Renewable energy

How much can we expect it to increase supplies over the next two decades?

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Main issues – wind power

- The Future
- An illustration (western part of Denmark)
- Big challenges
  - Grid reinforcements
  - Daily forecasting
  - Market design
- Additional costs caused by the irregularity of wind power production
Wind Power – Basic Characteristics

- **No reliable availability**
  - The power output is dependent on wind speed

- **Limited predictability**
  - The Wind prognosis is as good/bad as the weather forecast

- **Unfavourable geographical allocation**
  - Attractive wind conditions are usually located in sparsely populated coastal areas → energy transportation
Offshore – Main Driver for future RES Capacity?

Installed capacity [in MW]

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<tr>
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<th>2003</th>
<th>2010</th>
<th>2020</th>
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<tbody>
<tr>
<td>onshore</td>
<td>28,500</td>
<td>75,000</td>
<td>180,000</td>
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<tr>
<td>offshore</td>
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1 2003 /Source: EWEA
2 Targets EWEA
A System with more than 20% Wind Power

Hourly Wind Production in % of Consumption, January 1 - August 29, 2005.

- Hourly Wind Production in % of Hourly Consumption
- Acc. Wind Production in % of Acc. Consumption

0% 25% 50% 75% 100% 125%
Additional wind power require additional transmission capacity

- Dena: North See Wind Power:
  - 2010: 4,430 MW
  - 2020: 18,640 MW

- Grid expansion:
  - Long realization times mainly due to time-consuming approval procedures

Grid reinforcements must come before new offshore wind power
Wind forecasts

- Based on the forecasts from a met. centre (ex. Danish Meteorological Institute).

- The Wind forecasts for the next 24 hours are very unreliable (ex. average deviation: 35%).

- In western part of Denmark the wind forecast error typically determine the direction of the imbalance in the system 70-80% of the time!

- In western part of Denmark imbalances up to 1,800 MW in some hours (8 January 2005)

- The imbalances caused by the unpredictable nature of the wind power is the main reason, why the TSO has to secure a large amount of regulating reserve.
Aggregated wind production curve
(All wind turbines in DK West)
Market Demand

DK West: January 2005

Domestic base load market: about 1,800 MW
Residual Domestic Market

MW

DK West: January 2005

Domestic market for thermal units (prioritized and commercial)

Local CHP with priority could not respond to market signals at that time, but to time-of-day tariffs

Demand minus wind power
Share of domestic market left for commercial producers.

Even these producers have constraints due to district heating and system security.
Export is the proper solution when there is an electricity demand in neighbouring countries.

If not, electricity overflow means waste of energy and money.
Costs relating to residual supply as a function of wind power share

Wind power share (%)

Costs of residual supply

- Total yearly costs
- Additional costs due to wind
- Unit costs

1 DKK = 0,13 EUR