

Tech-Talk
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**The devil is in the detail:
Comparison of Electricity Market Models**

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Agenda

- 1. Model and Data Description**
- 2. Results**
- 3. Conclusion**

Model and Data Description

Modell	Elmod-LP	Elmod-MIP	StElmod
Problem	Linear	Mixed Integer	Mixed Integer
Features	Dispatch	UC+ Dispatch [+Regelenergie], min. Erzeugung, Start-up cost, Ramping, min./max. Ausschaltdauern	UC + Dispatch + Regelenergie, min. Erzeugung, Start-up cost, min./max. Ausschaltdauern, [Intraday, Redispatch],
Model horizon	8760h	168h x 52(+1) [Hydro (CH/AT) LP-Presolve]	36h (rollierend)
Calculation time	ca. 10 Min.	ca. 2h (parallelisiert)	ca. 30h (inkl. Intraday und Redispatch)
Reference	DIW Data Documentation 72	DIW Discussion Paper 1400	DIW Discussion Paper 1301

- **Base year 2013 for (based on TSO data):**
 - Renewable feed-in
 - Cross-border flows
- **Block-sharp power plant representation**
- **Temperature-based minimum and maximum output for CHP plants**
- **Minimum load, ramping speeds, start-up costs, and efficiencies etc. are based on DIW Data Documentation 68 and 72**

Results 1

Fig. 1: Generation results

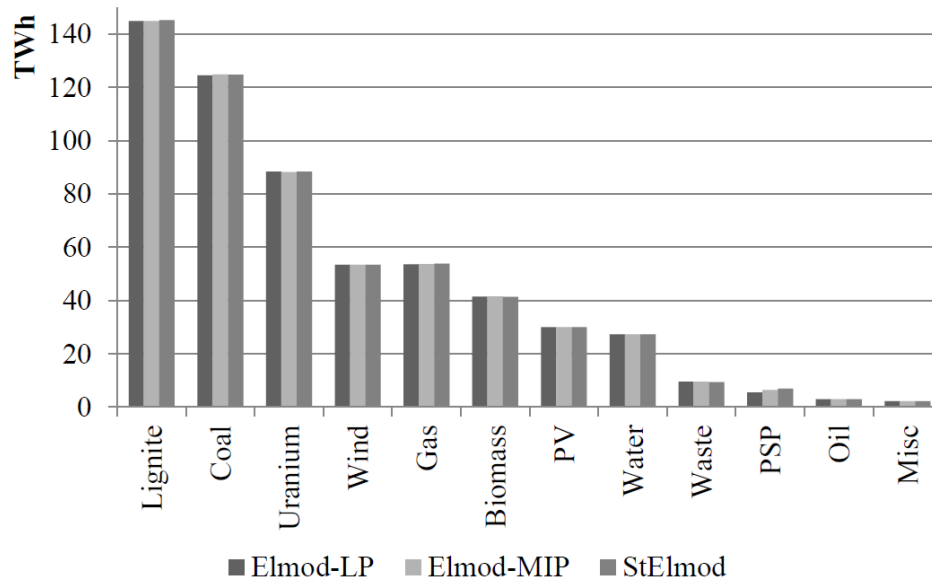
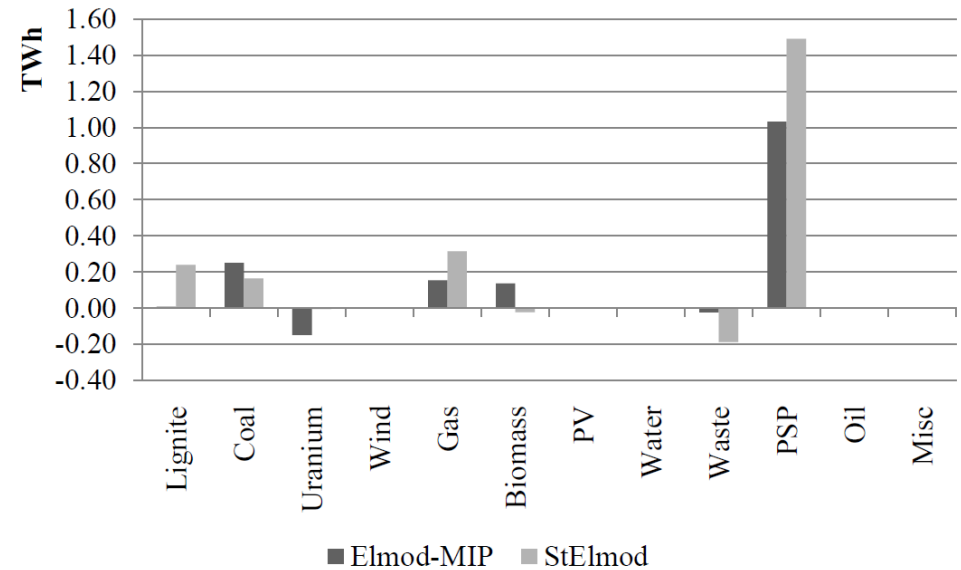


