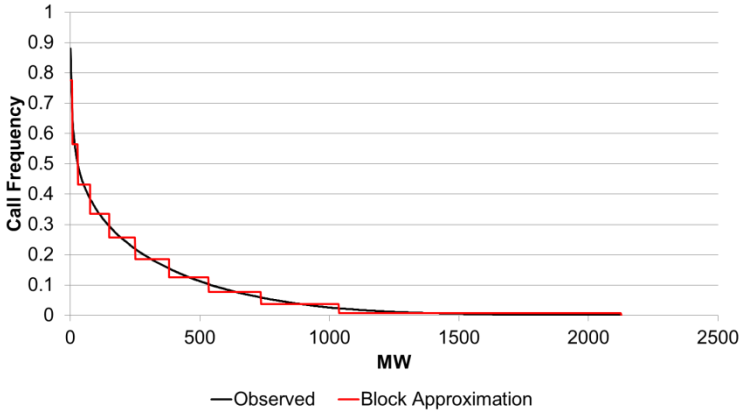
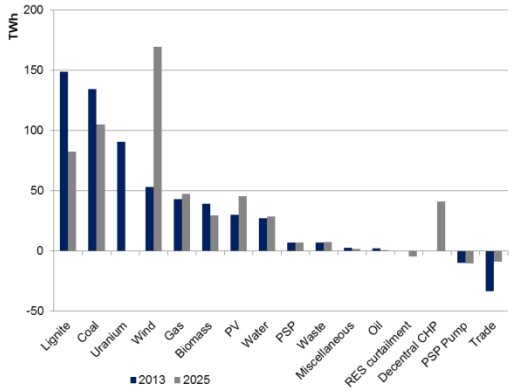
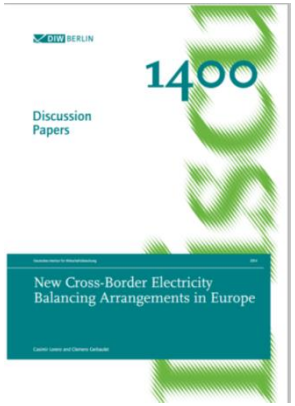
Strommarkttreffen

14.08.2015







Entwicklung des Regelleistungsmarktes in Deutschland bis 2025

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DIW Berlin, Department of Energy, Transportation, Environment

Agenda

Motivation

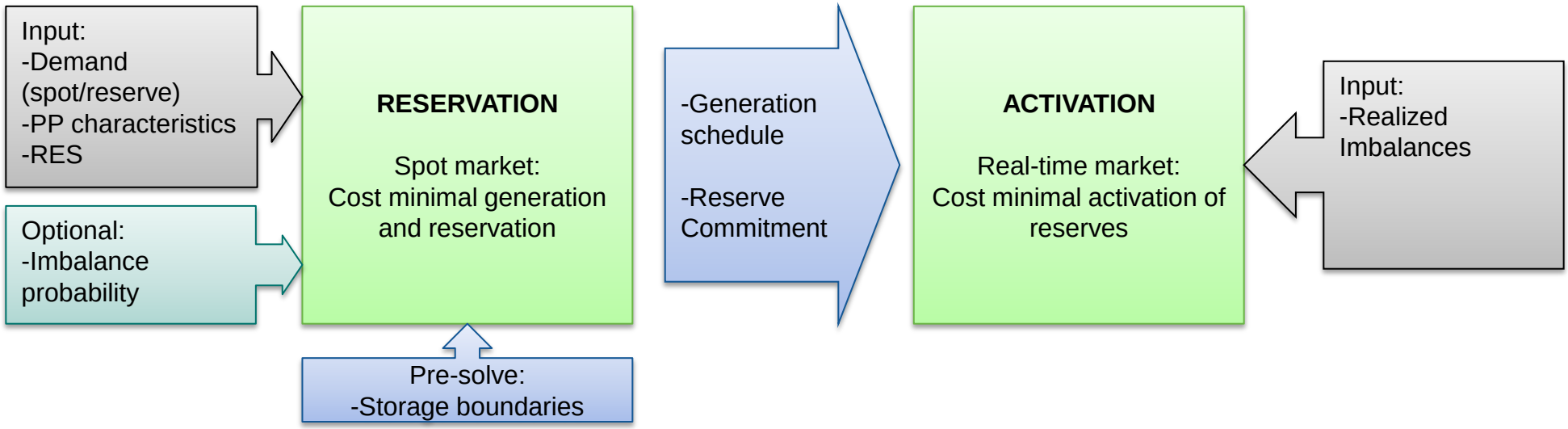
- **We built a fundamental electricity sector model and apply it to the German dataset**
- with a focus on the balancing market;
- Including the anticipation of calls by the market participants in the reservation phase,

- **Our model calibrated to represent the year 2013. Questions:**
- Is a proper representation of the balancing market in a fundamental model possible?
- How do quantities, prices and costs match the real market outcome?
- Does the anticipation of calls in the reservation phase increase the quality of the results?

