HOW POWER TARIFFS DESIGN INFLUENCES DEMAND RESPONSE

A micro-economic assessment of load shifting investments profitability using the agent-based power market model AMIRIS

Johannes Kochems, Institute of Networked Energy Systems | Presentation at Strommarkttreffen, Berlin, 31.03.2023

Research question

Influence of power tariffs design on demand response investments

*How does **power tariffs** design impact the economic viability of **demand response**?*

- studied for different exogenously determined systems

- applying different power tariffs varying in
  - share of energy payments that is **dynamic**, i.e. varying with day-ahead power price
  - split between **capacity-** and **energy-related** payments

- considering a **portfolio** of industrial **loads** for **load shifting**
  - goal: minimize overall payments for power consumption
  - corresponds to rationale of aggregator benefiting from shared savings

Method: Assessing micro-economic profitability

Utilizing the agent-based power market model AMIRIS

1 Power system & Power tariff design

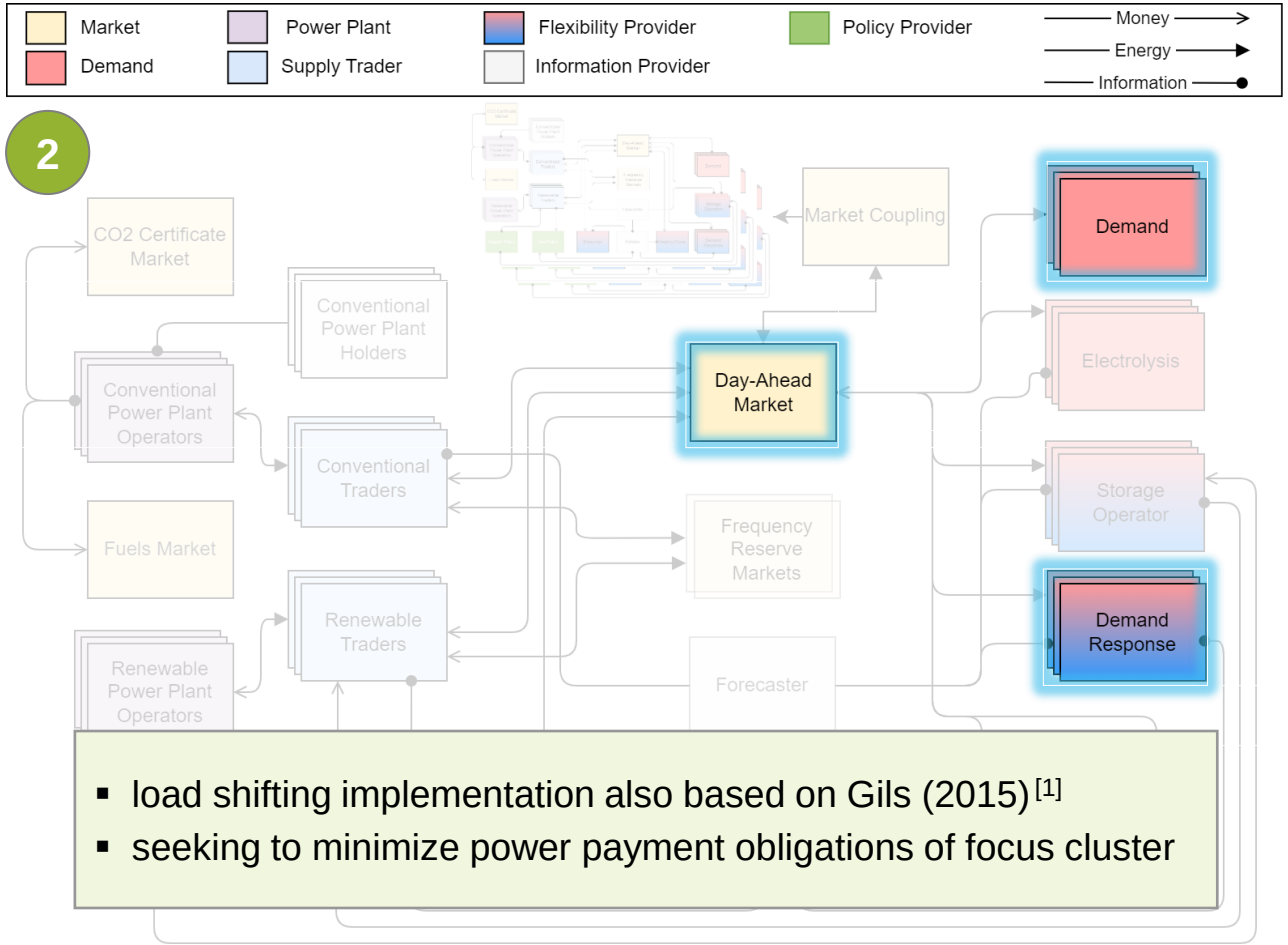
- power system: investments from fundamental power market model *pommesinvest*
- power tariffs: derived current payment obligation for load shifting **focus cluster**