Fig. 2: Generation relative to *Elmod-LP*



- **Very similar generation results**
- **Differences mainly in PSP-utilization**
 - Linear model abstracts from most technical characteristics which limit the flexibility of power plants
 - Storage is mostly used for a cost-minimizing shift of generation between different time periods
- **In Elmod-MIP pumped hydro storage is increased by 18% and in StElmod by 27 %**

Results 2

Fig. 3: Coal-fired generation in week 21

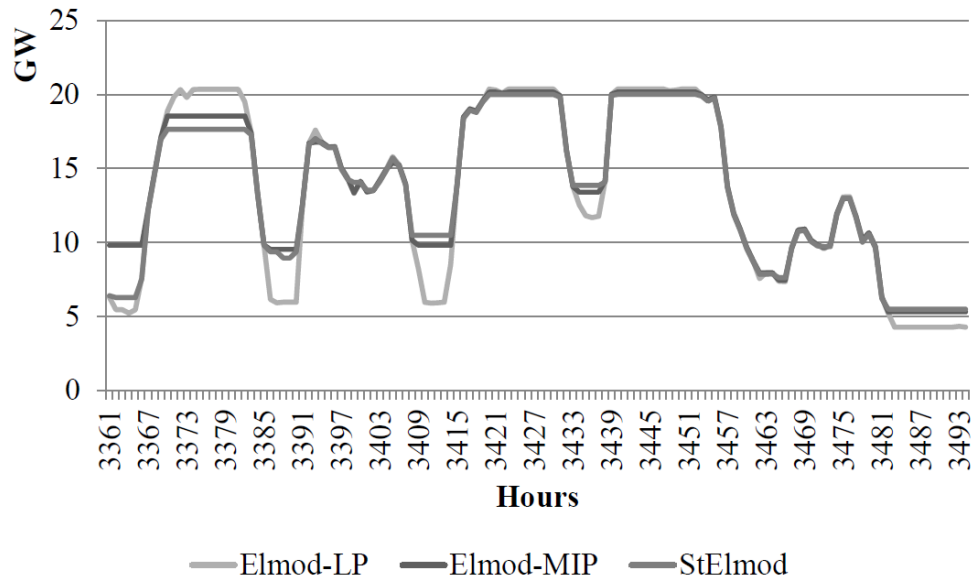
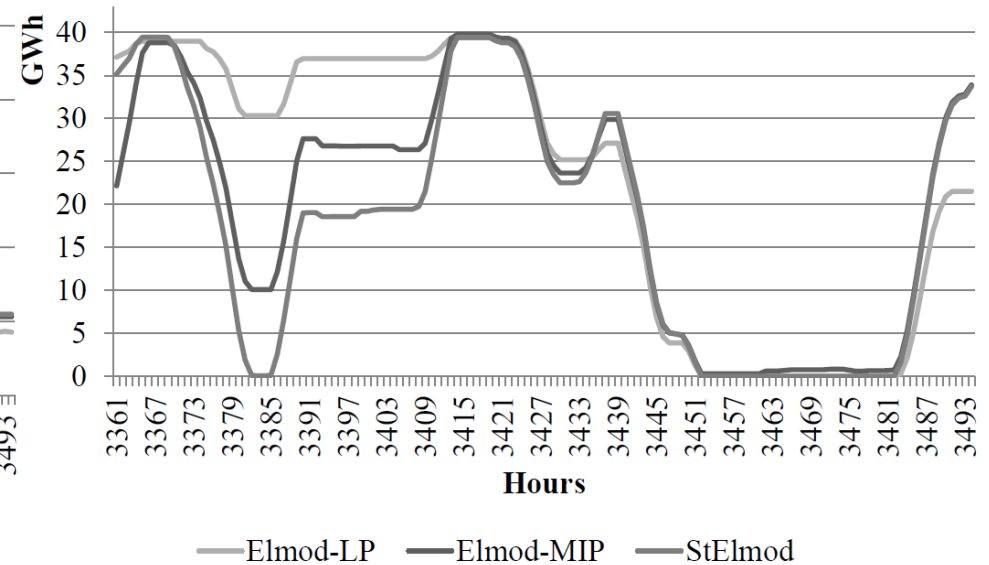


