Future wind power forecast errors and associated costs in the Swedish power system

Presentation at Winterwind 2012
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Confidentiality class: None (C1)

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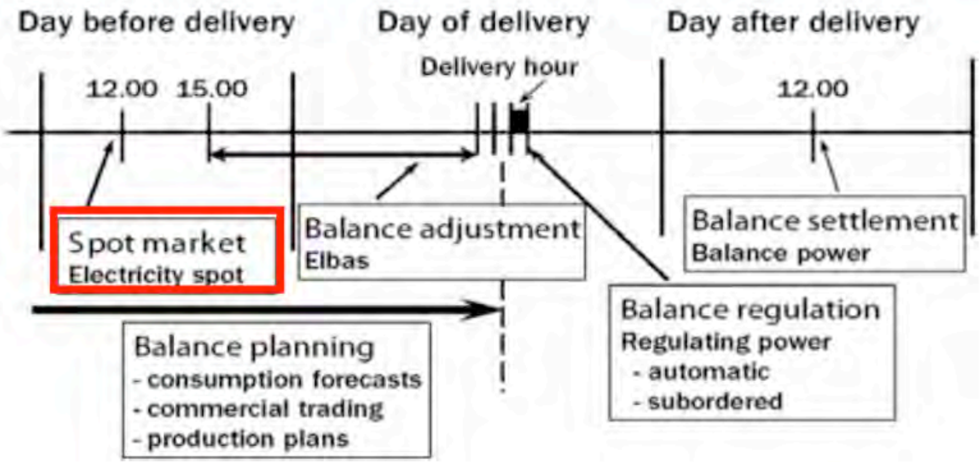
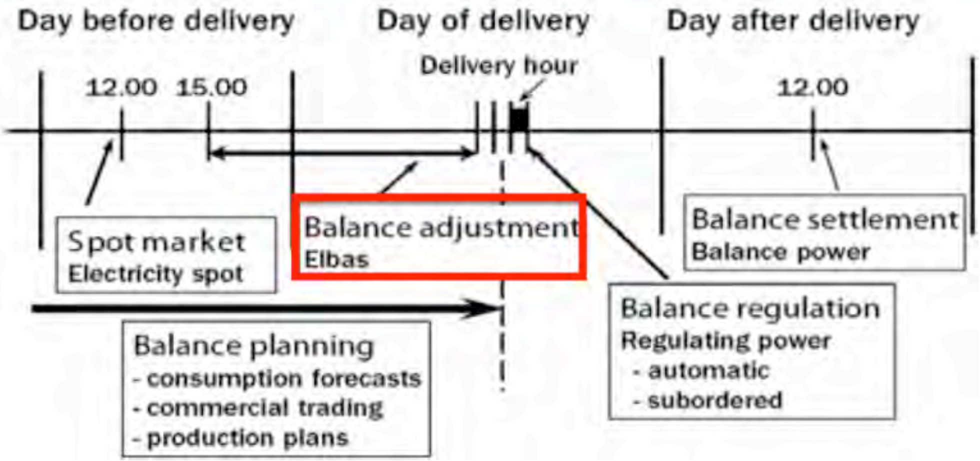
- Nordic electricity market
- Day ahead forecast errors
- Model with different actors 10 and 30 TWh wind power scenarios
- Imbalance costs
- Are there any possibilities to reduce imbalance costs?
- Conclusions

Nordic Electricity market



- Bids to the day-ahead market are provided 12-36 hours in advance

Nordic Electricity market



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- It is possible to trade on the intra-day market in order to compensate for forecast errors

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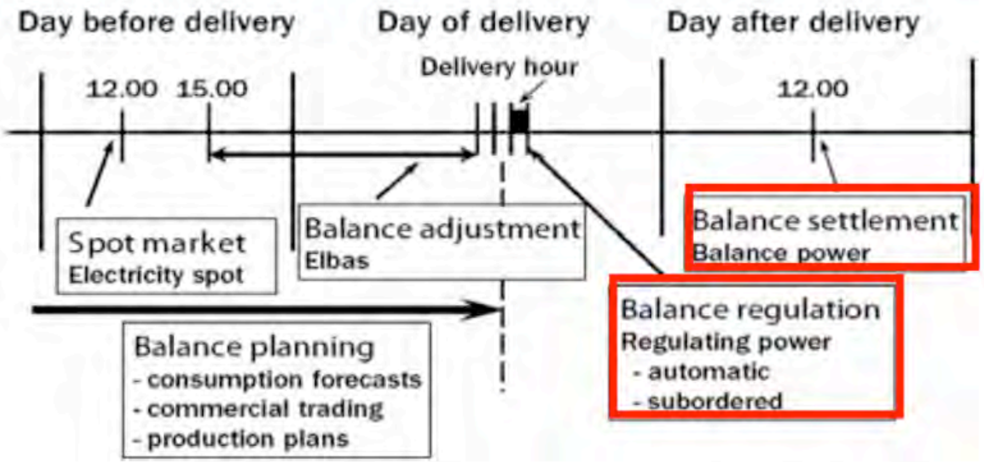

- Bids to the day-ahead market are provided 12-36 hours in advance
- It is possible to trade on the intra-day market in order to compensate for forecast errors
- The forecast errors are handled by the TSO during the hour of delivery
- Those who have caused to for forecast errors then have to pay

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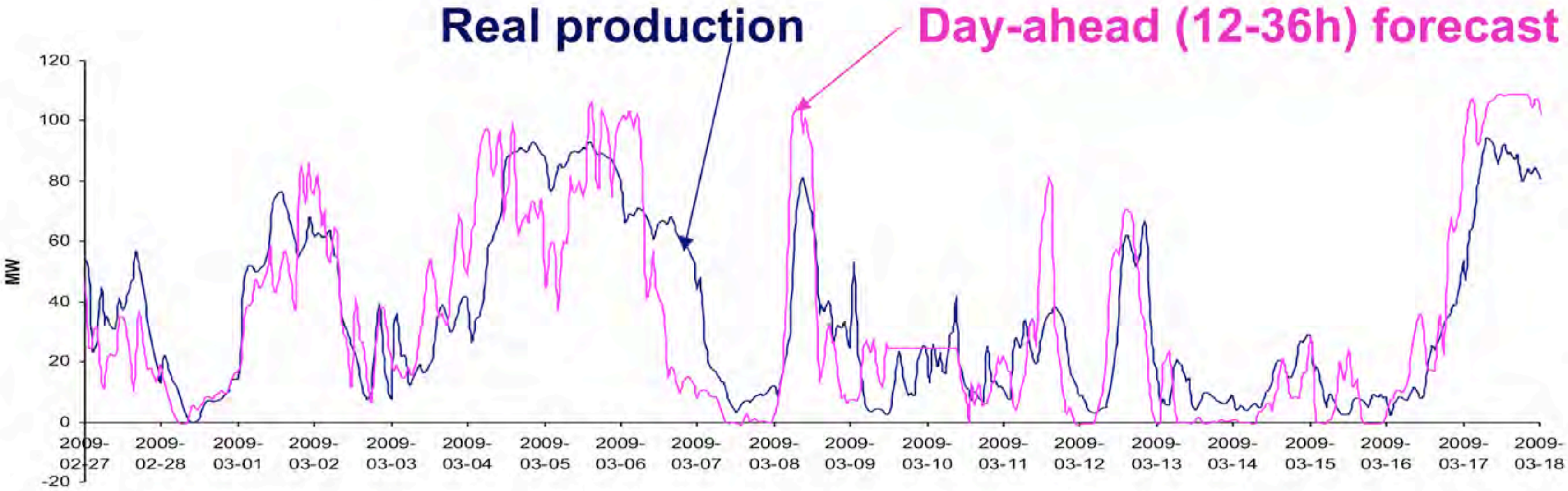
Example of day-ahead forecast from Lillgrund wind farm