- **Application for 2025: How does the balancing market react on the future power plant fleet?**
- The future scenario setting is based on the “Szenariorahmen 2025 Scenario B“
- Entry of new market participants from different areas is likely (PV, wind, DSM, heating, etc.)
- We include:
  - Participation of wind power in providing negative reserves
  - Increased flexibility of conventional combined heat power plants

Model Structure

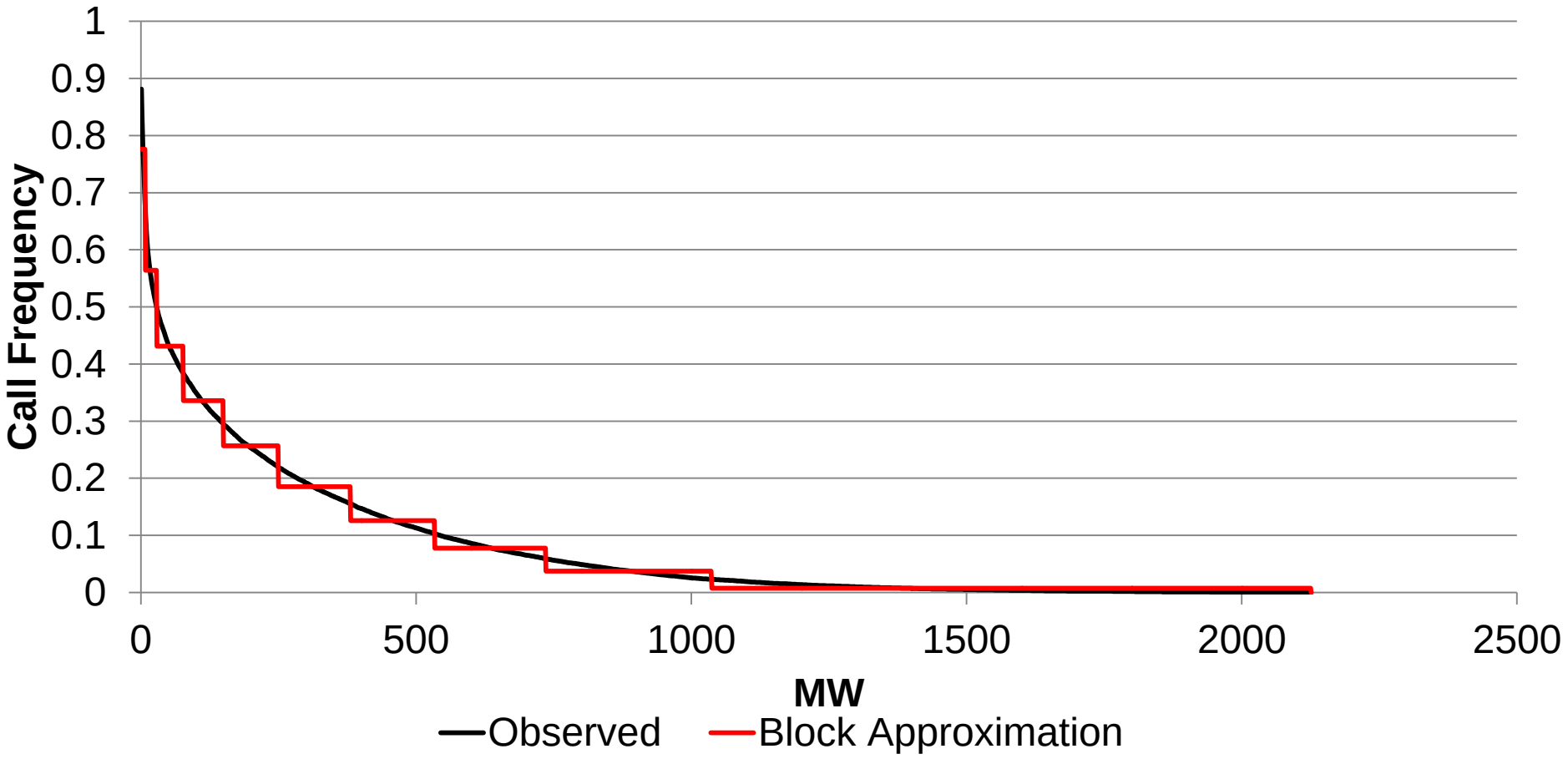
- **Cost minimization unit-commitment model with hourly resolution, 365 x 12+24+12 hours**
- **Block sharp representation of power plant portfolios**
- **Fixed import and exports for neighboring countries' cross border interaction**
- **Two-step model: 1) reservation and 2) reserve activation**
- **Optional: Anticipating the cost of activated reserve volumes**



