

# Tender frequency and market concentration in the balancing power market

*The case of Germany*

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02.09.2016 | Frank Obermüller  
Strommarkttreffen: Regelleistung

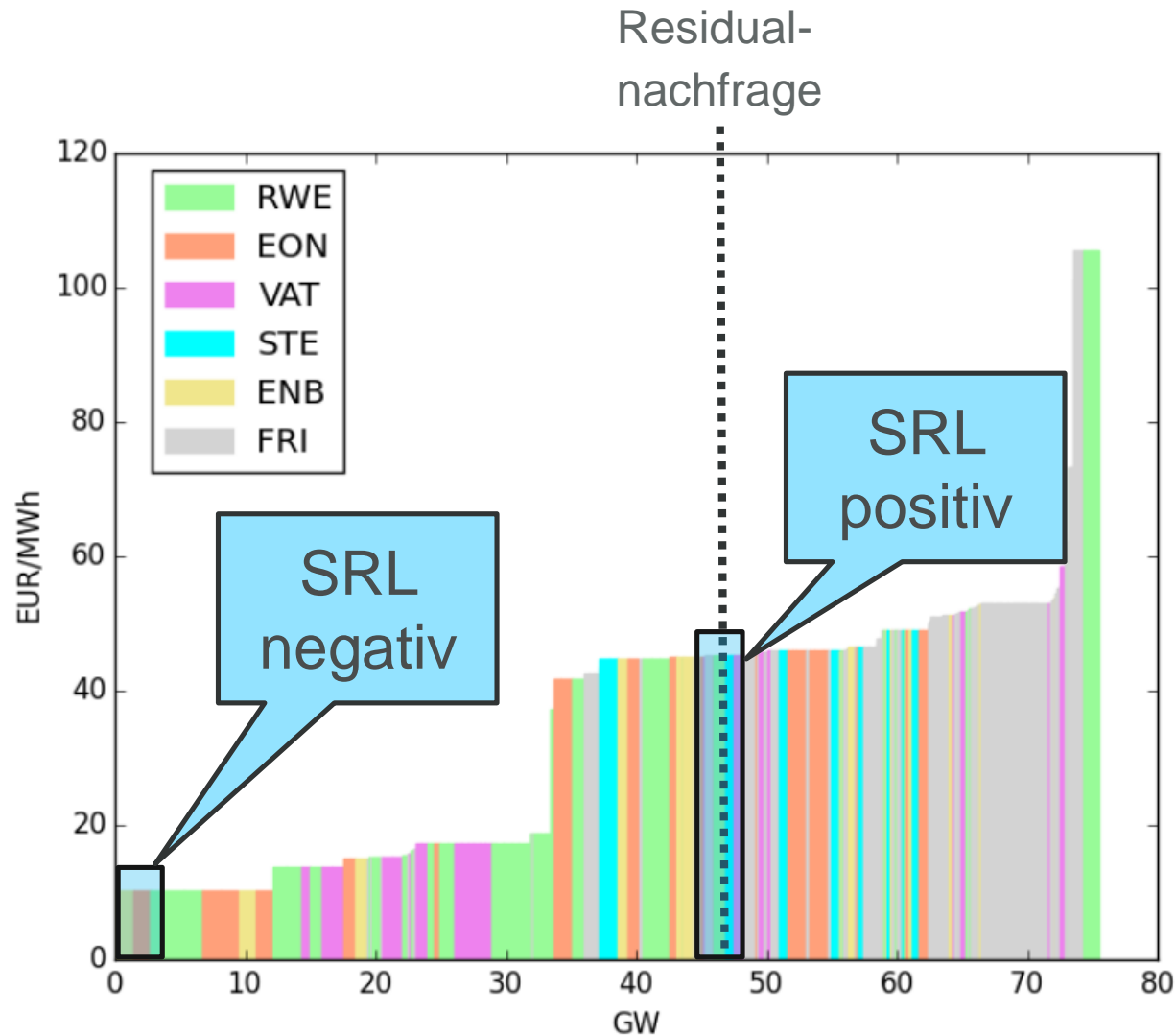


Figure 2: Merit Order in Germany colored as to the operators

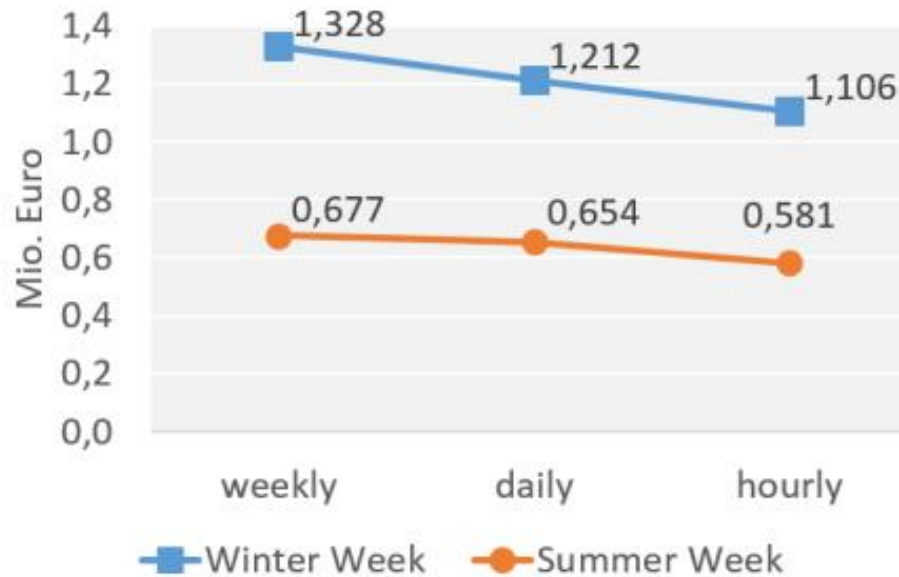
# Methode

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1. Optimierungsmodell: Blockscharfes MIP-Modell
2. Kraftwerkspark wurde Betreiberstruktur zugeordnet: Pooling ist erlaubt
3. Variation der Vorhaltdauer für Primär- und Sekundärregelleistung (Woche, Tag, Std)
4. Zeitliche Auflösung: Winterwoche und Sommerwoche in stündlicher Auflösung (2014)
5. Regionale Auflösung: Deutschland, historisch fixierte Exporte

Untersuchungsfokus:  
Auswirkungen der Vorhaltdauer auf die Markkonzentration

# Kürzere Vorhaltdauer reduziert Kosten



Costs of primary and secondary balancing power (compared to no provision)