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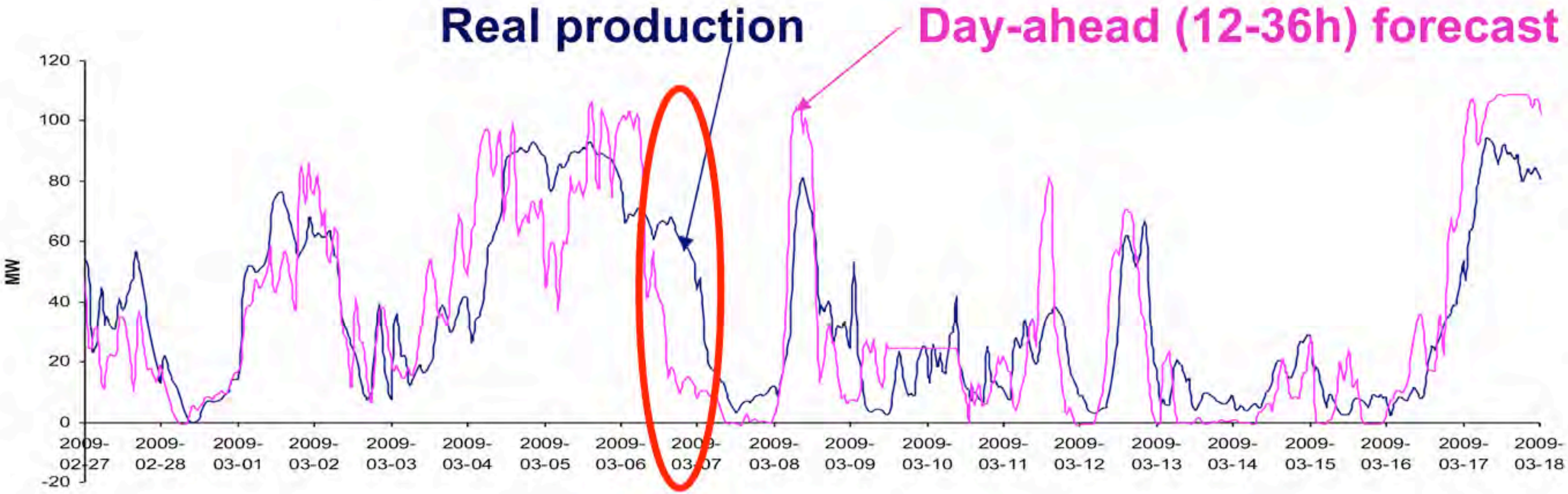
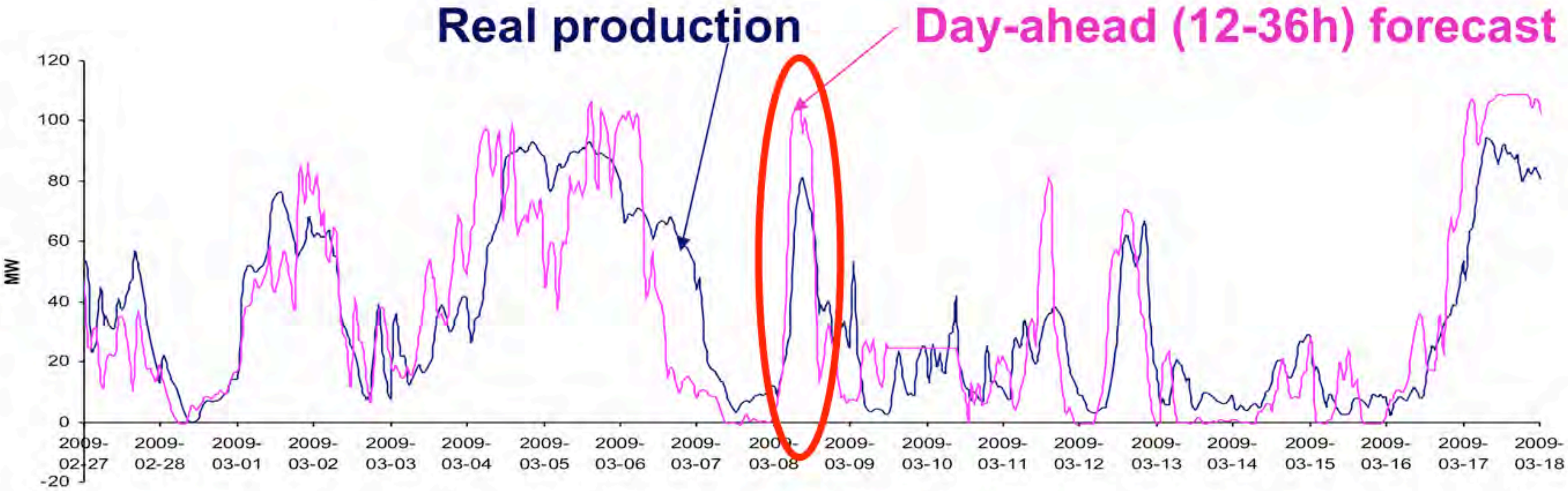


Weather front arrived later than forecasted

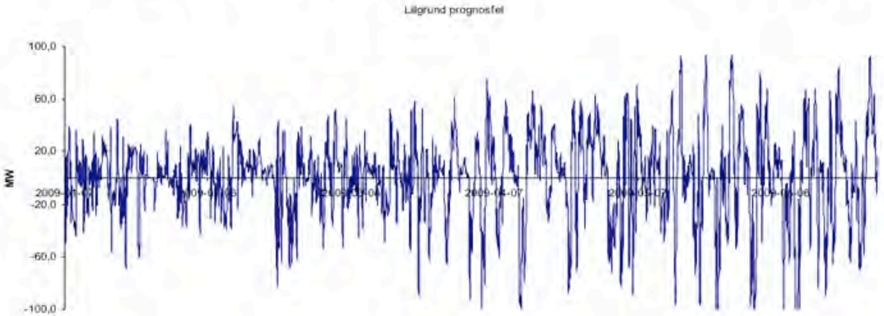
Example of day-ahead forecast from Lillgrund wind farm

