Tender frequency and market concentration in the balancing power market

*The case of Germany*

Andreas Knaut, Frank Obermüller and Florian Weiser

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Enerday
Introduction

Motivation in economic literature

1. High cost of capacity provision in primary and secondary balancing markets:
   a. Costs of 320 Mio Euro in 2014
      (Just, „The german market for system reserve capacity and balancing energy“, 2015)

2. Efficiency increases due to shorter provision duration:
   a. Economic literature shows that a shorter provision duration increases efficiency
      (Müsgens, Peek, Ockenfels, „Balancing Power Markets in Germany: Timing Matters“, 2011)
   b. Germany’s discussion for a reduced provision duration of one day
      (Weißbuch, Grünbuch, Eckpunktepapier Bundesnetzagentur of 23.11.2015)

3. Balancing power markets underlie low competition due to high entry barriers:
   a. Market concentration existed for tertiary reserve power
      (Growitsch, Höffler, Wissner, „Marktkonzentration und Marktmachtanalyse für den deutschen
       Regelenergiemarkt“, 2010)

Research Question:
What are efficiency gains and effects on market concentration in primary and secondary balancing markets under a shorter provision duration?
Introduction
German electricity market design

Auction of primary and secondary reserve

Week before (Tue & Wed)

Day-ahead Market

Day before (12:00)

Intraday Market

Hourly / 15 Minutes (45 min before delivery)

Physical delivery

Primary and Secondary Reserve

- Weekly auction
- Products for whole week

Day-ahead

- Daily Auction
- Products for one hour
Introduction – Recap: Bidding behavior in balancing markets

Capacity bids in balancing markets are mainly driven by opportunity costs to day-ahead market:

- **Positive balancing power:**
  - Inframarginal: Costs for withholding production from day-ahead market
  - Extramarginal: Costs for operating at a certain load level

- **Negative balancing power:**
  - Inframarginal: Almost 0 costs
  - Extramarginal: Costs for operating at minimum load + provision delta

**Figure:**
Exemplary merit order and opportunity costs for positive balancing power
Methodology
Overview

Inputs
- Usual inputs
- Operator structure
- Balancing power characteristics

Model
MORE
(with focus on balancing power)

Output
- Cost minimal balancing power capacity provision
- Deviation of provision duration: Weekly, daily, hourly.

Ex-post analysis
Market concentration evaluation

Short description of MORE:
- Economic fundamental electricity market model
- Cost minimizing mixed-integer model
- High representation of technical details
- Hourly resolution
Methodology
Model assumptions

• Focus on typical winter week and summer week:

• Every power plant can only provide a certain share of its capacity for balancing power:

<table>
<thead>
<tr>
<th>primary balancing power</th>
<th>secondary balancing power</th>
</tr>
</thead>
<tbody>
<tr>
<td>CCGT</td>
<td>2.50 - 4.00%</td>
</tr>
<tr>
<td>Coal</td>
<td>1.00 - 2.50%</td>
</tr>
<tr>
<td>Lignite</td>
<td>1.00 - 2.50%</td>
</tr>
<tr>
<td>Nuclear</td>
<td>2.00 - 2.50%</td>
</tr>
<tr>
<td>OCGT</td>
<td>5.00 - 12.50%</td>
</tr>
<tr>
<td>Oil</td>
<td>2.00%</td>
</tr>
<tr>
<td>Pumped Storage</td>
<td>10.00%</td>
</tr>
</tbody>
</table>

Share of total capacity that can be used for balancing power provision
A decrease of the provision duration decreases total system costs:

a. From weekly to hourly:
   - 222k Euro in winter week
   - 96k Euro in summer week

b. From weekly to daily:
   - 116k Euro in winter week
   - 23k Euro in summer week

- An hourly provision is the efficient benchmark in our model
- A great share of cost reduction can be achieved by switching from weekly to daily provision.
Results – Provision duration has impact on operators

Positive secondary balancing power provision by operator, Winter

Weekly provision

Daily provision

Hourly provision

- Shorter provision duration allows for situation specific provision by operator
- Similar impact on market concentration is expected
Results – Definition of Market concentration indices

1. **HHI** (Herfindahl-Hirschmann-Index):

\[
HHI = \sum_{i=1}^{n} s_i^2 \quad \text{for } s_i \text{ market share of firm } i \text{ (in %) and total number of firms } n.
\]

2. **CR(m)** (Concentration ratio of \( m \) greatest firms):

\[
CR(m) = \sum_{i=1}^{m} s_i \quad \text{for } m \leq n \text{ firms}.
\]

3. **RSI** (Residual Supply Index) for largest operator \( i \) and capacity available for balancing power:

\[
RSI(i) = \frac{TotalAvailableCapacity - AvailableCapacity(i)}{TotalDemand}
\]
Results – Strong hourly fluctuation for the market concentration indices

Exemplary market concentration ratio for positive secondary balancing power in a winter week for weekly, daily and hourly provision duration:

- Market concentration has strong hourly fluctuation
- Usually, the shorter provision duration sets an upper and lower boundary for the longer provision duration
Results – Reduced provision durations can increase market concentration

Duration curves: Sorted with decreasing order

Positive secondary balancing power

- Summer week has usually a slightly higher market concentration
- **Winter week:** Daily provision avoids high market concentration but reaches lower levels
- **Summer week:** A weekly provision seems to be a good compromise; daily is not favorable.
### Discussion and Conclusion

- **Increased efficiency** by a shorter provision duration (e.g. hourly)
- Balancing power markets are **closed markets** which are subject to few producers
- Several market indices point to **market concentration** in the German balancing power markets
- Therefore, a market concentration **increase should be avoided**
- An hourly provision duration raises danger of an increase of market concentration in specific situations while it increases efficiency at the same time
Thanks for your attention

Andreas Knaut   andreas.knaut@ewi.research-scenarios.de
Frank Obermüller frank.obermueller@ewi.research-scenarios.de
Florian Weiser   florian.weiser@ewi.research-scenarios.de

Energiewirtschaftliches Institut an der Universität zu Köln (EWI)
awi Energy Research & Scenarios gGmbH
Alte Wagenfabrik
Vogelsangerstraße 321
D-50827 Köln