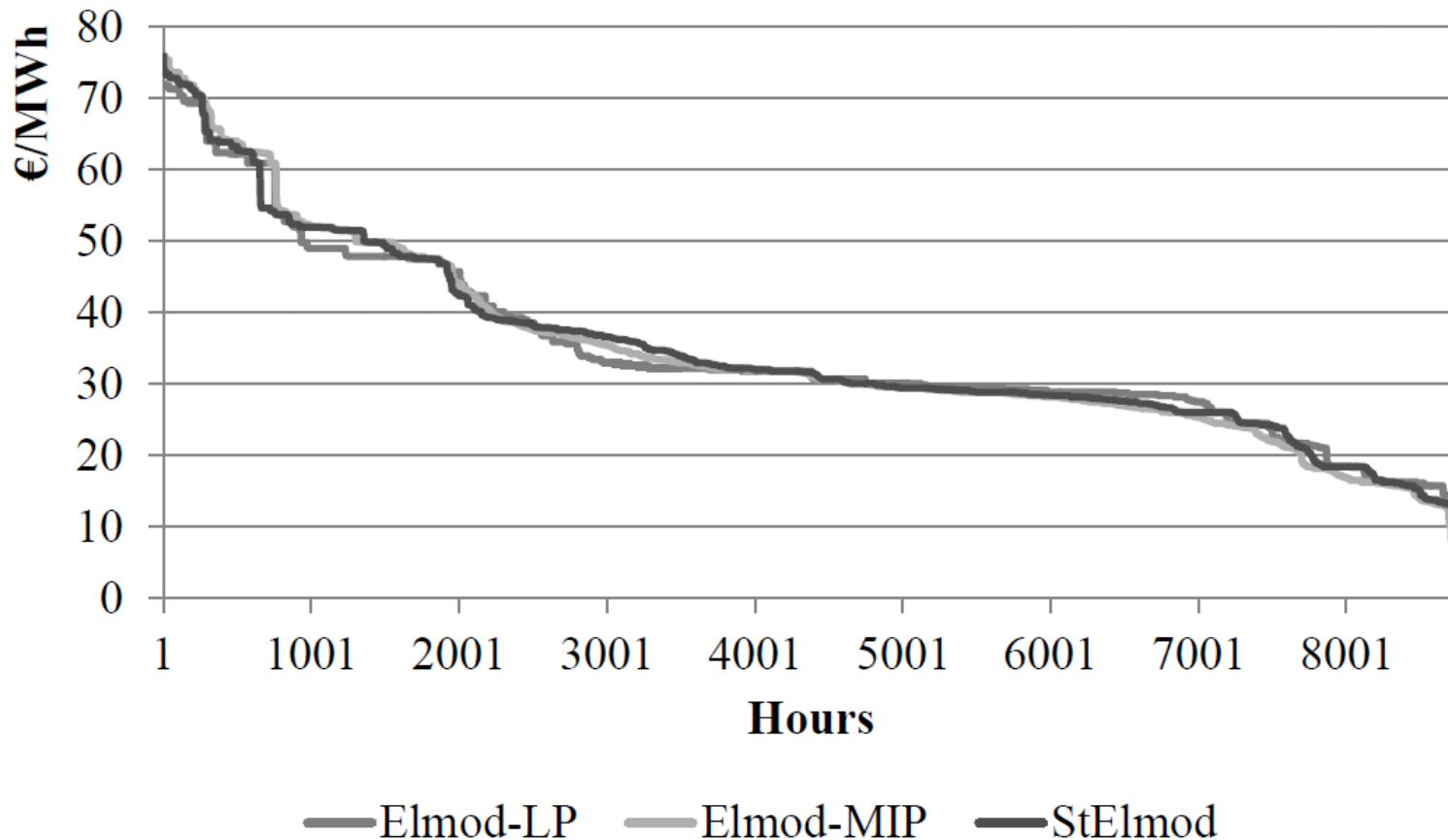
Fig. 4: Aggregate PSP-levels in week 21



- **First 5 days of week 21 in 2013 (low residual load on Friday)**
- **Power plants ramp-down / ramp up much lower/ higher in the linear model**
 - Minimum run constrains
 - Start-up costs to turn on additional plants
- **Storages are levels are increasing/decreasing much faster**

