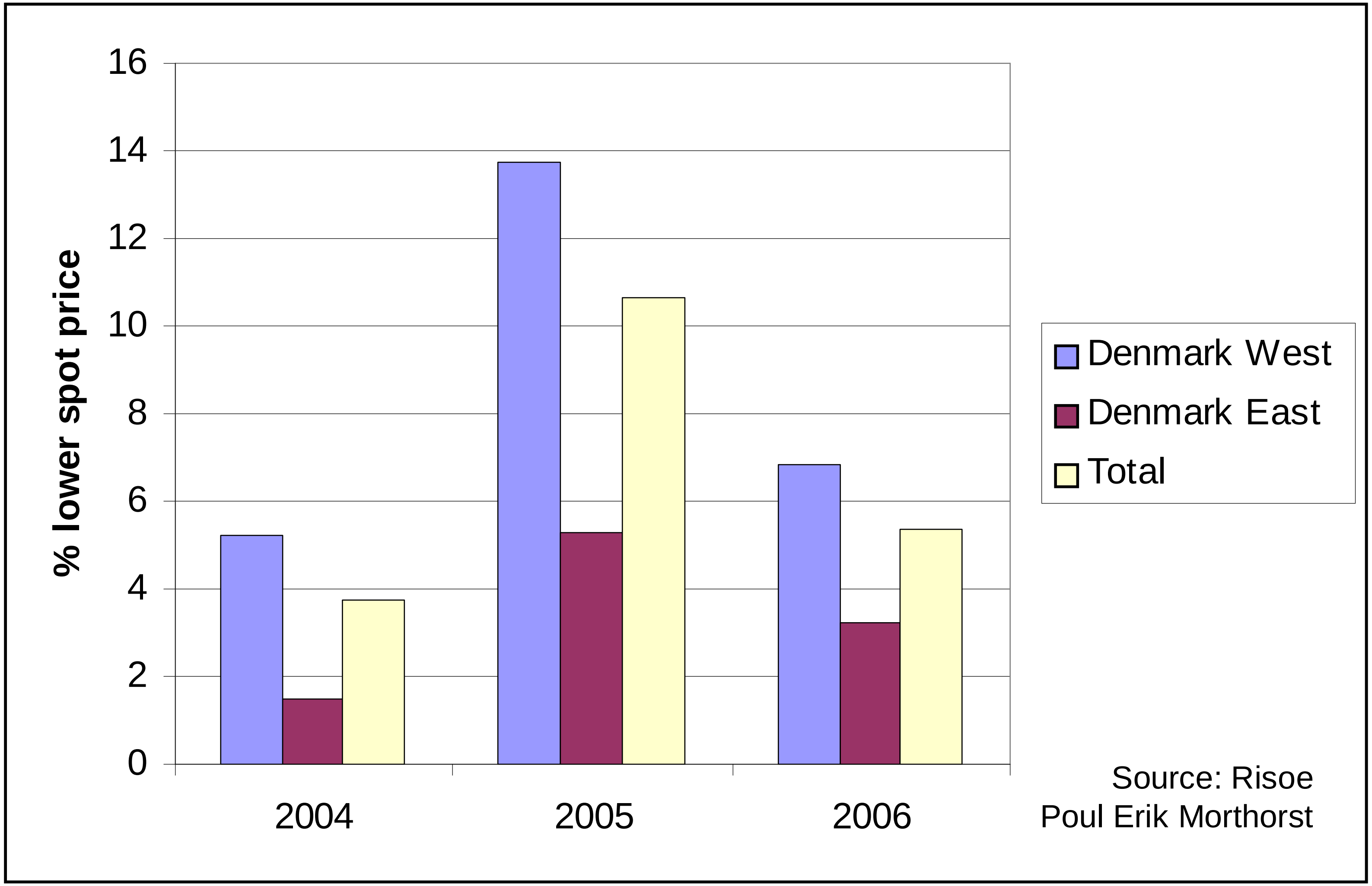
- More variable, less predictable and controllable supply of electricity, particularly impacting markets, network operation of transmission and distribution networks, i.e.:
  - More price variation, higher balancing cost, lower capacity values, and lower revenues base load generators in markets