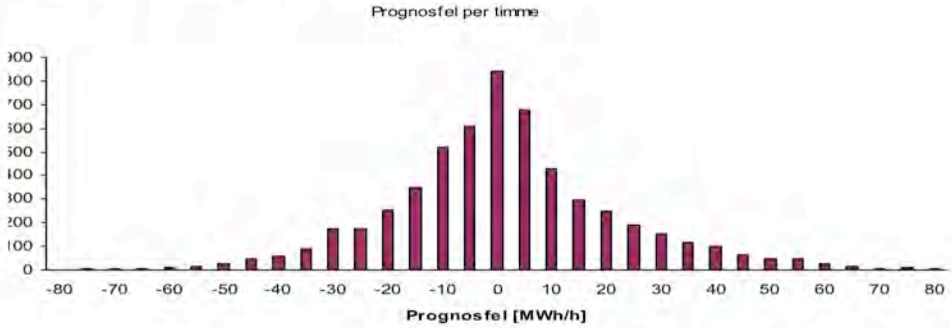


Wind speed less than forecasted

Analysis of Lillgrund forecast errors (day-ahead, 12-36h)

- Installed capacity 110 MW
- Yearly production: 330 GWh
- Mean power: 37 MW = 33% of installed capacity
- Forecast error: 130 GWh = 41% of yearly production
- Mean deviation: 12 MW = 10% of installed capacity





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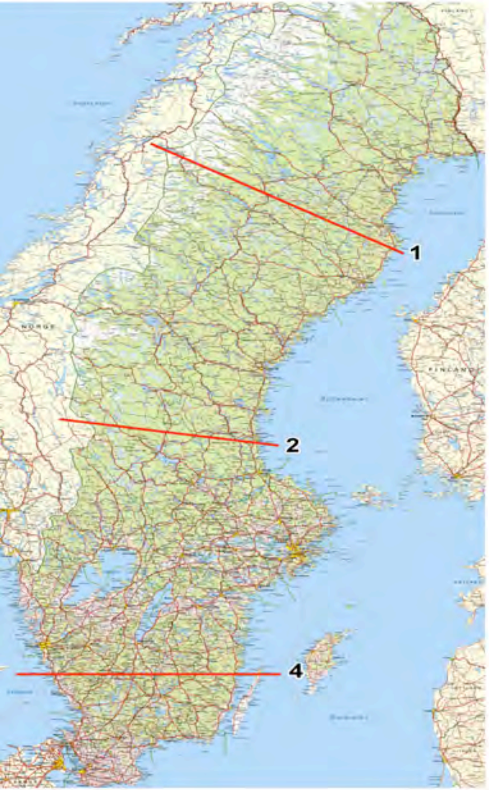
Swedish wind power scenarios with 10 and 30 TWh

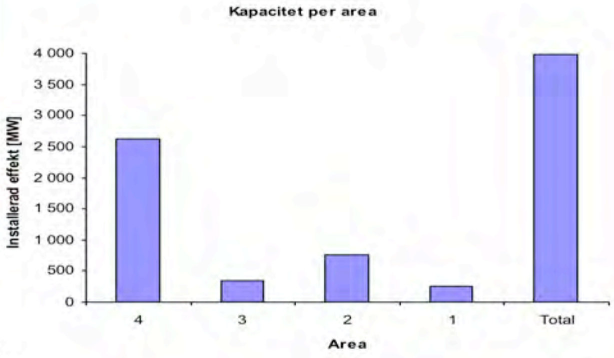


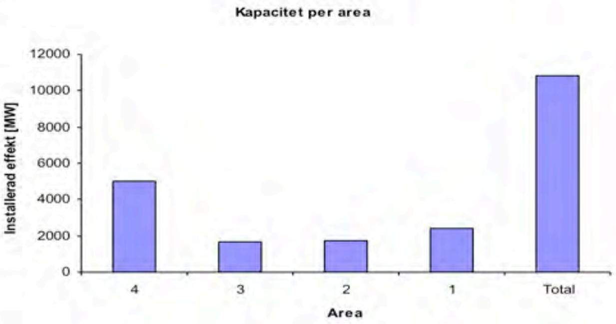
Scenarios are based on:

- Projects under construction
- Projects which have been granted permission

Under construction

With permission





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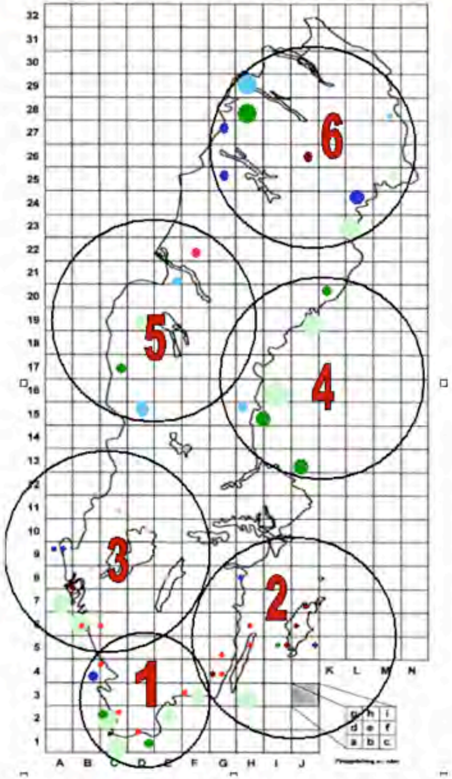
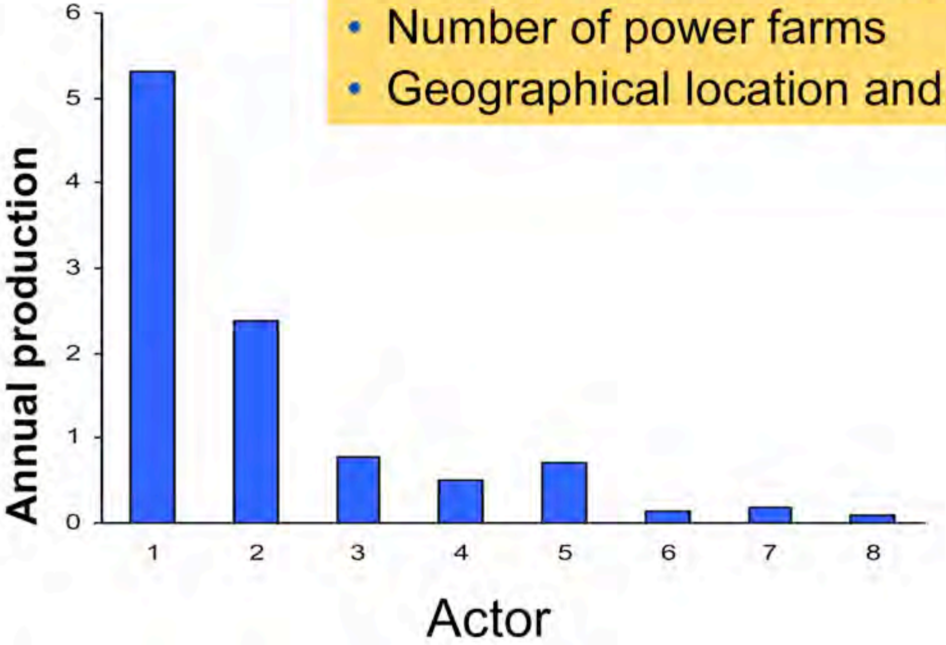
Eight actors