# Vorhaltezeit beeinflusst vorgehaltene Technologie- und Betreiberanteile

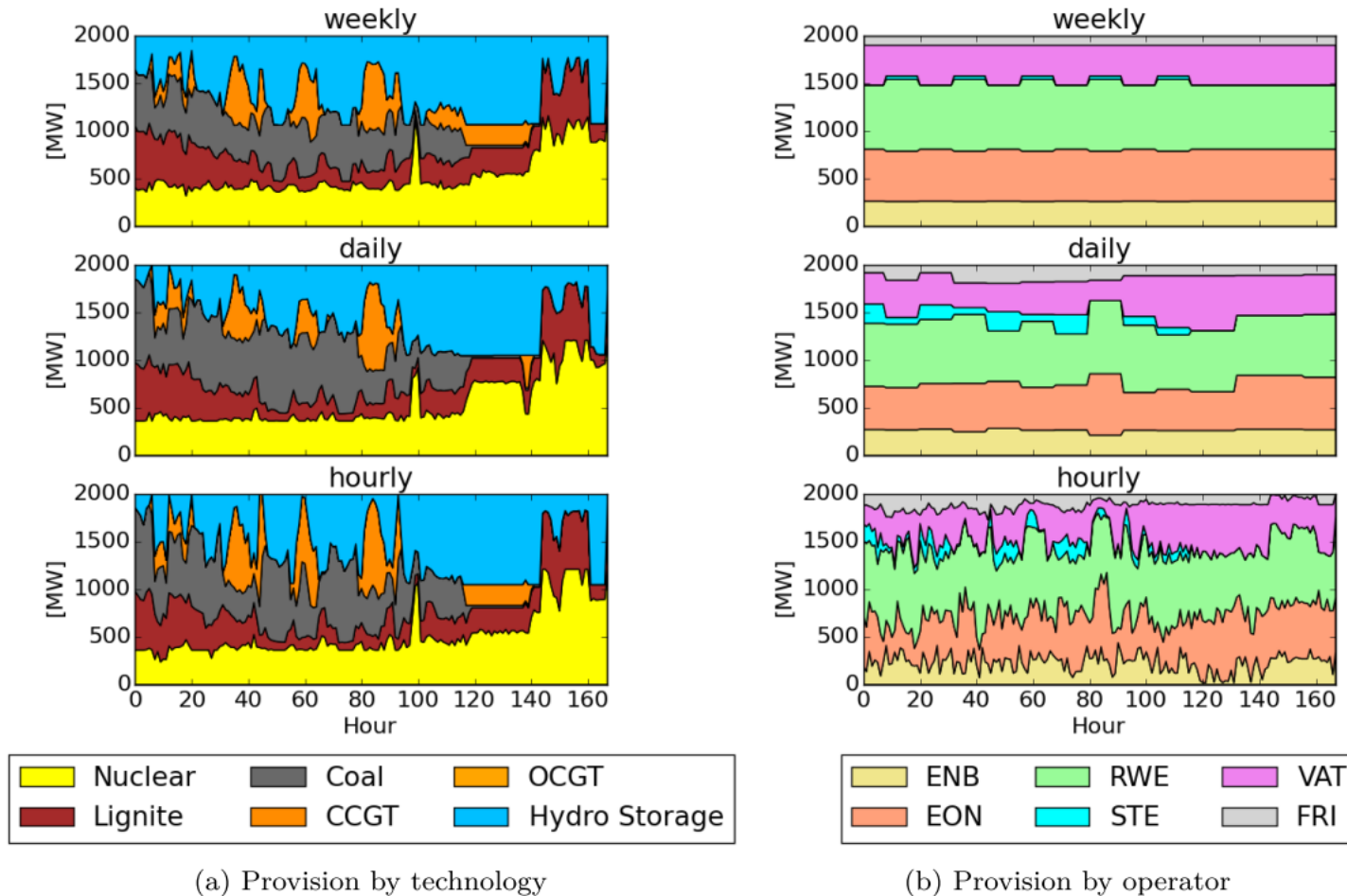
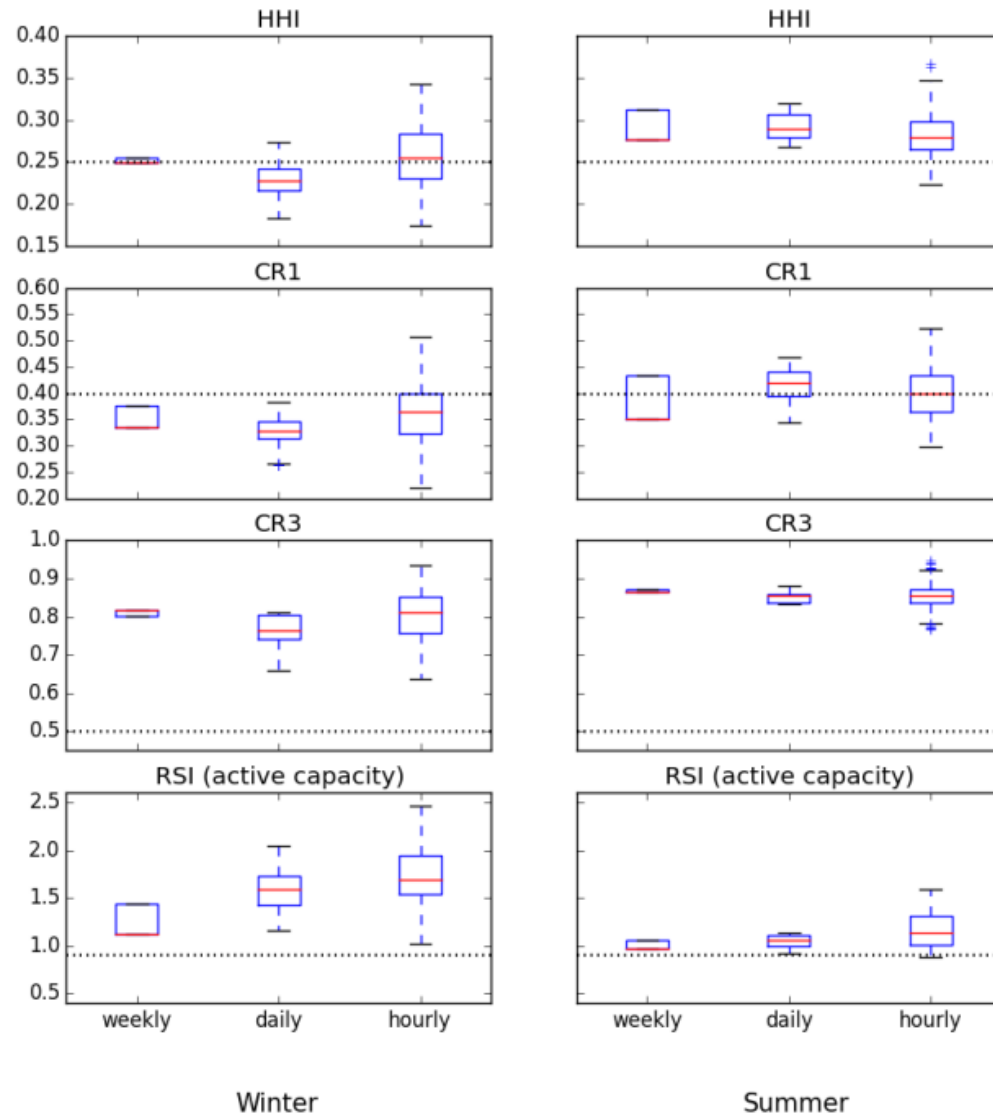