3 Assessment of profitability with annuities

Overall goal: annuity ≈ 0

Interpretation:
system optimal investment choices are economically viable

2



- load shifting implementation also based on Gils (2015) [1]
- seeking to minimize power payment obligations of focus cluster

Input Data: Feed-in of renewables, temperature, balance energy price, marginal cost, load, ...

https://gitlab.com/dlr-ve/esy/amiris/amiris
https://github.com/pommes-public/pommesinvest

Scenario design

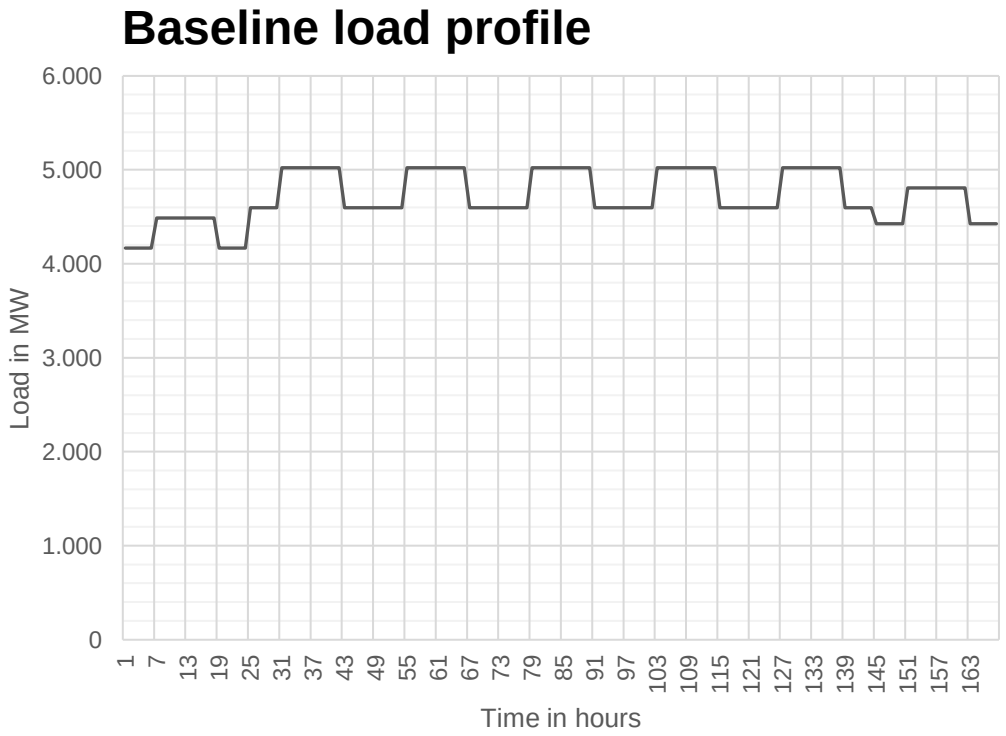
Considering exogenous scenarios with demand response