Different combinations of:

- Amount of installed wind power
- Number of power farms
- Geographical location and spread



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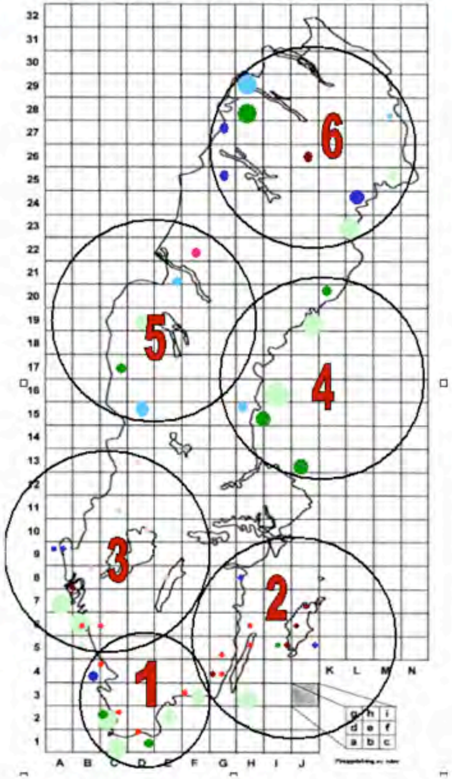
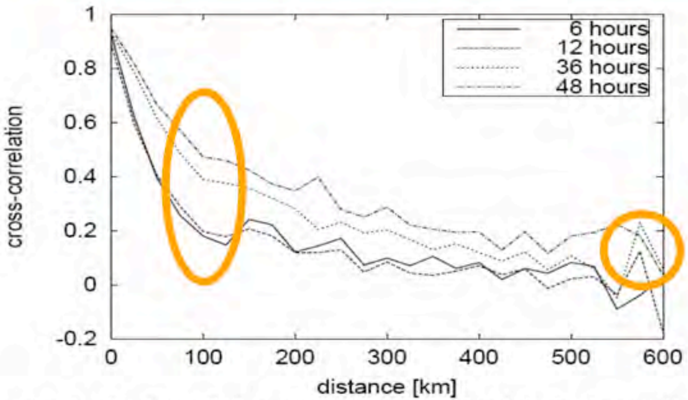
Model of forecast error for 12 – 36h forecasts



- The forecast error, per farm, is assumed to have a standard deviation of 13% of installed capacity (20% in Lillgrund)
- The relative forecast error decreases when an actor owns more parks in the same area.
- The relative forecast error decreases when an actor owns farms in several areas.



Correlation data are adopted from Germany

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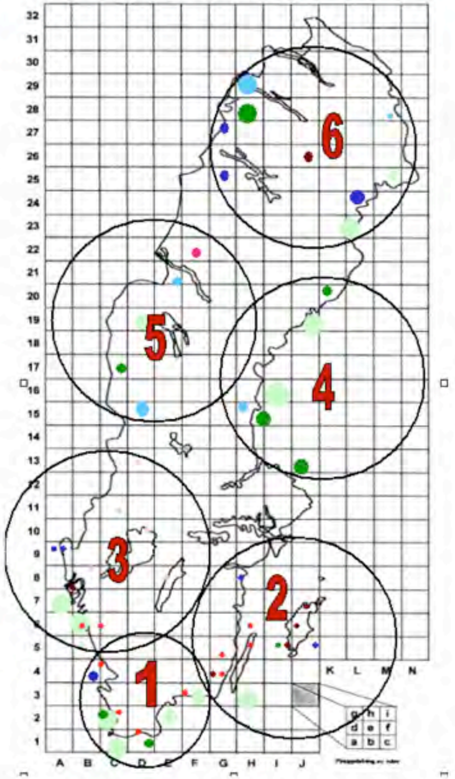

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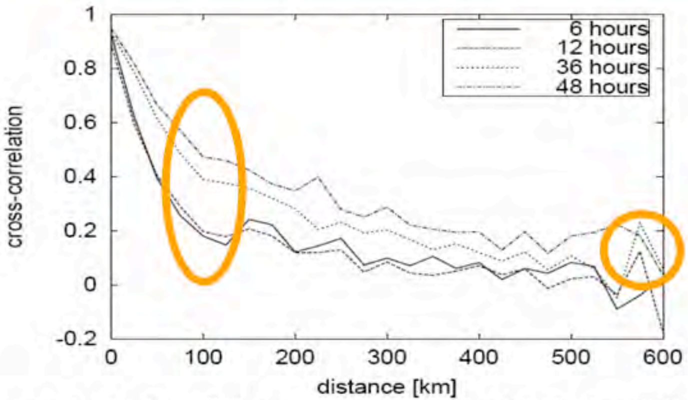

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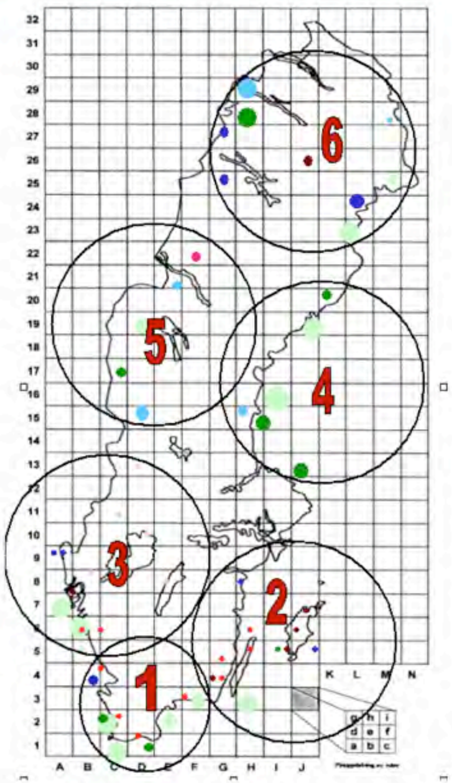