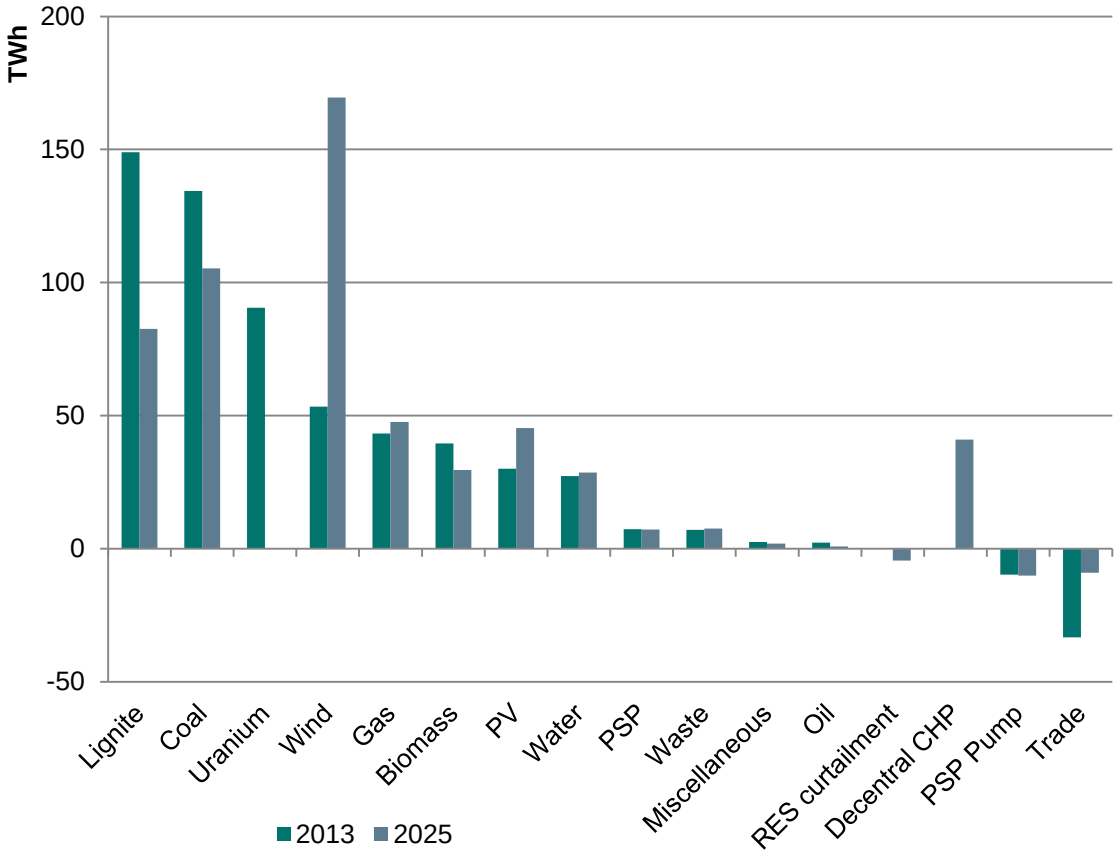
- **Certain CHP plants have the possibility to store their heat for several hours**
- **Wind turbines can reserve up to 5 % of the actual infeed as negative balancing power**