Figure 5: Comparison of the technologies (left) and operators (right) providing positive secondary balancing power for the weekly, daily and hourly provision duration in the winter week

# Kürzere Vorhaltedauer kann situativ die Marktkonzentration erhöhen (SRL positiv)



# Diskussion und Ausblick

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- Eine kürzere Vorhaltedauer (z.B. stündlich) erhöht die Effizienz
- Verschiedene Marktkonzentrations-Indizes deuten auf eine Markkonzentration im deutschen Regelleistungsmarkt hin
- Eine weitere Erhöhung der Marktkonzentration sollte daher vermieden werden.
- Eine stündliche Vorhaltedauer birgt die Gefahr einer erhöhten Marktkonzentration in bestimmten Stunden während gleichzeitig die Effizienz gesteigert wird

## Ausblick:

- Ableiten von Marktmacht aus der Messung von Marktkonzentration
- Veröffentlichung der Analysen

**Bei Fragen sehr gerne kontaktieren!**

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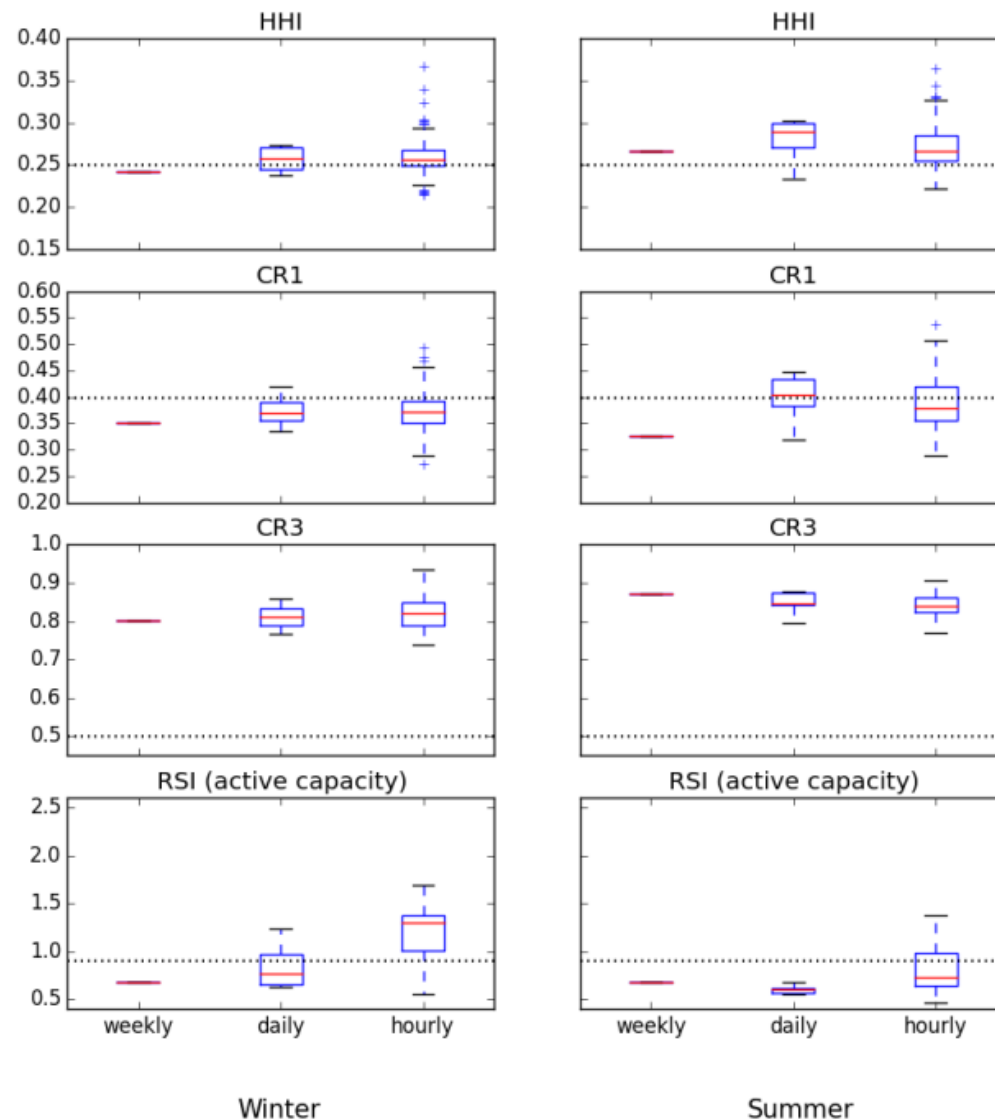
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# Backup