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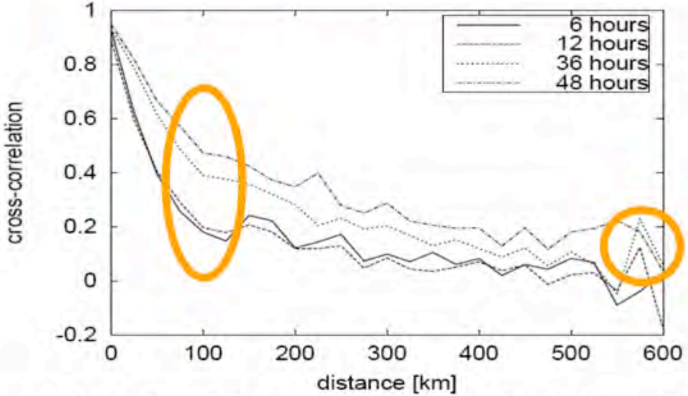

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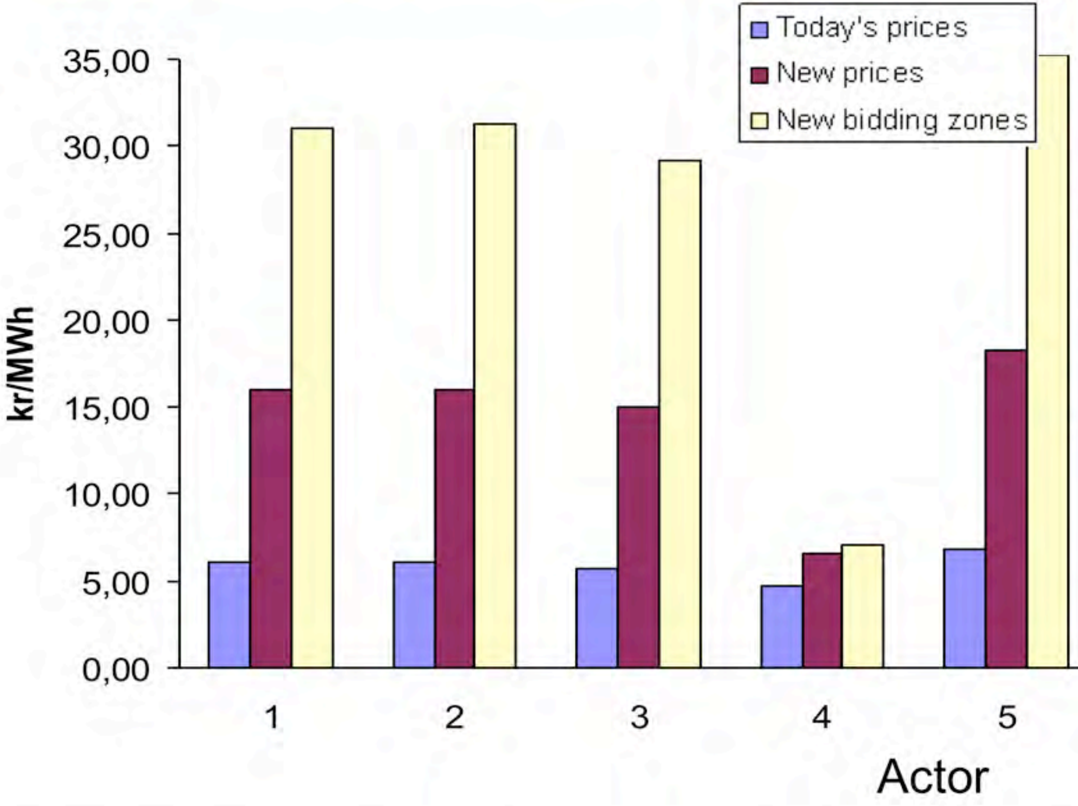
Imbalance costs: scenario with 10 TWh wind power



Assumptions:

- **Today's prices are based on statistical data**
- **New prices consider higher price level due to higher demand**
- **New bidding zones assume that cut 4 is congested 30% of time**

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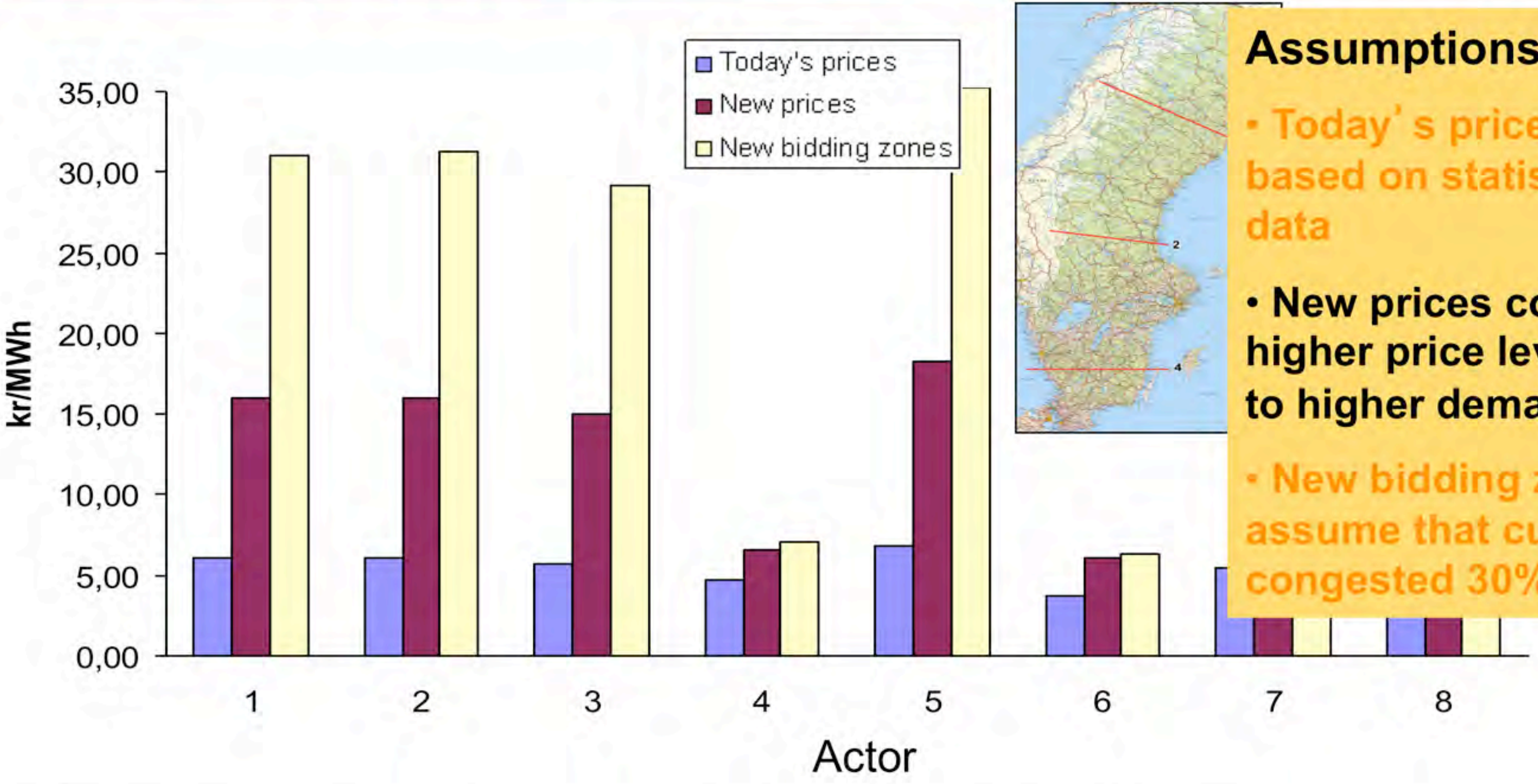