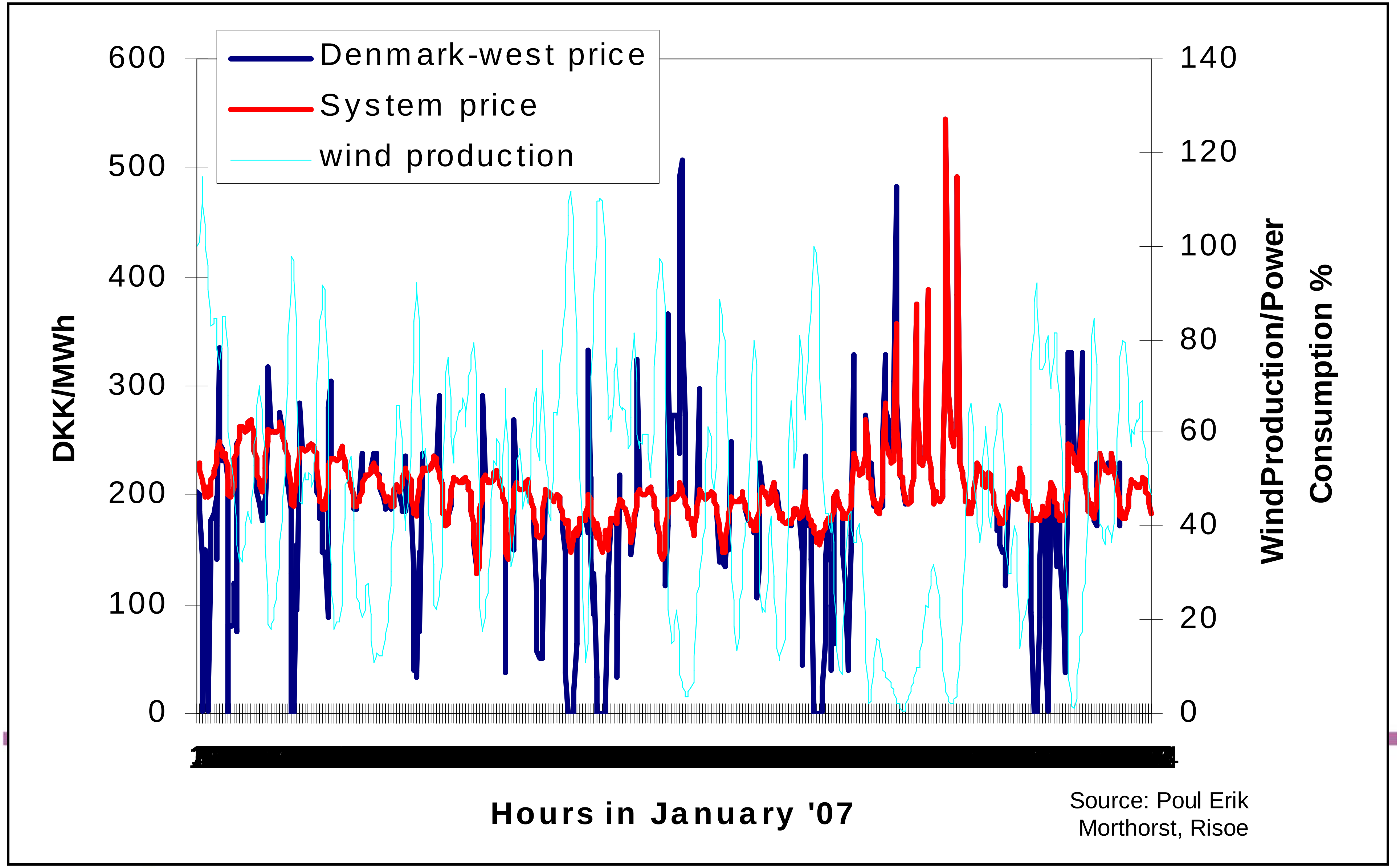
    → More demand for flexible and better predictable generation
  - More expensive network operation through voltage rise, increased fault levels and higher variability direction of power flows, i.e. more energy losses etc