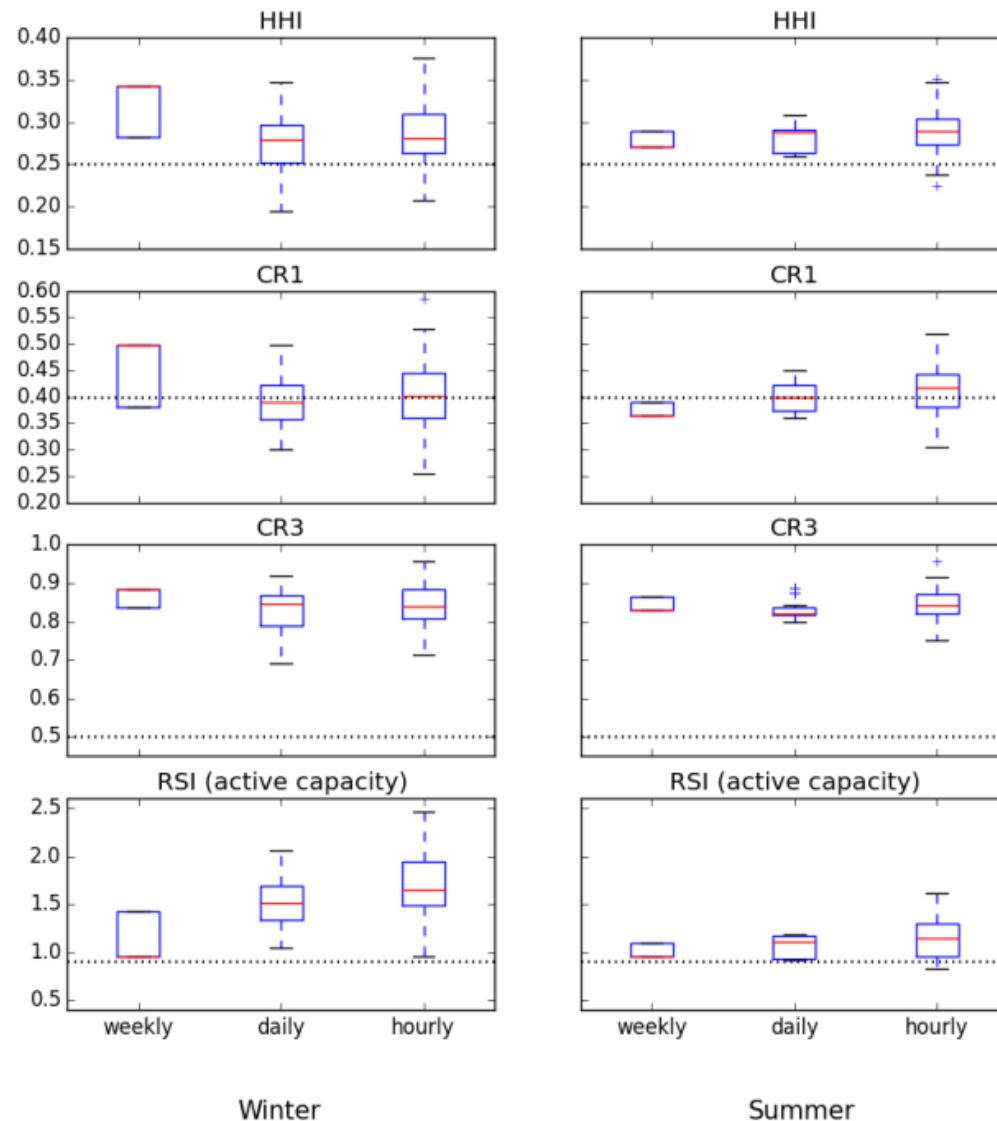
# Markkonzentration

## Primärregelleistung



# Markkkonzentration

## Negative Sekundärregelleistung

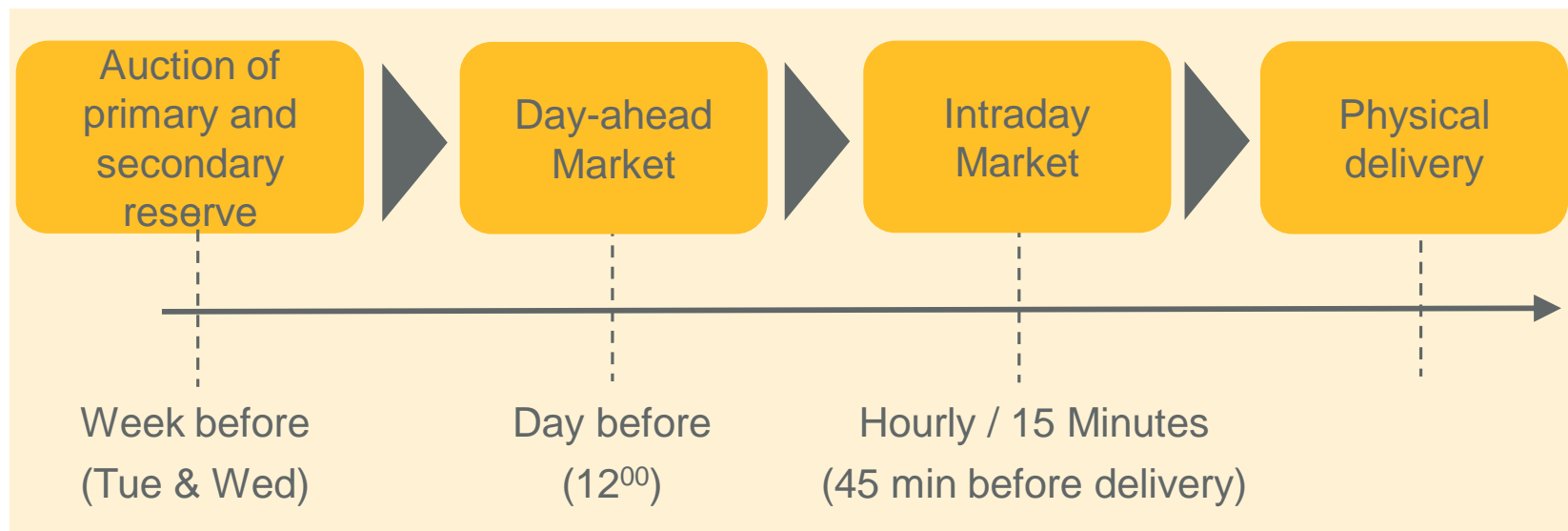


# Detailed Presentation

(including descriptions)

# Introduction

## German electricity market design



Primary and Secondary Reserve
<ul style="list-style-type: none"><li>• Weekly auction</li><li>• Products for whole week</li></ul>

Day-ahead
<ul style="list-style-type: none"><li>• Daily Auction</li><li>• Products for one hour</li></ul>

# Introduction

## Motivation in economic literature

### Research Questions:

What are efficiency gains by shortened provision durations in primary and secondary balancing power markets? How do shortened provision durations influence the market concentration?

### 1. 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 about a reduced provision duration of one day (Weißbuch, Grünbuch, Eckpunktepapier Bundesnetzagentur of 23.11.2015)

### 2. 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)

### 3. High cost of capacity provision in primary and secondary balancing power markets

- a. Costs of 320 Mio Euro in 2014 (Just, „The German market for system reserve capacity and balancing energy“, 2015)

# Introduction – Bidding behavior in balancing power markets

Capacity bids in balancing power 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