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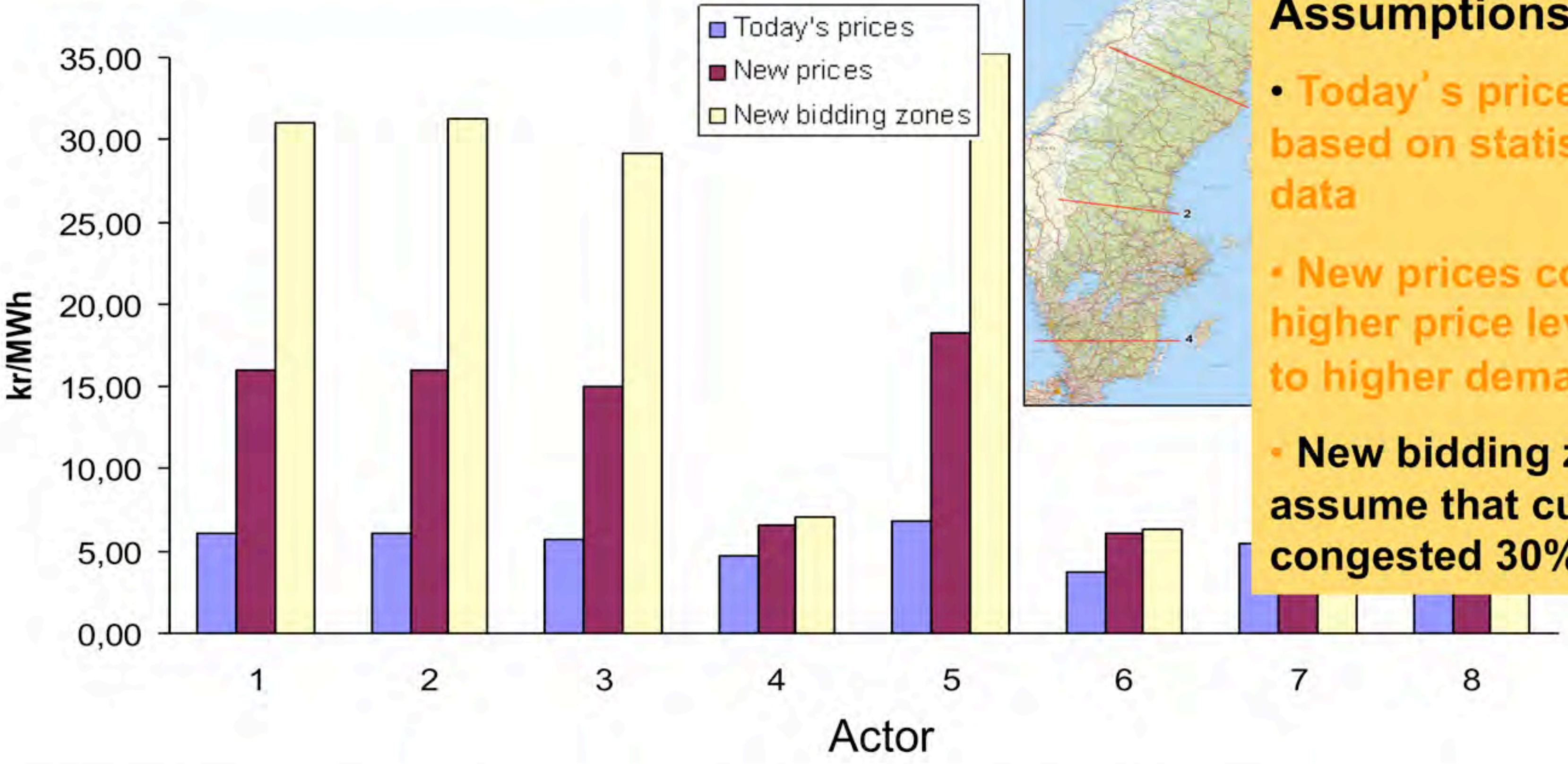

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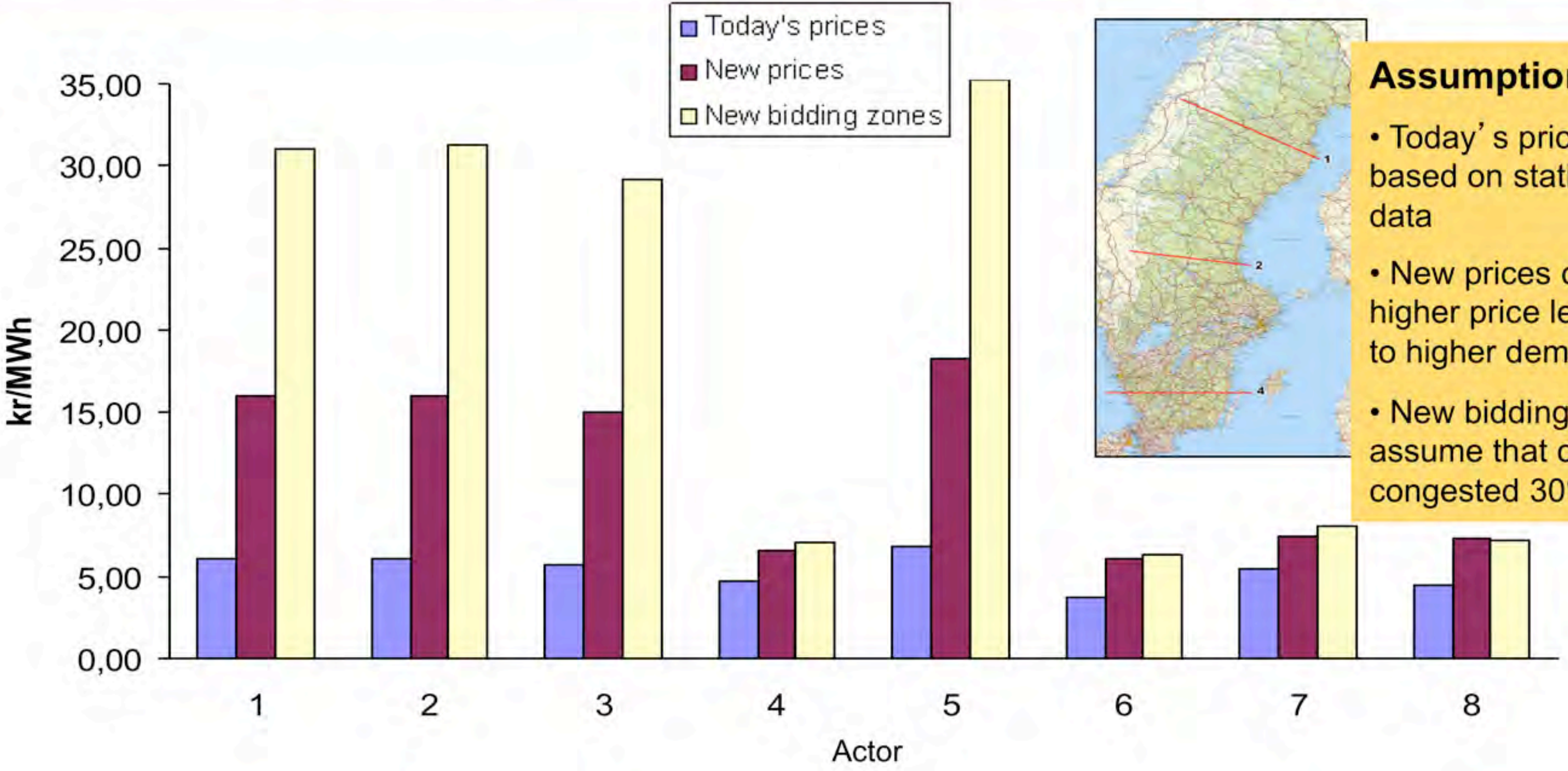