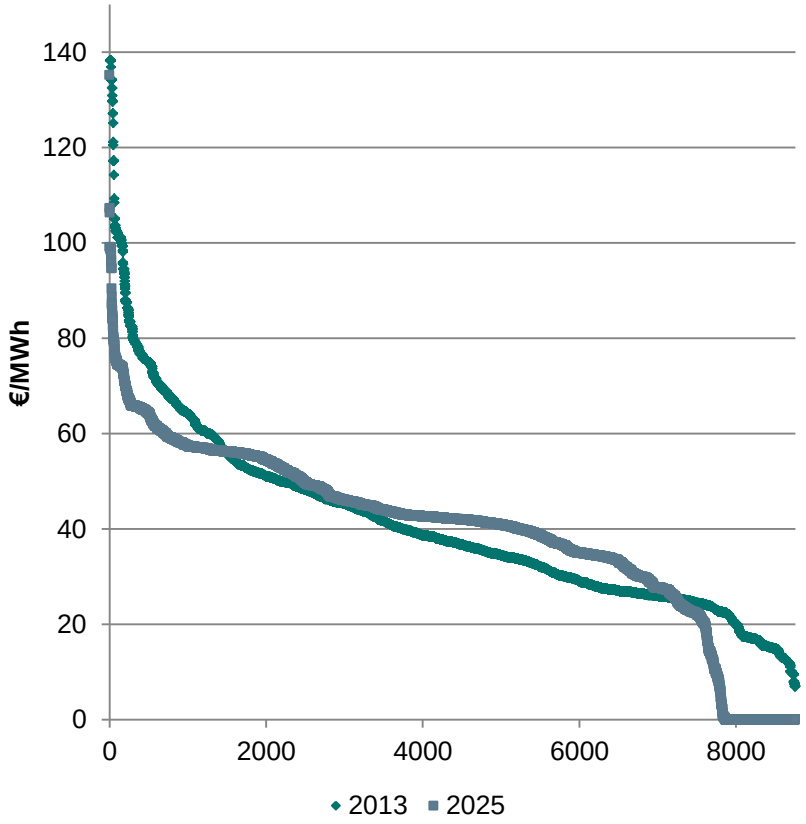
Positive Secondary Control Calls in Germany 2013

- **When the historical call distribution is anticipated:**
  - 10 blocks with varying probability and size are fitted to match the actual curve