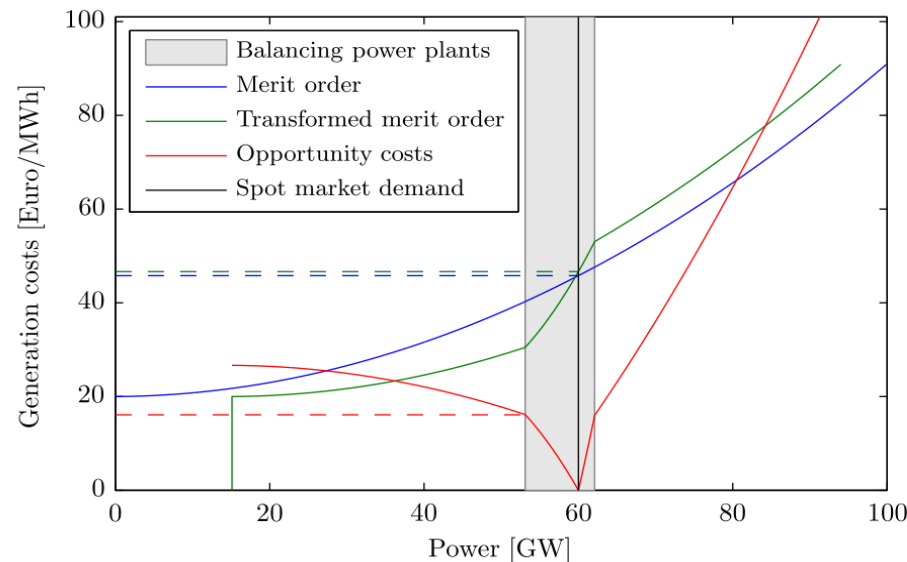
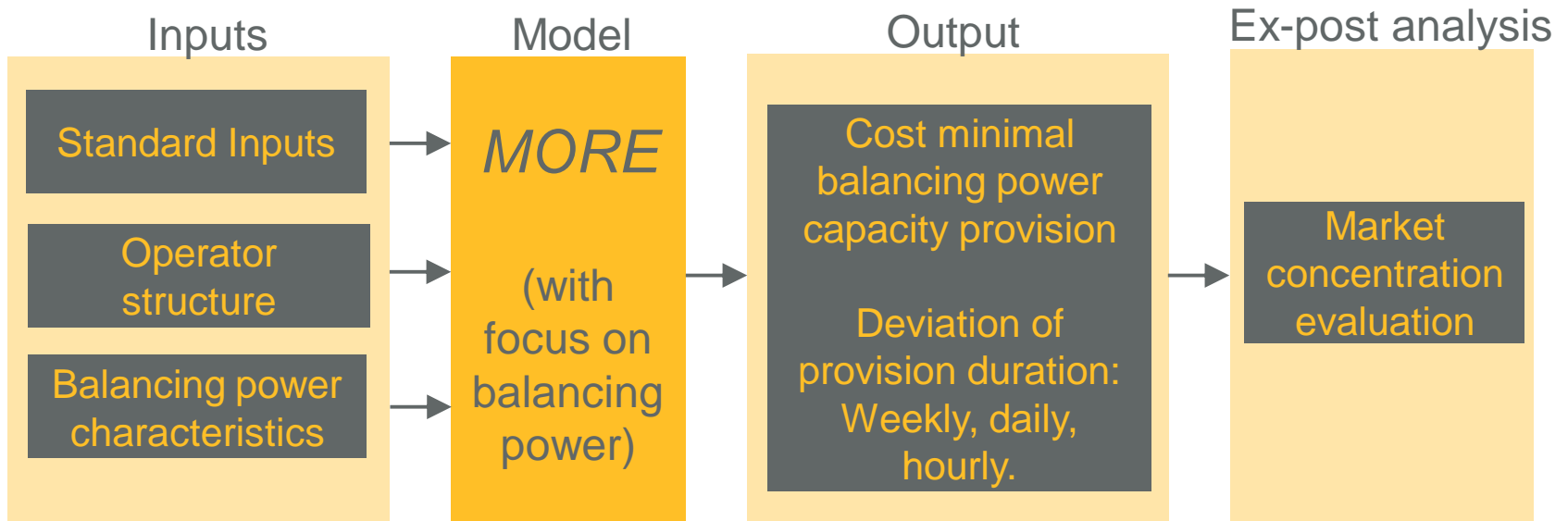


Figure:  
Exemplary merit  
order and opportunity  
costs for positive  
balancing power



## Short description of *MORE*:

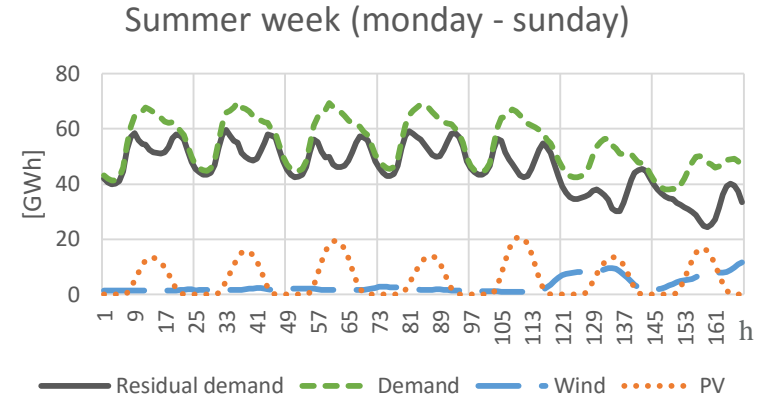
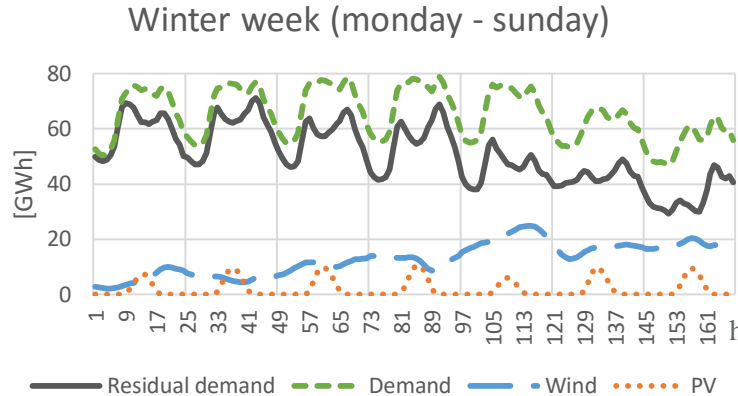
- Economic fundamental electricity market model
- Cost minimizing mixed-integer model
- Good representation of technical details
- Hourly resolution



# Methodology

## Model assumptions

- Focus on typical winter week and summer week:

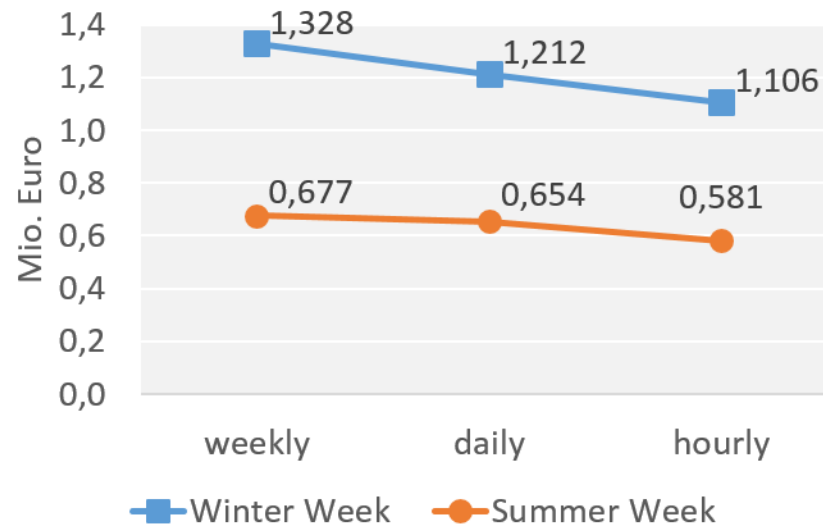


- Every power plant can only provide a certain share of its capacity for balancing power:

	primary balancing power	secondary balancing power
CCGT	2.50 - 4.00%	25.00 - 40.00%
Coal	1.00 - 2.50%	5.00 - 12.5%
Lignite	1.00 - 2.50%	5.00 - 12.50%
Nuclear	2.00 - 2.50%	10.00%
OCGT	5.00 - 12.50%	50.00 - 60.00%
Oil	2.00%	20.00%
Pumped Storage	10.00%	15.00%