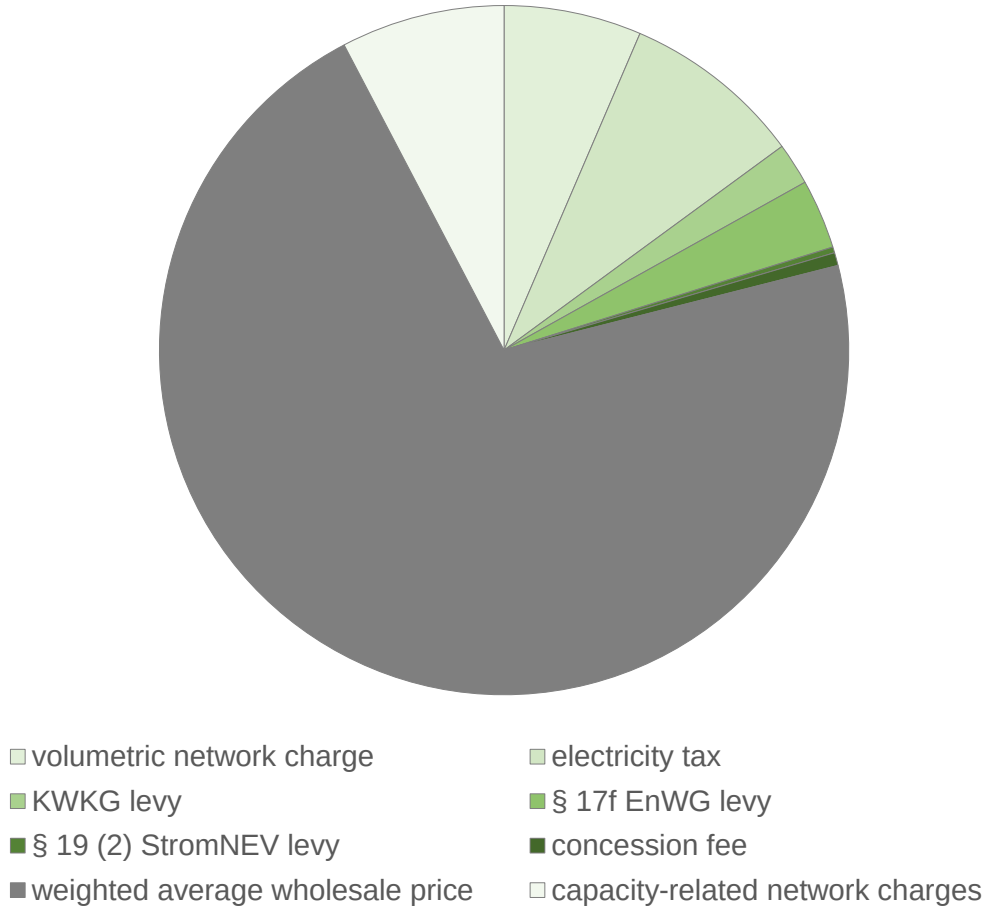
	DR pessimistic (DR 5)	DR optimistic (DR 95)
costs of DR	↑	↓
technical potential of DR	↓	↑
maximum allowed shifting time	↓	↑
costs of other flexibility options	↓	↑