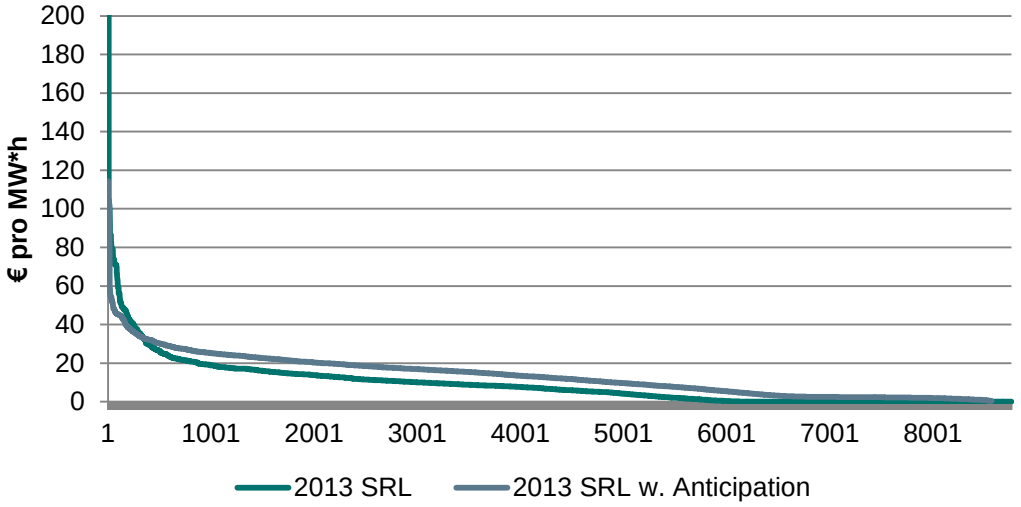
Results: 2013 and 2025 spot market

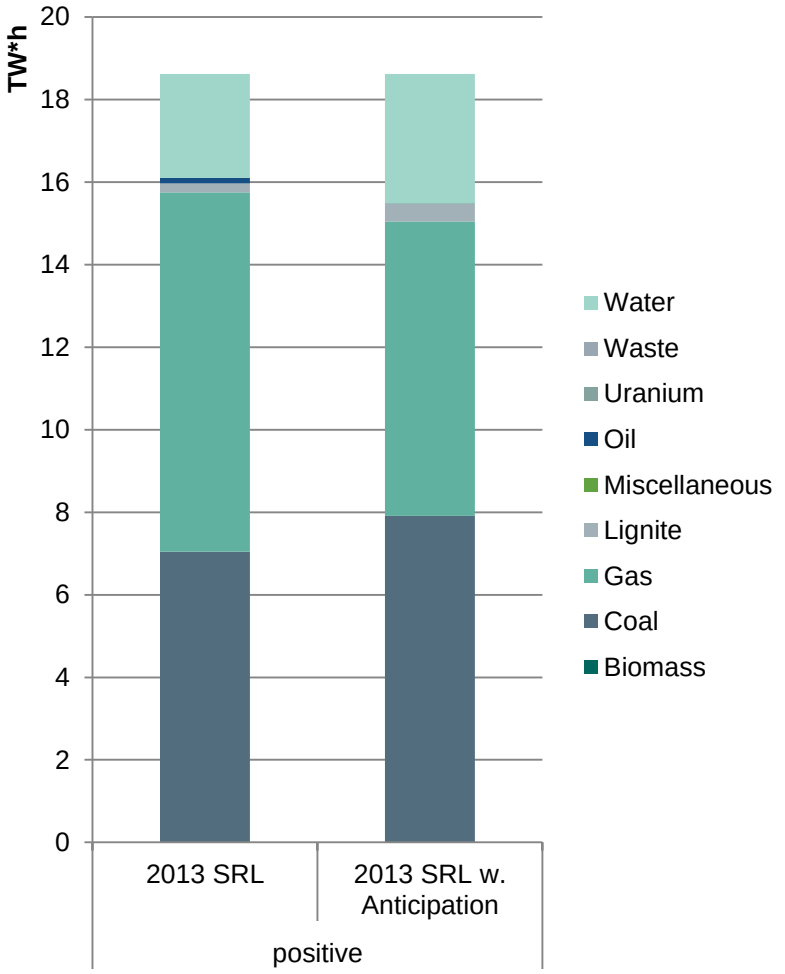




- **Model shows a good representation of 2013.**
- **In 2025: Nearly 1000 hours with a price of zero and an average price of 39€/MWh**
- **Exports are reduced from 33 TWh to 9 TWh.** (Calculated with a European load flow model and an extended dataset to provide Information on cross border flows for this application)

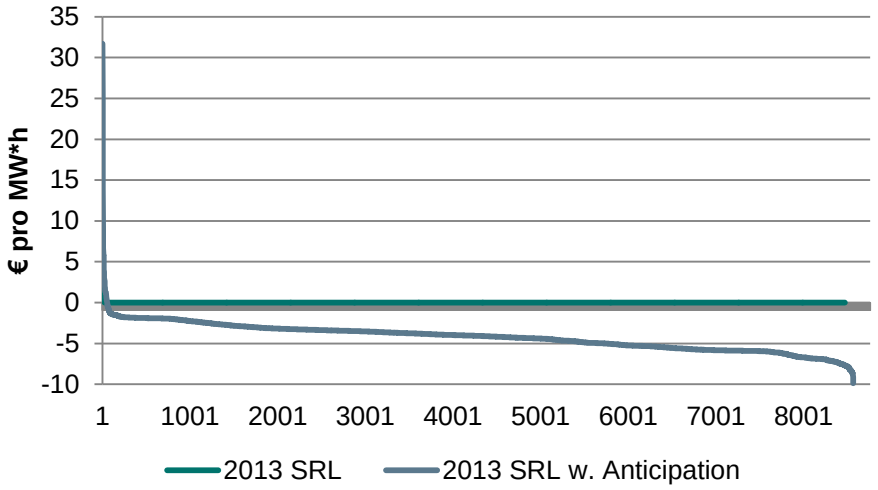
Results: Balancing Market in 2013 – Effect of Anticipation