Results 3

Fig. 5: Price duration curves



Results 4

Fig. 6: Prices of *Elmod-MIP* relative to *Elmod-LP*

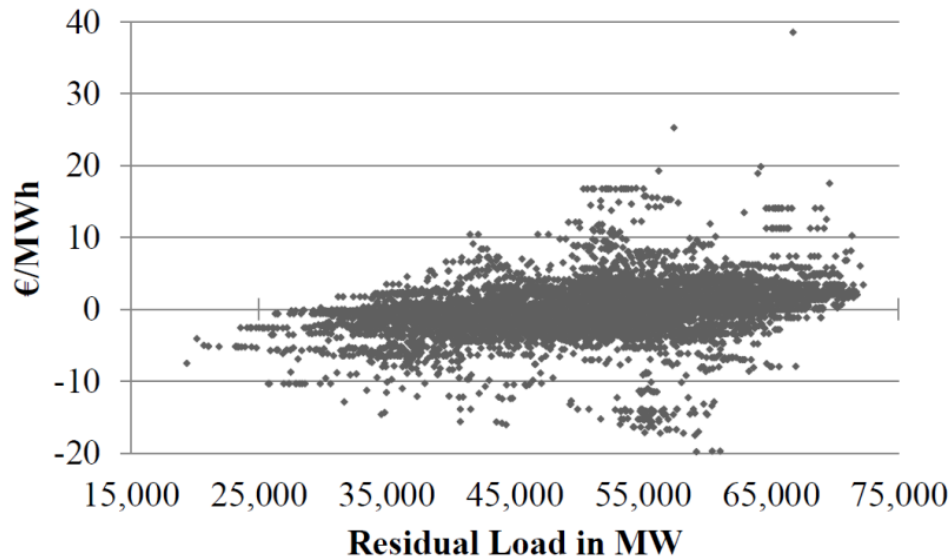
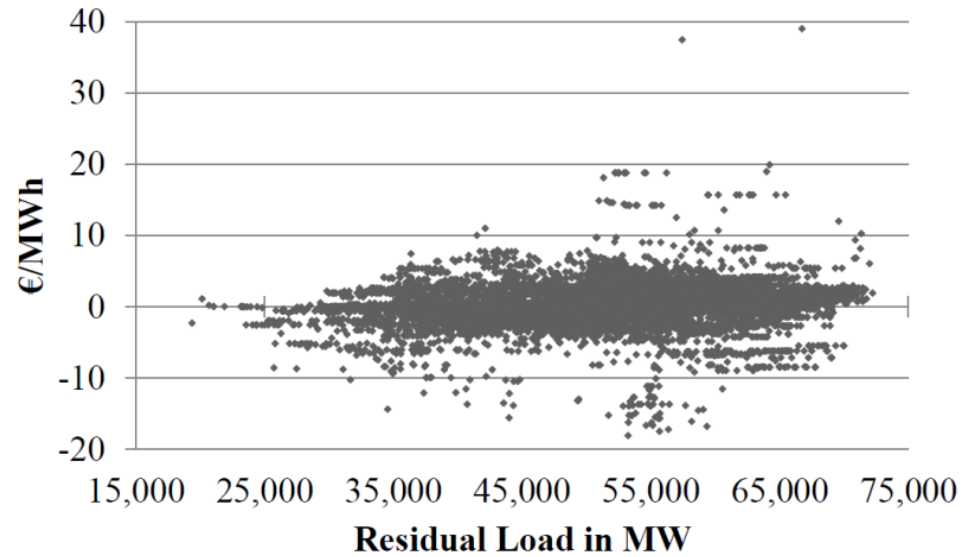


Fig. 7: Prices of *StElmod* relative to *Elmod-LP*



Conclusion

- **Only small differences regarding the generation, prices and emissions**
- **Due to the fact that a very high must run is induced by CHP constraints**
- **Differences only in the way flexibility is provided by conventional generation**

- **Differences are expected to increase with higher RES-shares**

- **Prices are more volatile in the MIP-Elmod and StElmod**

- **The economic interpretation is that currently flexibility is not limiting the integration of volatile renewables**

- **Consideration of congestion management possibly increases the importance of UC as redispatch costs are influenced by the locational distribution and technical capabilities of conventional capacities that can be ramped up or down**

Thank You for Your Attention!

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