    → More demand for technical and economic options for improving network controllability, i.e. by more demand response

Lower spot market prices: results for 3 years



Impact on Spot Price: DK example



Response options to increase network controllability

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- Usual option of fit-and-forget way DSOs react to less predictable, more fluctuating and more diverse network load situations (upward flows) with a response→ network reinforcement.
- However, this way becomes an increasingly expensive way of network planning.

- Alternative options to increase network controllability of DSOs:
  - Active network management
  - Demand response
  - Micro-grids
  - Storage
  - Flexible deployment of DG

Active network management

Three phases of going to Active network management (ANM):

1. Real-time network control→ i.e. monitoring transformers
2. Real-time control of demand and generation
3. Local system balancing, i.e. by micro-grids → see a next slide

- ANM means less investments in network reinforcement, but more in DSO activities such as communication, i.e. ICT tools and often higher energy losses

Institutional and regulatory measures:

- DSOs need to be indifferent between network reinforcement and ANM to further efficient network planning: move to incentive regulation instead of rate-of-return regulation
- Promotion of network innovation
- Real-time and locational network pricing to steer network flows

Demand response options

- Shifting energy demand from peak to off-peak demand lowers peak demand and consequently demand for network services

- Problem now: low price-elasticity of demand (non-visibility of real-time energy use and associated costs) for small customers

→ Implementation of smart metering is a precondition for more demand response

System advantages:

1. Higher "network capacity usage rate" (higher overall system efficiency)
2. Less network interruptions (higher security of supply)

But... higher data management costs of real-time metering and pricing

Institutional and regulatory changes:

- Introducing real-time, peak and day ahead pricing and further interruption contracts etc

Micro-grids

Definition micro-grids: LV network operating independent from MV and HV networks

Therefore:

1. higher security of supply in rural areas with a comparable amount of generation and load
2. lower costs than extension of network capacity by reinforcements

- Before implementation of local balancing and islanding earlier phases measures of ANM concept have to be implemented and black start has to be technically feasible

- Institutional and regulatory measures: especially real-time and locational pricing are necessary for better steering of network flows

Storage options

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Application of the storage option in cases of:

- Electricity at times the network is constrained
- Increase of network reliability (provision of reactive power, protection and isolation for system faults)

→ network reinforcement can be postponed/avoided

Required institutional and regulatory measures :

- Time and location dependent network tariffs to account for contribution of storage to resolve network constraints
- Adjustment of network planning practices and concomitant investment incentives to promote trade-off between use of storage in network operation and additional network reinforcement
- Allow introduction of independent storage facility for several purposes including network aims both for economies of scale of storage facilities and to overcome unbundling provisions

More flexible deployment of generation

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- Congestion management: diminishes power flows in congested areas and prevent a change in flow directions → saves network reinforcements

- System benefits:
  1. Higher "network usage capacity" (higher efficiency)
  2. Less network interruptions (higher security of supply)

- Required institutional and regulatory measures:

  - Density and location of entry point and specific network situation relevant for impact→ time and locational network pricing is required

  - Avoided costs network operator have to be passed on partially as remuneration to down regulated distributed generators.