Share of total capacity that can be used for balancing power provision

# Results - Efficiency increases with shorter provision duration



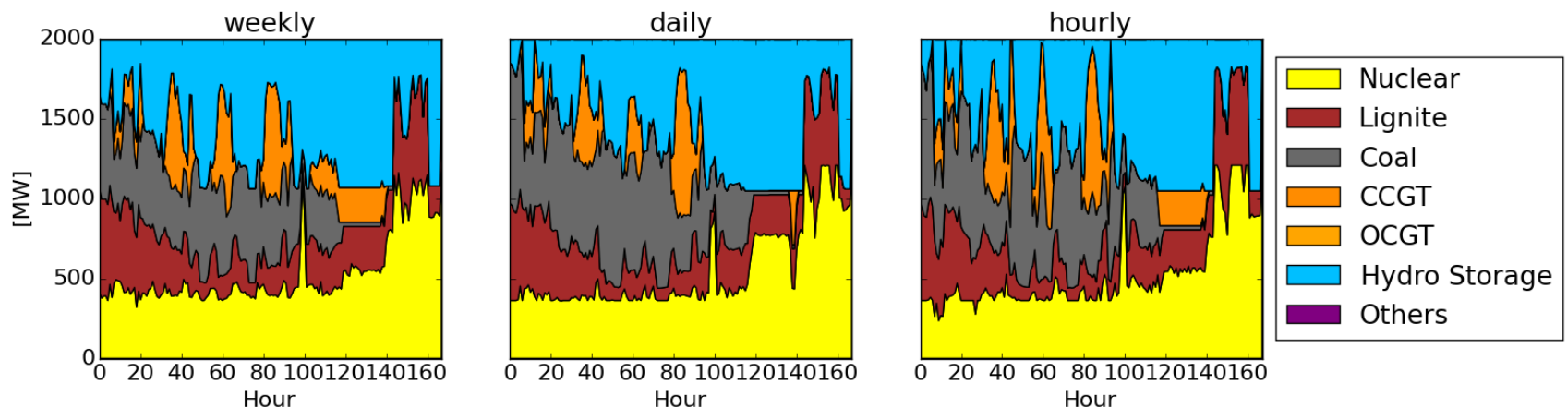
A decrease of the provision duration decreases cost of balancing power provision:

- From weekly to hourly:  
222k Euro in winter week  
96k Euro in summer week
- From weekly to daily:  
116k Euro in winter week  
23k Euro in summer week

- Higher costs of balancing power provision in the winter
- An hourly provision is the efficient benchmark in our model

# Results – Capacity provision by fuel has fluctuation

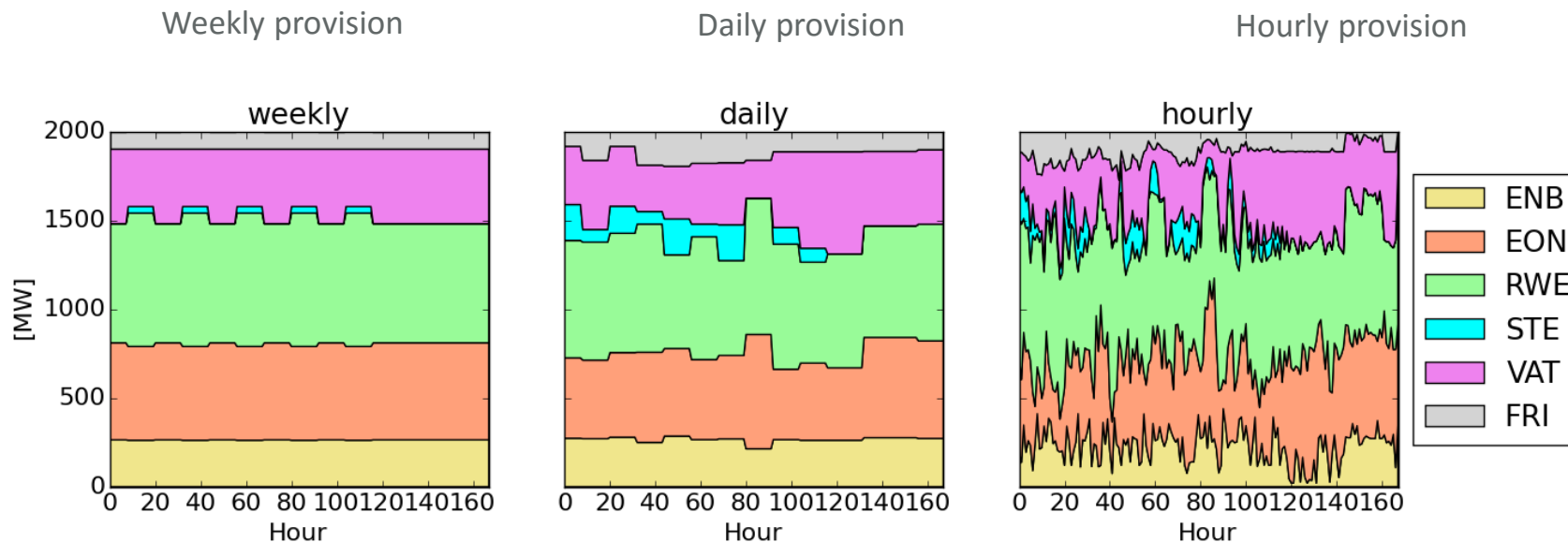
For the positive secondary balancing power in the winter week, the following power plant technologies provide capacity (similar in the case of other products):



- Strong hourly fluctuation in technology despite a weekly provision duration
- Pooling effects which allow for capacity fluctuation in weekly provision duration are significant

# Results – Provision duration has impact on operators

## Positive secondary balancing power provision by operator, Winter



- 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):

$$HHI = \sum_{i=1}^n s_i^2$$

, for  $s_i$  market share of firm  $i$  (in %) and total number of firms  $n$ .