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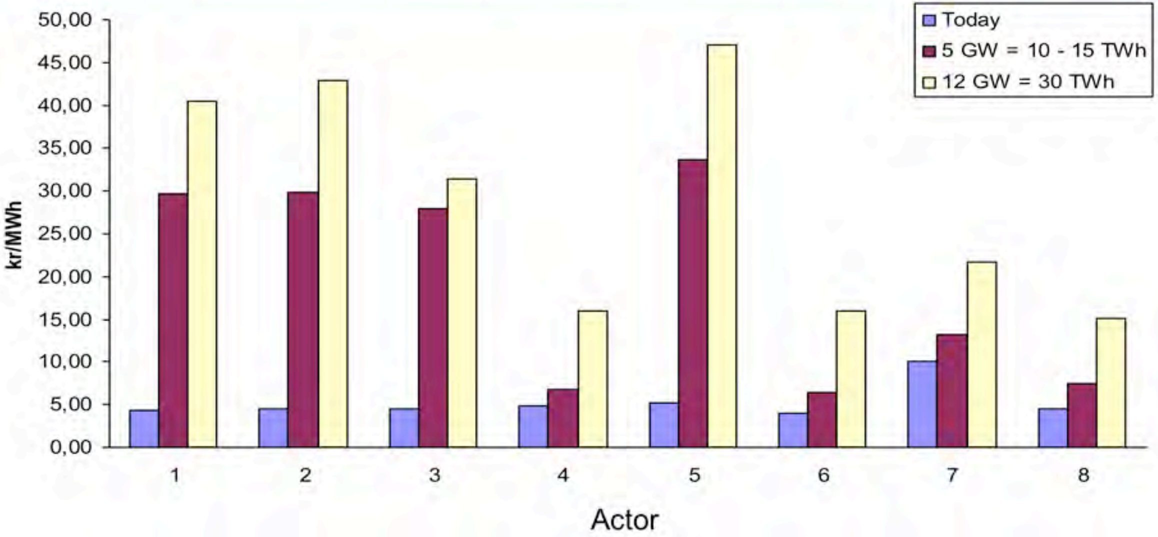
Why does it become more expensive?

- Wind power dominates forecast errors – fewer hours in “correct” direction. 50% error (= independent) changes to 75 % error
- Higher regulating prices due to higher volumes
- Number of hour without activation of regulating power decreases (to 50%).
- Price areas ➔ imbalances in different areas are not added.



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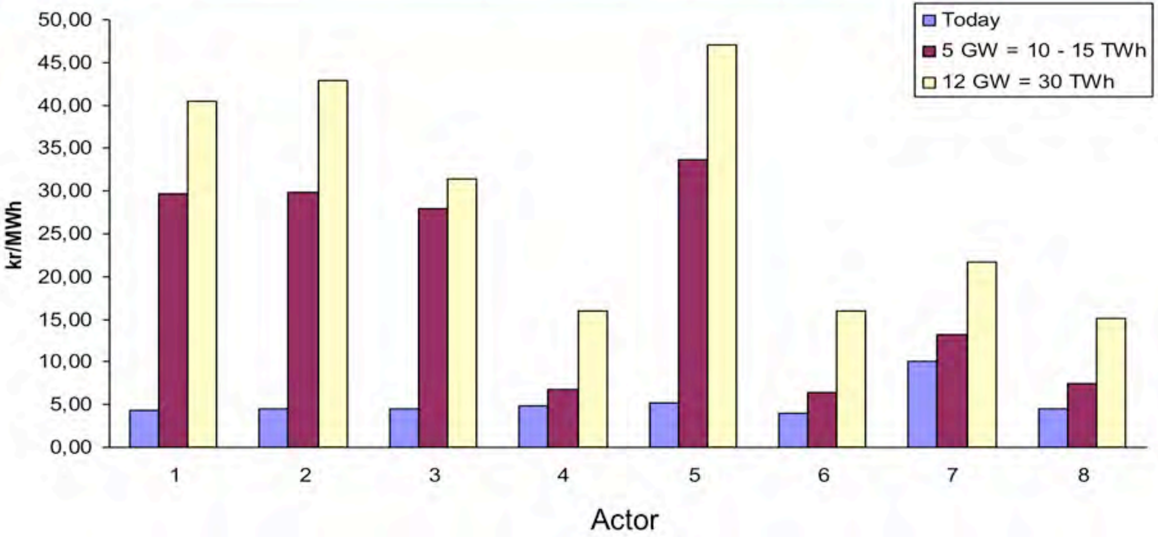