Applicability of DSO & Demand response options (i)

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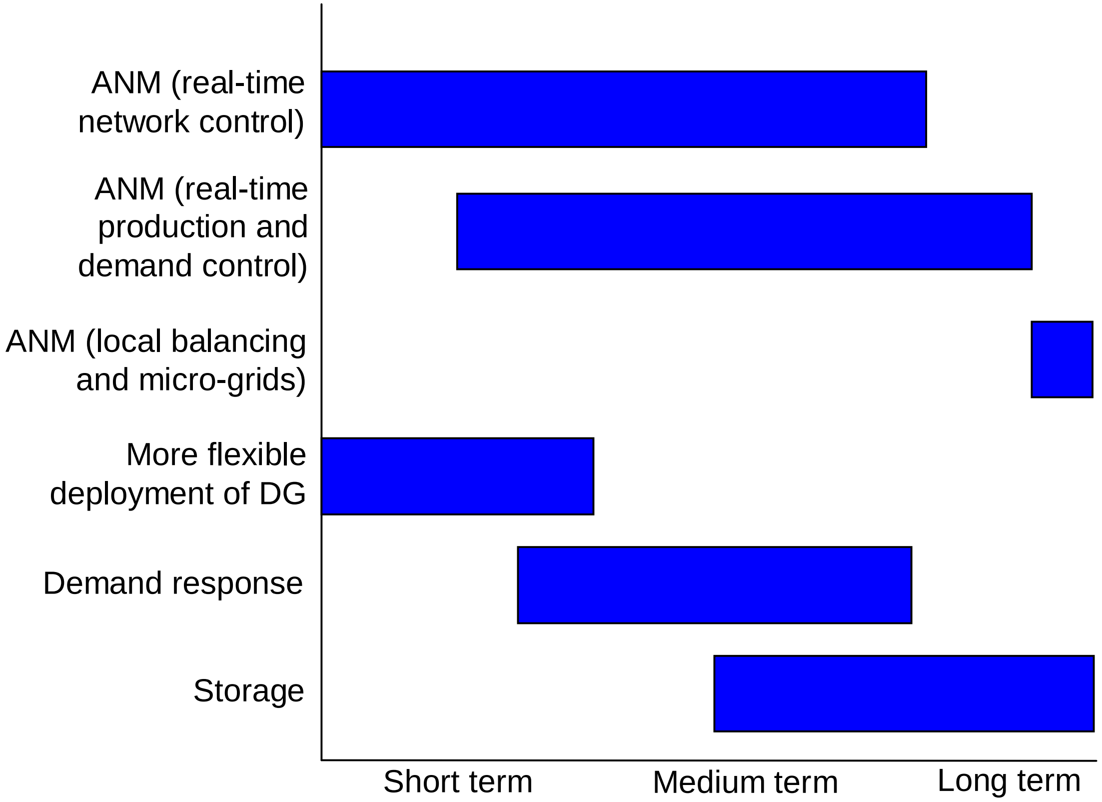
Criteria for feasibility in time:

- Feasibility in the short-term depends on:
  - technology is sufficiently proven
  - limited network investments needed
  - no change in the network operation philosophy necessary
  - no or limited regulatory adjustments required
  - limited participation of consumers in the solution required

- Feasibility in the longer-term depends on:
  - Cost-efficient monitoring and control network devices are available
  - ICT based communication systems to be able to deal with large amounts of data about network operation, generation and demand are put in place
  - Modest to complex changes in network regulation, i.e. use of system and locational tariff system charging of generation and demand

Applicability of DSO & Demand response options(ii)



RESPOND

Renewable Electricity Supply interactions with conventional POwer generation, Networks and Demand

Conclusions

- Contribution of intermittent RES-E & DG will increase substantially in EU countries in next decades
- Need for timely development & implementation of market-based technical and economic response options in EU MS
- RESPOND identified many options for system segments, generation, trade, load balancing, networks and demand side. Priority options for DSO&DSM:
  - More monitoring and control of distribution network operation
  - More monitoring and control of DG and demand options for:

    1) More flexible deployment of DG at extreme peak supply of RES-E generators

    2) Demand response by real-time pricing etc
  - Further development/implementation of ANM concept for DSO
- Deployment of storage for DN and introduction of micro-grids will depend much more on specific system and network conditions per country/region

  → i.e. less wide-scale possibilities and higher costs for longer-term

- NOTE: Precise values of different options and avoided costs closely depends on characteristics of national power & DN system:

  - DG characteristics (concentration and location)
  - network characteristics
  - national policy and regulation

Project partners & Contact

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