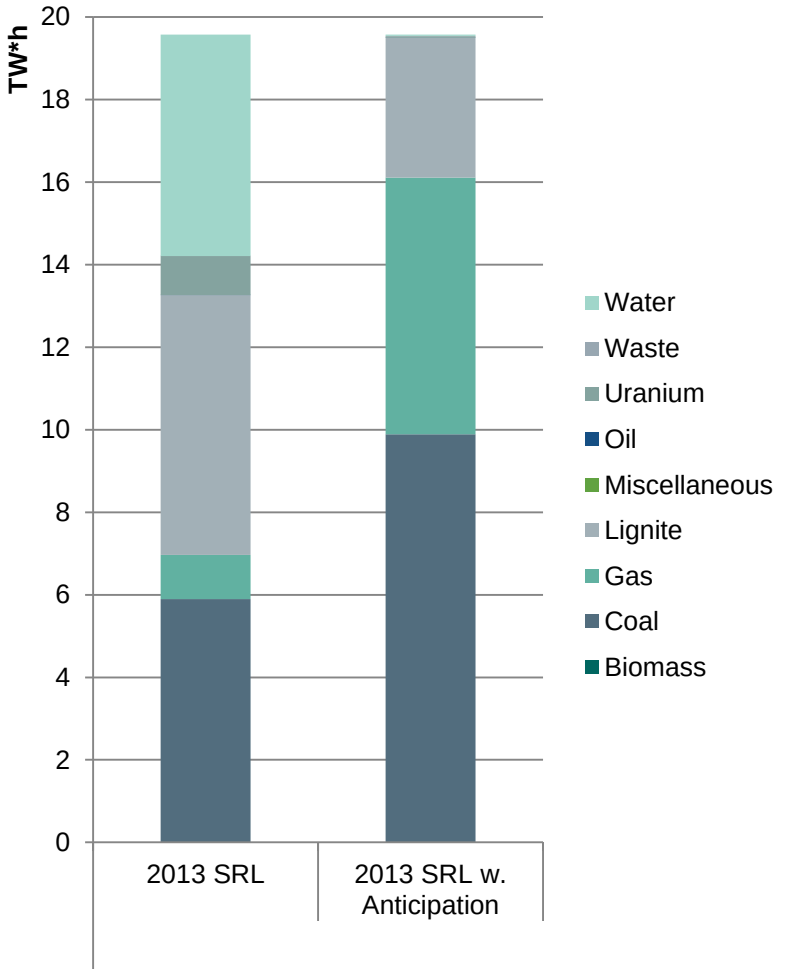




- **Average Prices for positive balancing capacity (12€ per MW*h) meet real market outcome**
- **Most reservation in coal and gas fired power plants, few lignite, some hydro storage**
- **With anticipation:**
- Slight changes in reservation towards less gas and more coal
- Increase in average price of about 2€

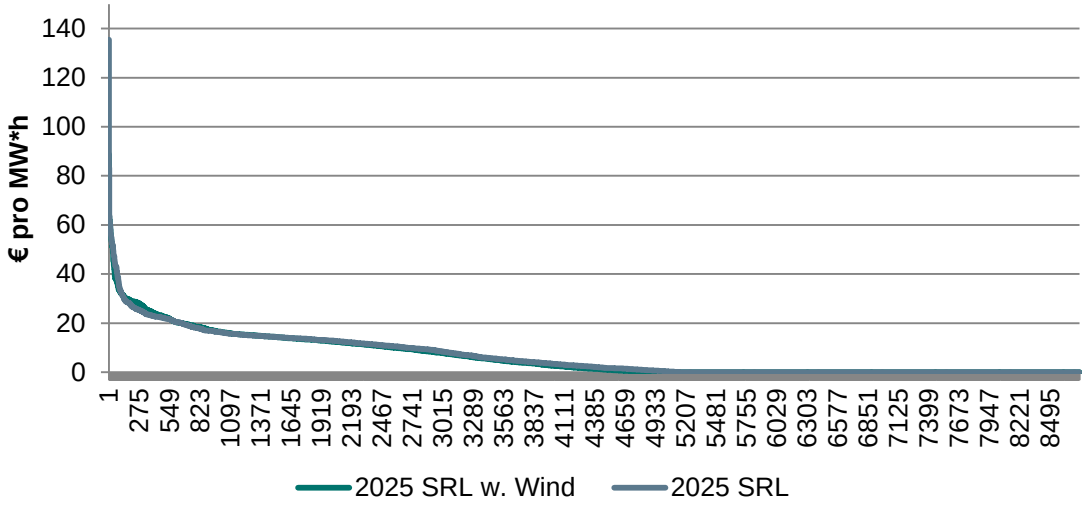
Results: Balancing Market in 2013 – Effect of Anticipation