DR: Demand Response

Power tariffs parameterization

From real-life payment obligations …





weighted average power price: 129 €/MWh

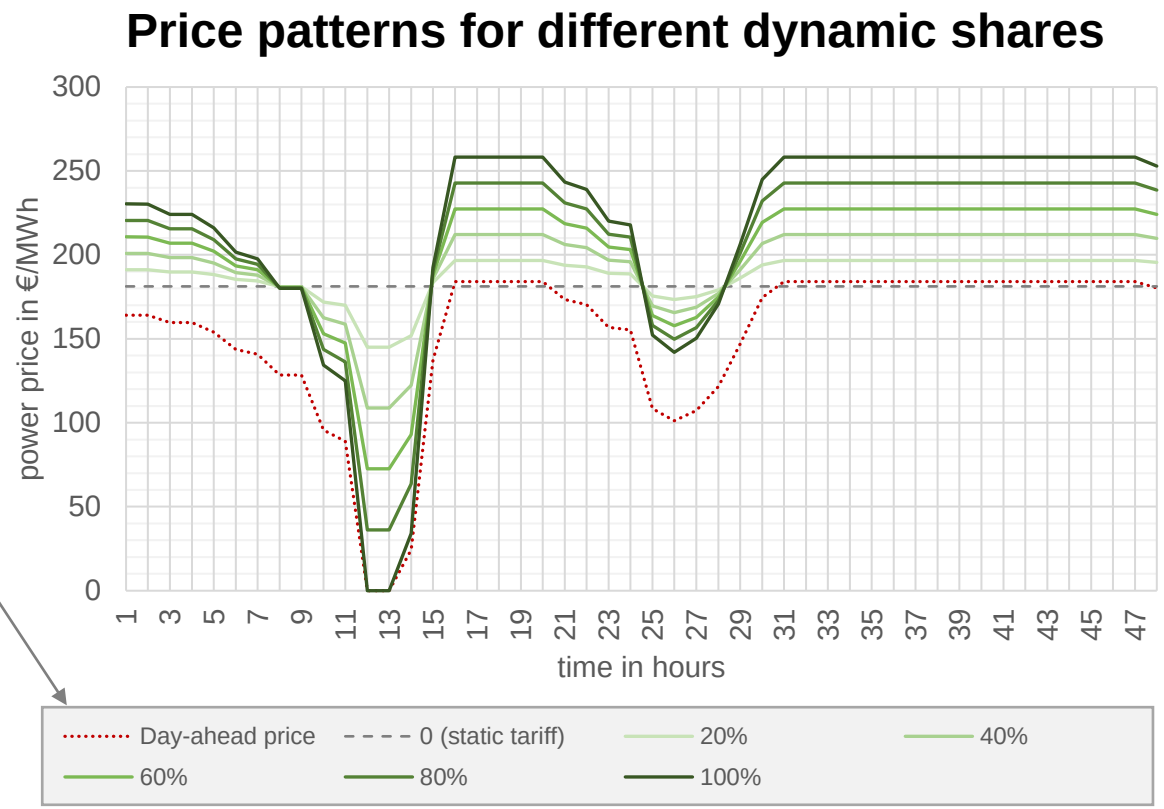
total: 181 €/MWh

Data sources: load profile: sources compiled in [2]; tariffs [3] – [12]

Power tariffs parameterization

… to 31 power tariff designs – varying in dynamic share & capacity / energy split

