System Reliability and Ancillary Services
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Generation in the Danish electricity system*

20 Central Power Stations

4,300 MW

>5,000 Wind Turbines

4,900 MW

~650 Local CHPs

~90,000 Solar PV

2,500 MW

600 MW

*January 2015
Wind power share in Denmark

- **2014**: 39%
- **January 2014**: 62%
- **13-19 January 2014**: 105%

Sunday 19 Jan
Strong grid and interconnectors

Interconnector capacity: ~5.800 MW

Maximum electricity consumption ~6.000MW
Keeping the system balanced

Power Production

Power Consumption

50 Hz

GE

DK

NO

HVDC
Balancing philosophy

Disturbances

Primary reserves

Activation

Restoration

Normal operation

Secondary reserves

Manual reserves and regulating power

Time

Power

Activation

Restoration
The Nordic regulating power market (RPM)

- The setup is now around 15 years old
- Implemented quite fast only appr. 9 months
- Most of the rules from back then still apply today
- Harmonization of settlement in 2009
- Participation of wind parks since 2011
- NOIS has developed to be an IT tool, that is used to operate the Nordic Regulating Power Market (RPM)
How the RPM works

- Capacity contracts and voluntary bids
- Common Nordic merit order list
- Activation of cheapest, Nordic bids unless there’s a congestion
- Most expensive, activated bid sets the imbalance settlement price

- Used to ease grid constraints e.g. redispatch with Germany

Source: Nordpoolspot
Available resources on the RPM

Reserves and voluntary bids at the RPM in Western Denmark
Example: wind integration in the Nordics

**Fact:**
Significant increase in installed wind capacity in the Nordic in the period from 2008-2014

**Questions of interest:**
Has this affected imbalances?
Has this affected the Regulating power market?
Do we have to change the balancing incentives for the BRP’s?
Example: wind integration in the Nordics

• BRP’s imbalances have increased significantly in DK and SE.
• Increased wind power production is the main reason.
  (Structural changes another, crossed in graphs)
• Production imbalances are moved to consumption imbalances.
• **However, yearly regulation volumes have not increased but decreased.**
Grid constraints – redispacht with GE

Regulation process in GE:
1. Available German resources are regulated
2. Neighboring countries are asked if they can regulate
3. German wind parks are regulated
Thank you for your attention

Questions?