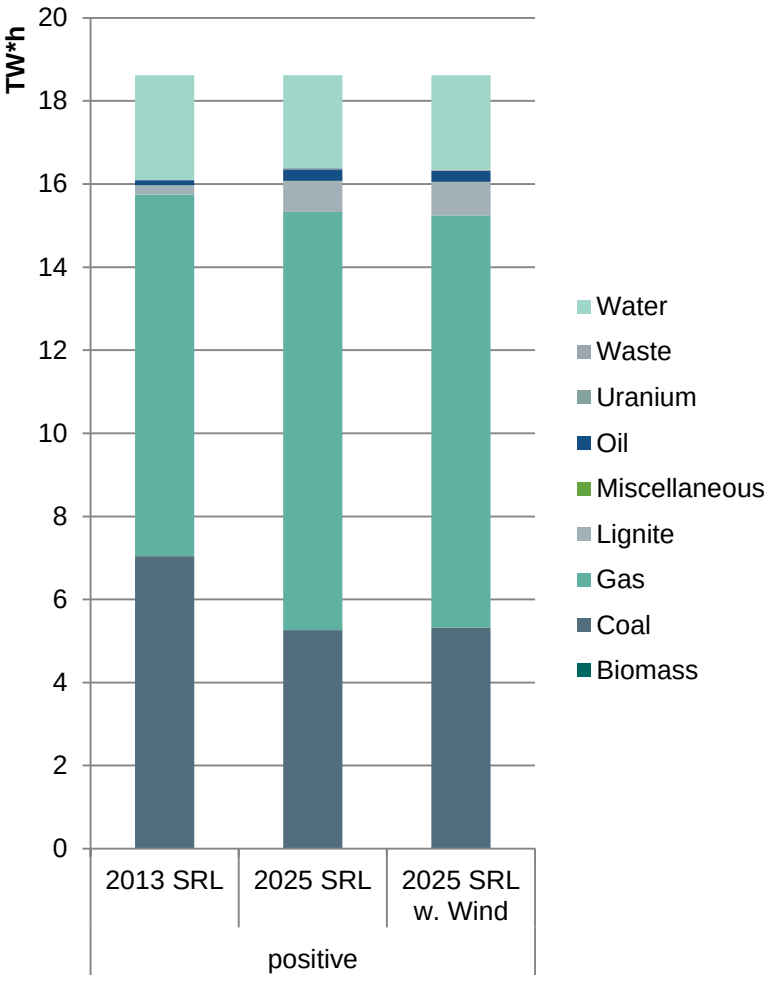




- **Prices for negative balancing capacity do not represent the market outcome in 2013**
- **No better representation when anticipating the cost of possible calls**
- Even negative prices occur due to anticipation of saved fuel cost
- Significant change in reserved capacities
  - Less water and lignite / more gas and coal because of higher cost saving due to higher fuel costs

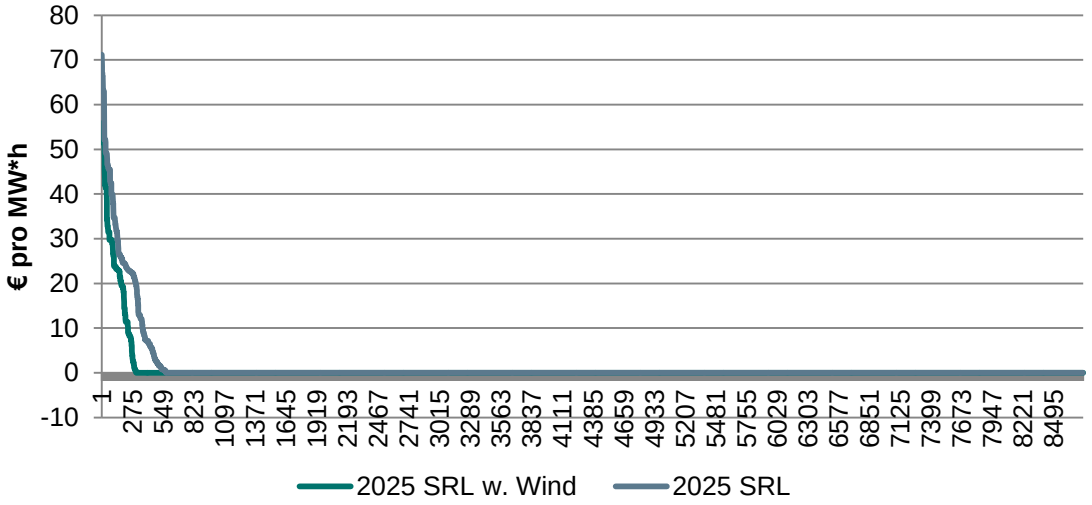
Results: Positive Balancing Market in 2025