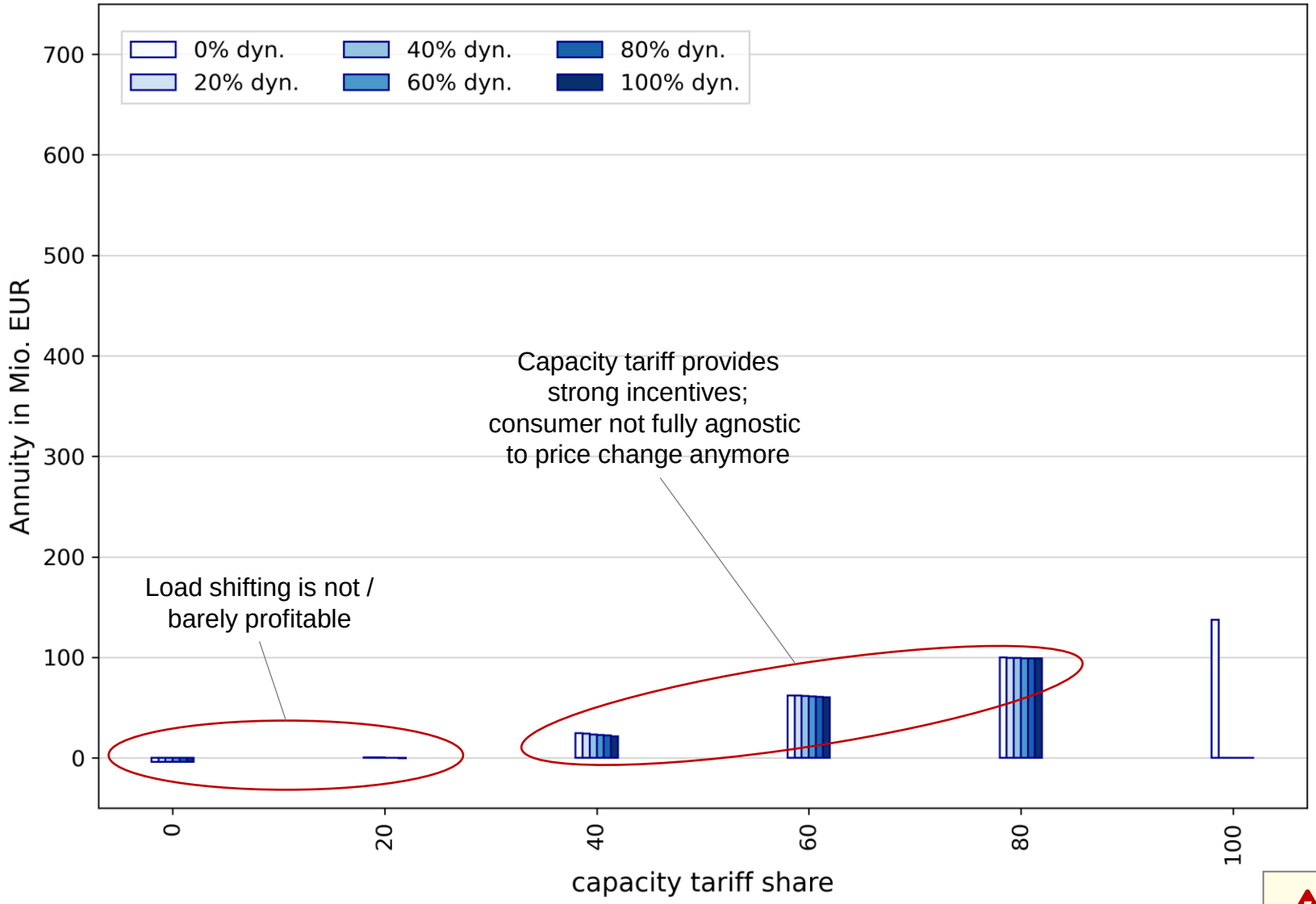
tariff split: capacity / energy share \ dynamic share of energy tariff	0	20 %	40 %	60 %	80 %	100 %
0 / 100%						
20% / 80%						
40% / 60%						
60% / 40%						
80% / 20%						
100% / 0						



For comparison: real world capacity tariffs shares are estimated around 2% to 20% of total electricity tariff in Germany. [9]; [13] – [14]

Preliminary results: Pessimistic case (DR 5)

