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INATECH

Signals In, Reactions Out

Navigating Design and Modeling Challenges in Dynamic Grid Fees

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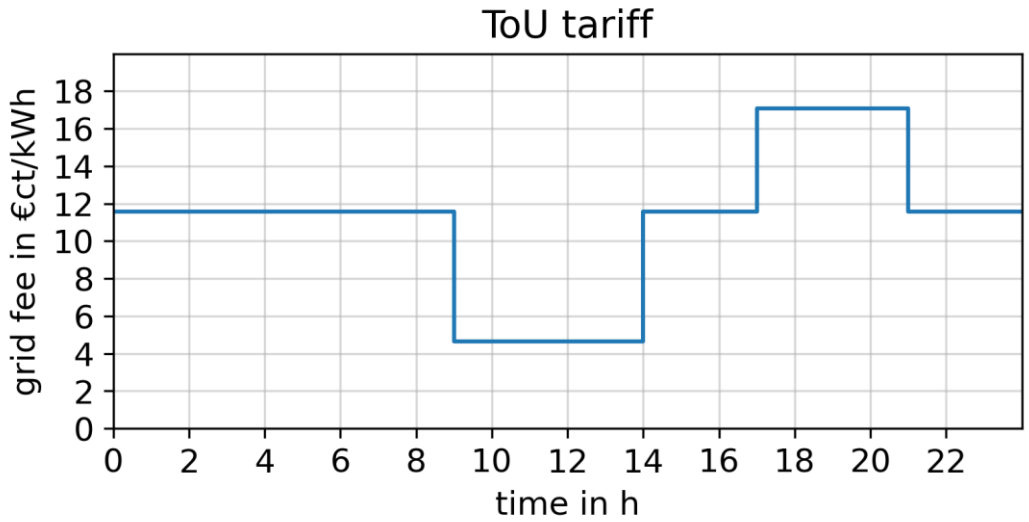
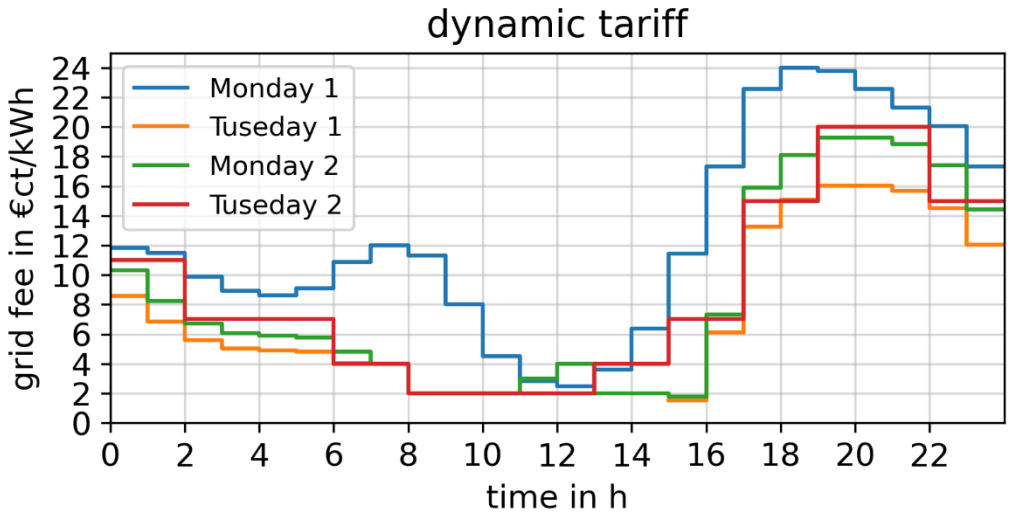
Motivation

- From past to future
  - Past: generation adjusted to demand
  - Future: demand adjusted to available generation
- Current grid fee designs
  - Little to no incentives to provide demand side flexibility
- Effective system: endogenous signals
  - Availability of generation – market signal
  - Availability of transport capacities – grid signal

Grid Signals

- Include grid signal in market price
  - Market split
  - Nodal pricing
  - ➢ Only for transmission grid
- Separate grid signal
  Grid utilization from load flow calculations
  - Time variable, e.g. Time-of-Use (ToU)
    - Calculated once, apply for e.g. one year
  - Dynamic
    - Calculated close to real time, e.g. daily





Design options – determination of rate

Which factors have to be considered when determining the amount of the grid fee?