## 2. CR(m) (Concentration ratio of $m$ greatest firms):

$$CR(m) = \sum_{i=1}^m s_i$$

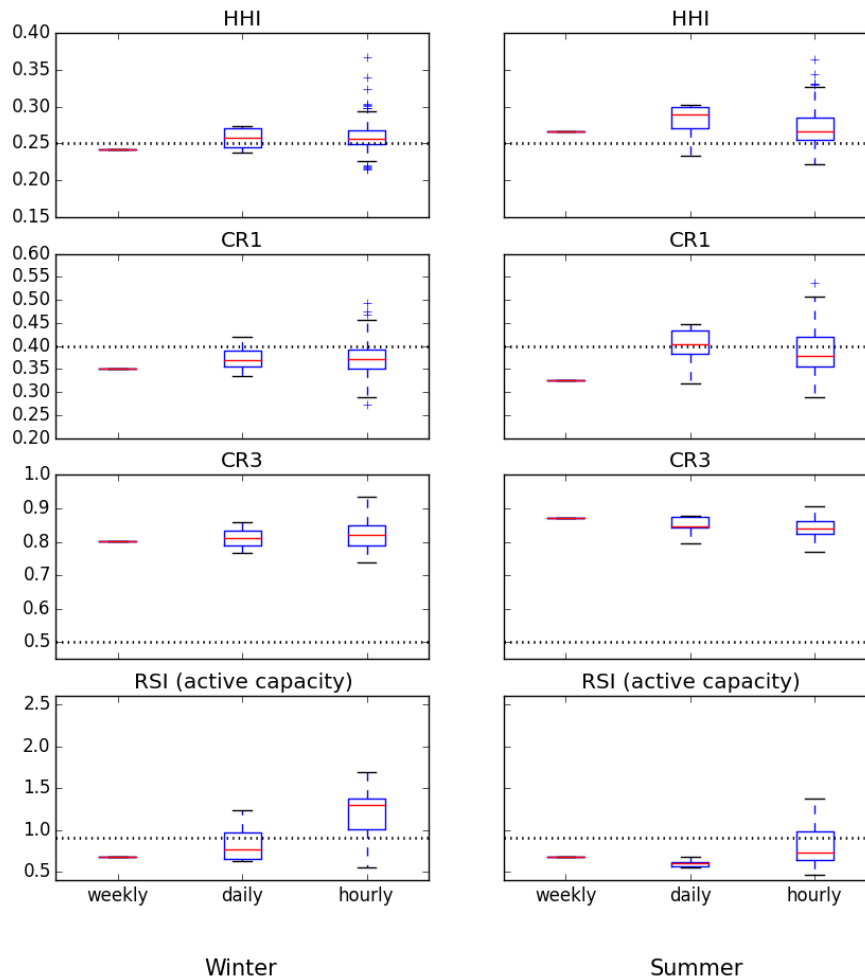
, for  $m \leq n$  firms.

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

$$RSI(i) = \frac{TotalAvailableCapacity - AvailableCapacity(i)}{TotalDemand}$$

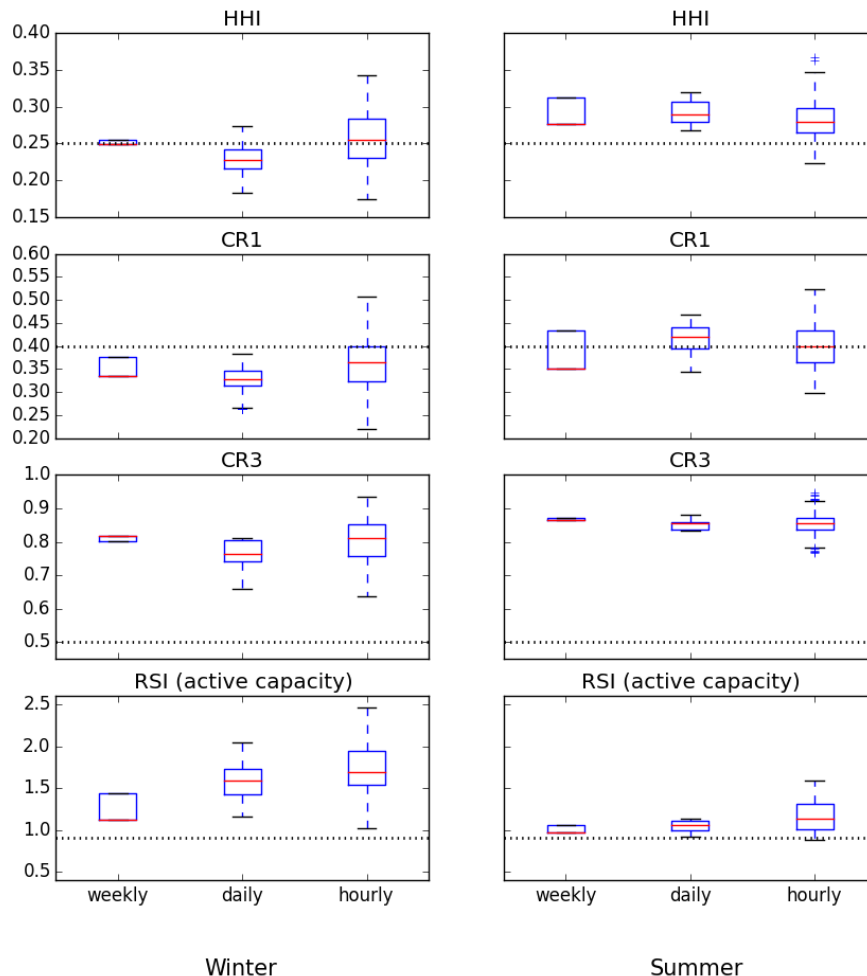
In the case of HHI and CR, higher values indicate higher market concentration. In the case of RSI, lower values indicate higher market concentration.

# Results – Market Concentration of the Primary Balancing Power



- In general high market concentration (especially with weekly market design)
- Indices take on broader range for an hourly / daily market design than with weekly design
- RSI increases with shorter provision duration implying lower market concentration, but indicates still high concentration in the summer

# Results – Market Concentration of the Positive Secondary Balancing Power



- Summer more concentrated than winter
- RSI indicates that market is not too concentrated due to available capacities that could replace the providing power plants
- Single hours have a very high market concentration in the hourly market design

