European approach to balancing markets – spotlight on Germany

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General alternatives for interaction between grids and markets

- **ISO model**
  - System operator is responsible for market and grid
  - Mandatory Power pool
  - System optimization by ISO covering both power plants and grid usage
  - Frequently used in the **US markets**, most well-known example: PJM

- **Power exchange model**
  - Separated responsibilities: grid operators and power exchanges
  - Trading both bilaterally and through Power Exchange
  - Decentralized optimization by market participants
  - Grid operation based on submitted schedules and management of deviations
  - Nowadays used in all liberalized **European markets**
Trading possibilities in German power market

- **End of month -1**
- **Day-ahead 8:00h**
- **Day-ahead 12:00h**
- **Delivery of regulating services**

**Future & Forward market**
**Short-term (OTC) Forward market**
**Spot Trading**
**Intraday Trading**
**Ex-post- Trading**
**Delivery of balancing energy**
Needs for Balancing Energy

New Information on / Changes in

- Load
- Wind
- Conventional Generator Outages
Assessment of Balancing Energy Needs

• **Day-ahead load forecast**
  – About 2 % forecast error
  – i.e. for Germany about 1200 MW MAE (Mean absolute error)

• **Plant outages**
  – About 25 per plant and year, 10 h per outage on average
  – i.e. for Germany about 1700 MW MAE (Mean absolute error)

• **Wind forecast**
  – 4 % RMSE of 25,800 MW
  – Own analysis 750 MW MAE for total German generation

→ euclidean sum yields 2250 MW corresponding to about 20 TWh
## Intraday market characteristics

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<tbody>
<tr>
<td>France</td>
<td>EPEXSPOT</td>
<td>75’ before delivery</td>
<td>1.02 TWh</td>
<td>0.2 %</td>
</tr>
<tr>
<td>Germany</td>
<td>EPEXSPOT</td>
<td>75’ before delivery</td>
<td>5.66 TWh</td>
<td>1.1 %</td>
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<td>IntradayS</td>
<td>Even ex-post trades</td>
<td>?</td>
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<tr>
<td>Nordic Countries</td>
<td>Nordpool</td>
<td>60‘ before delivery</td>
<td>1.82 TWh (2008)</td>
<td>0.5 %</td>
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<tr>
<td>Spain</td>
<td>OMEL</td>
<td>6 auctions per day</td>
<td>31.34 TWh</td>
<td>12.1 %</td>
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Intraday EEX – prices and volume

**Preis**

€/MWh

07.04.08  14.07.08  20.10.08  26.01.09  04.05.09  10.08.09  16.11.09  22.02.10

**Volumen**

MWh

07.04.08  14.07.08  20.10.08  26.01.09  04.05.09  10.08.09  16.11.09  22.02.10

Gesamt: 11.678.490 MWh
Why is liquidity much lower than expected?

- Large player are doing internal netting
- Downwards spiral of limited liquidity
- Market design – continuous trading
- Competition with regulation power market in the case of Nordpool
Reserve power – technical characteristics

http://www.amprion.net/en/control-energy
## Reserve power – market characteristics

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<thead>
<tr>
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<th>Primary control</th>
<th>Secondary control</th>
<th>Minute reserve</th>
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</thead>
<tbody>
<tr>
<td>Auction design</td>
<td></td>
<td>One-sided auction (monopsony of TSOs)</td>
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<tr>
<td>Auction frequency</td>
<td>Monthly</td>
<td>Monthly</td>
<td>Daily</td>
</tr>
<tr>
<td>Auction volume</td>
<td>623 MW</td>
<td>~ 2300 MW (positive)</td>
<td>~ 2300 MW (positive)</td>
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<tr>
<td></td>
<td></td>
<td>~ 2000 MW (negative)</td>
<td>~ 2450 MW (negative)</td>
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<tr>
<td>Purchased/delivered energy</td>
<td></td>
<td>1.3 TWh (positive)</td>
<td>0.2 TWh (positive)</td>
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<td>(2009)</td>
<td></td>
<td>2 TWh (negative)</td>
<td>1 TWh (negative)</td>
</tr>
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Advantages and Disadvantages of the Power Exchange Model

Cons

• Market operation does not fully reflect technical constraints
  – Nodal pricing hardly possible
• Coordination efforts between power exchanges and grid operators necessary
• Lower liquidity in the power market
• Decentralised optimization may result in inefficient resource use

Pros

• Decentralised optimisation provides opportunities for innovations
• Market incentives to avoid inefficient market designs
• Larger market zones less prone to exercise of market power
• Derivative markets easier to establish
• Market prices more easily provide right incentives for investment in generation
Thank you!