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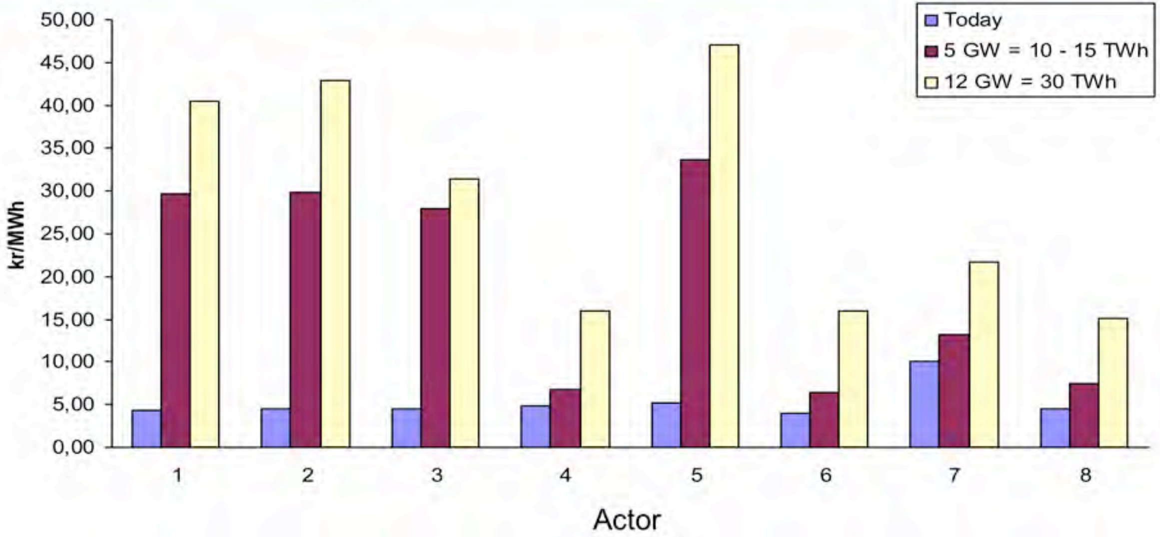

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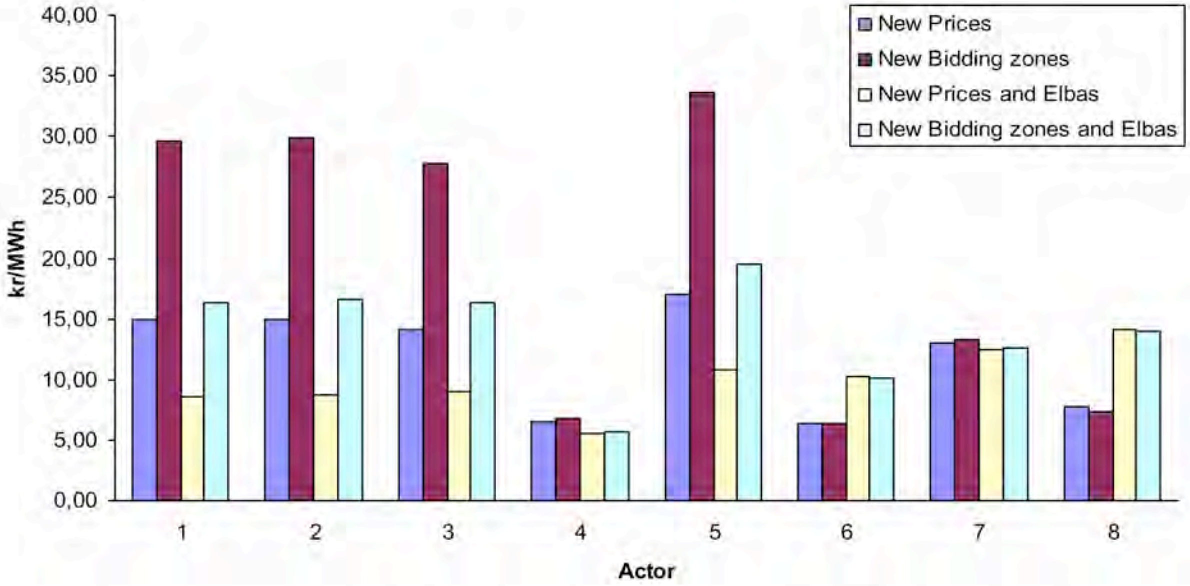
Possible improvement 1: Use intraday market Elbas

- Trading forecast errors on Elbas reduces the volumes with 50%
- Assumption: Forecast error (RMS) is reduced to 6% instead of 13%.



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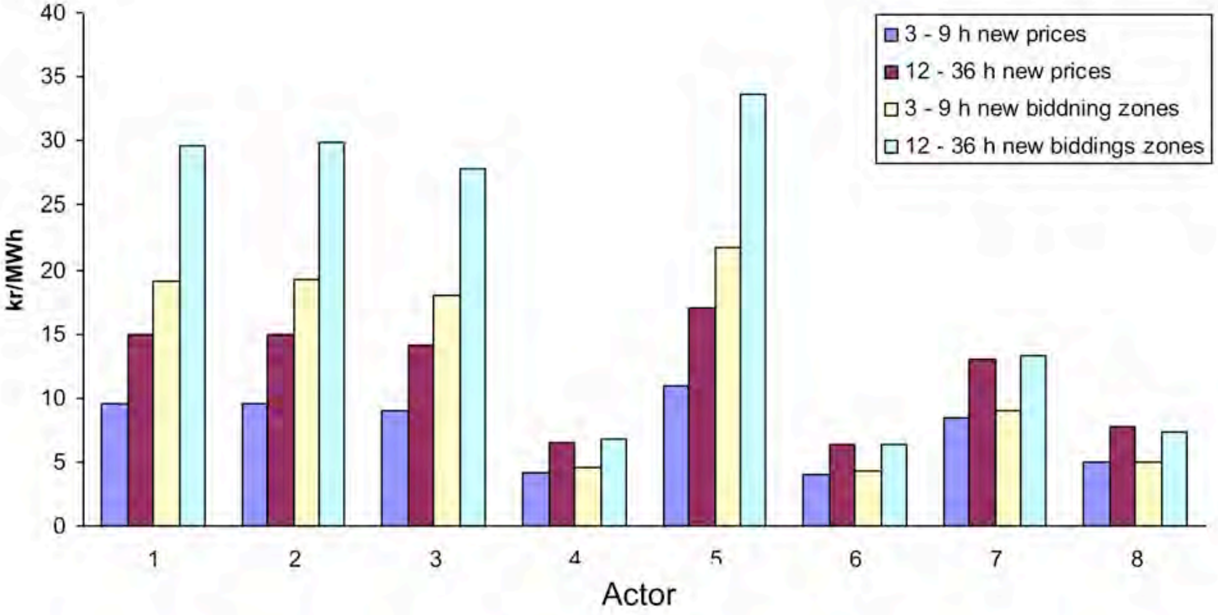
Possible improvement 2: Assuming 6h spot market

- Change spot market to trade every 6 hour
- Standard deviation 10%



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  - higher regulating prices
  - more hours with regulation
  - more hours with regulation correlated to wind power forecast error
  - thereby higher costs for balance responsible wind power owners.
- Geographical spread of the wind power leads to lower forecast error which implies lower costs.
- The introduction of price areas leads to lower possibility to counterbalance imbalances between different areas.
- Participation on intra-day market can reduce the imbalance costs with about 20%.

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Thank you for your attention!