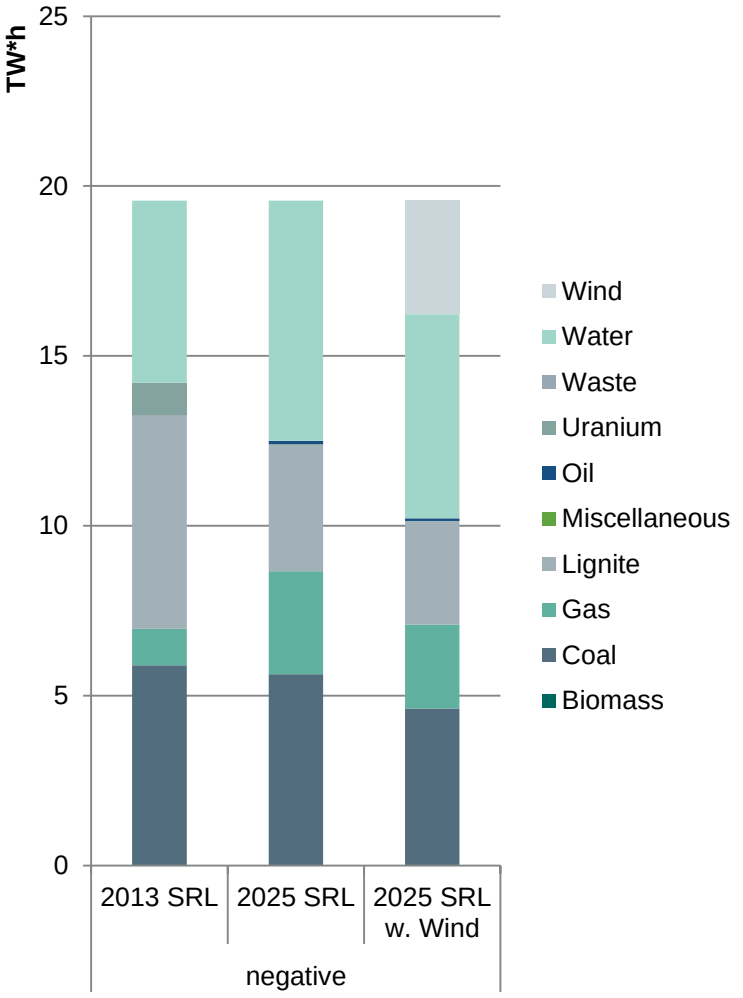




- **Prices for positive balancing capacity are reduced in comparison to 2013 (average 7€ per MW*h)**
  - Power plants are more often in part load or even at minimum load due to the spot market outcome. Hence they can provide positive balancing reserves without additional costs
- **More gas and lignite capacities reserved**
  - Due to the lower residual load lignite is more often in part load situations → 1000 hours with a price of zero at the spot market

Results:Negative Balancing Market in 2025 – Wind participation





- **Better (?) representation of possible prices for negative balancing capacity**
- **Positive prices observed in up to 700 hours (average 1.4 € per MW*h)**
- More gas/water and less lignite due to lower hours above minimum load
- **Participation of wind for negative reserves reduces prices to an average of 0.8 € per MW/h**
- Reserved capacities for all technologies are reduced

Conclusion

- **Prices for positive balancing reserves can likely be approximated using an fundamental model**
- **The model significantly underestimated prices for negative balancing reserves and does not represent the current market outcome**

- **Anticipation of call cost increase prices for positive reserves but must not lead to more realistic results - especially not for negative reserves**

- **The boundary conditions 2025 compared to 2013 leads to lower cost for positive balancing reserves and higher cost for negative reserves, with overall still lower costs**
- **Hence high penetration of volatile renewables could lead to lower prices on the positive balancing markets and higher on negative balancing markets**
- **Negative balancing prices can significantly be reduced by the participation of wind**
  - Even with conservative assumptions on the availability

- **The formulation of CHP constraints and the inclusion of part load costs are crucial for the existence of balancing prices in a fundamental model**

Thank You for Your Attention!

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