# Discussion and Conclusion

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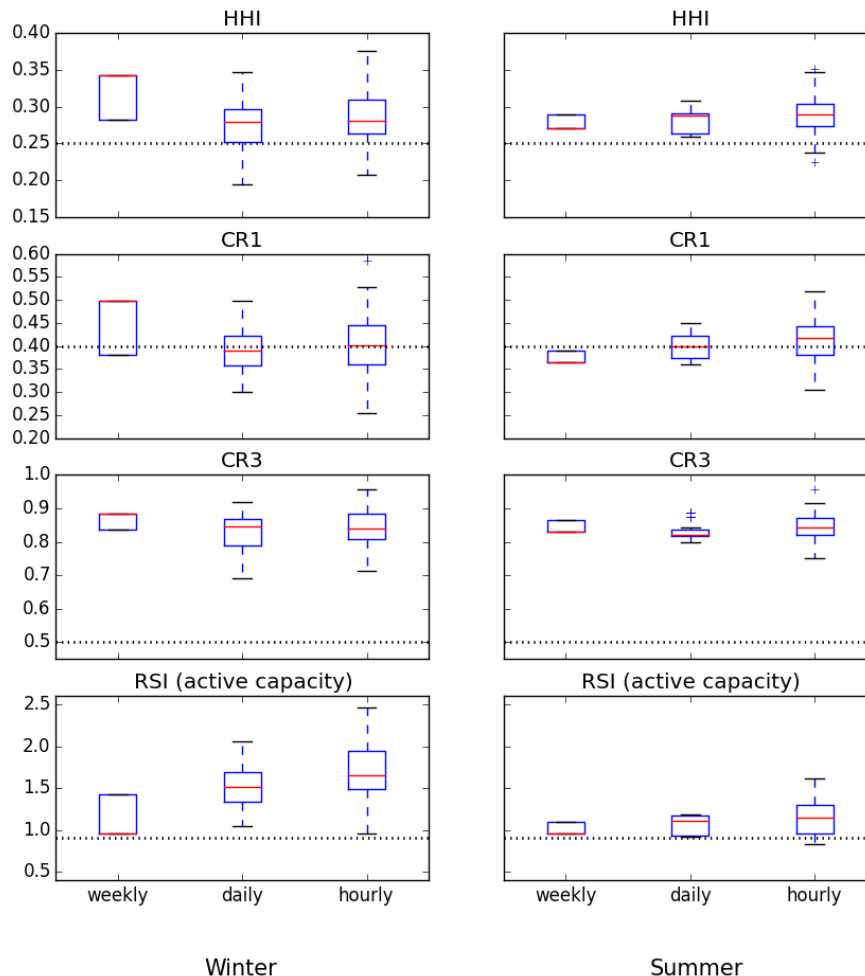
- A shorter provision duration (e.g. hourly) increases efficiency
- Several market indices point to market concentration in the German balancing power markets
- An increase in market concentration should therefore be avoided
- An hourly provision duration raises danger of an increase of market concentration in specific situations while it increases efficiency at the same time

## Outlook:

- Assessment of the implications from market concentration to market power
- Publishing results



# Results – Market Concentration of the Negative Secondary Balancing Power



- Similar to the case of positive secondary balancing power
- However, no abuse of market power is expected for this product, because opportunity costs are 0

# Model shortcomings

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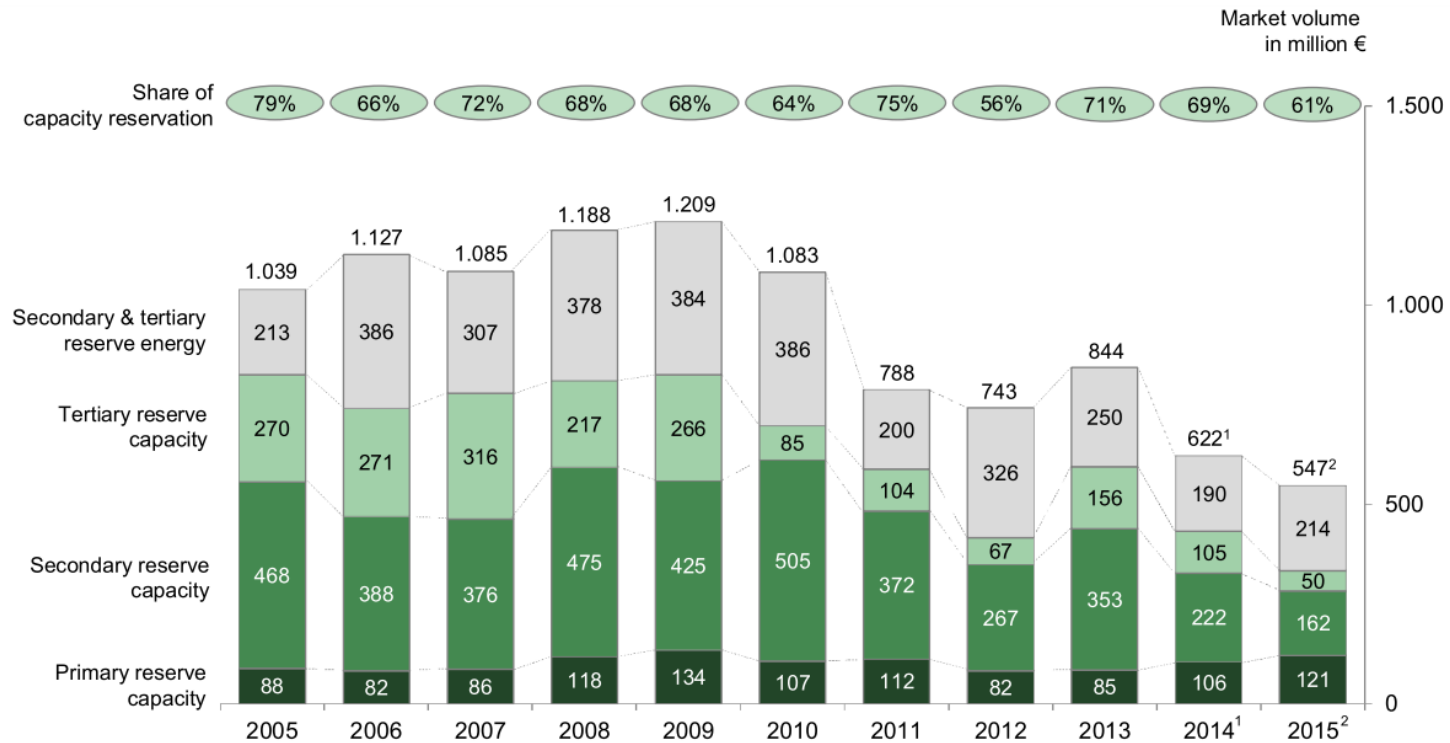
1. The model only allows to detect market concentration but no market power, i.e. how strong prices will be increased due to concentrated markets.
2. We use a static model in the sense that we do not consider new players to enter the balancing power markets due to shorter provision time.

Further players like wind generation, batteries and DSM could participate if the provision duration will be short enough. However, the capacity bids of those new players may not be competitive compared to conventional power plants with pooling effects of big operators. A participation also with shorter provision duration is questionable.

- E.g. Wind power: Realistic participation only for negative balancing power. Therefore, direct competitors are base load power plants (nuclear, lignite) which would be willing to bid negative prices.
- E.g. batteries: Would need to be over dimensioned to guarantee a balancing power provision even for an hourly provision duration, makes sense with double usage concept like electromobility.
- E.g. DSM: Only specific industry processes can participate in balancing power markets as the production can not be increased/reduced flexible enough.

# Costs in balancing power markets

- Capacity provision has share of more than 60%
- Secondary capacity has a high share



1. Bottom-up estimation 2. Estimation based on Jan-Aug 2015 data

Data source: Monitoring reports of the Bundesnetzagentur (available online: [www.bundesnetzagentur.de](http://www.bundesnetzagentur.de)); Regelleistung (2015); Amprion (2015)

FIGURE 5: MARKET SIZE OF THE GERMAN RESERVE CAPACITY AND ENERGY MARKET

Source: Just, „The german market for system reserve capacity and balancing energy”, 2015