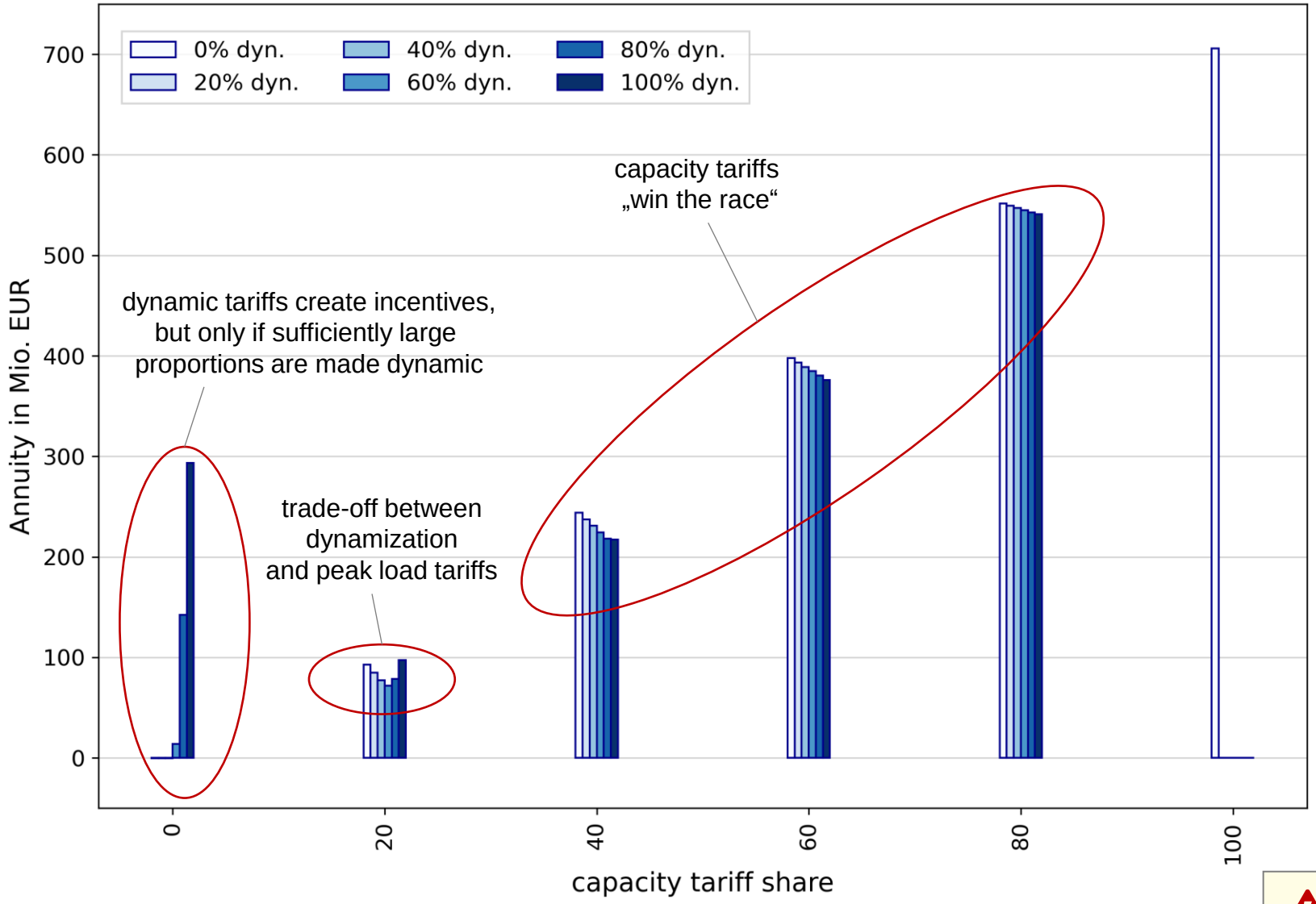
Strong incentive from capacity tariff in example case



Preliminary results!
Only indicating trends

Preliminary results: Optimistic case (DR 95)

Trade-off between dynamization and peak load tariff incentives



Preliminary results!
Only indicating trends

Conclusion and Outlook

Preliminary Findings

1. Higher **capacity** shares create **strong incentives** for shifting in the example case.

2. **Dynamic** tariffs become effective only if shifting time is sufficiently large for the example case.

3. Presumed strong dependency from **load profile** & **shifting time** needs further research.

Outlook

- Improve robustness and look at different load patterns
- Study parameter variations
- Contrast with overall economic potential estimates

Thank you!

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Imprint

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