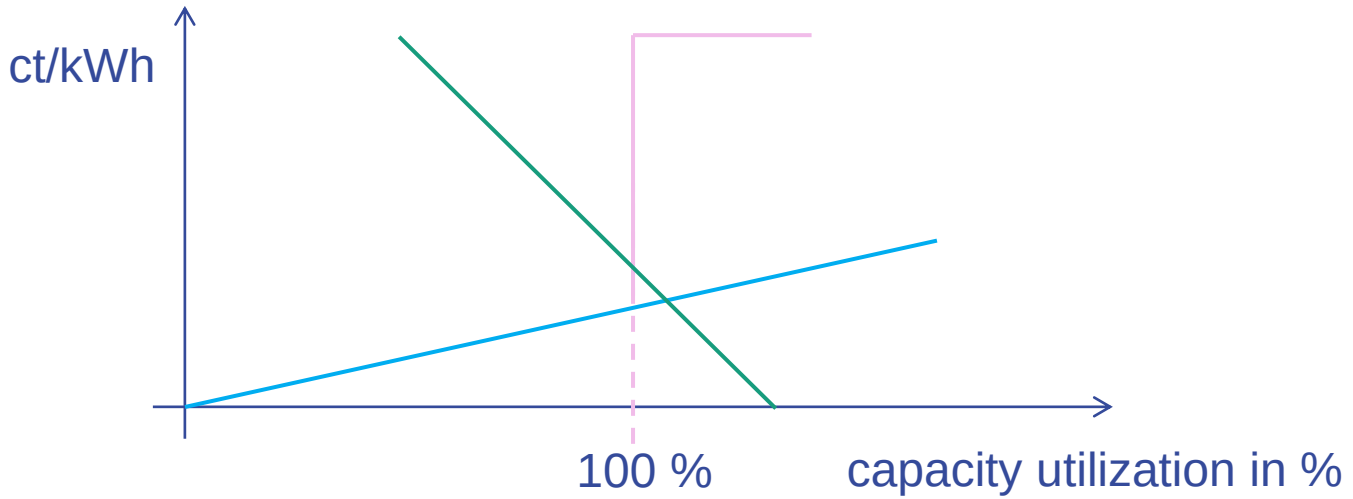
- Cost reflectivity
  - Only reflect variable grid costs in variable rate
  - Reflect utilization of grid by consumer in the grid fee
    - Measurement of utilization by (relative) capacity rather than volume
    - Temporal and spatial granularity for precise reflection
    - Allow for negative rate?

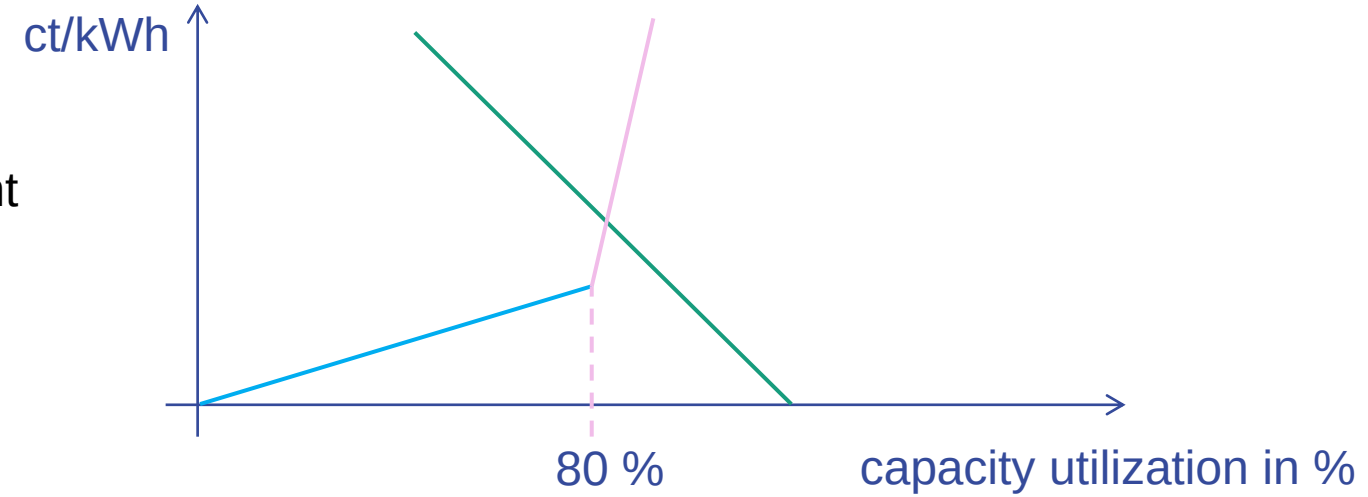
Determination of rate - optimal pricing

- Variable costs: mainly driven by losses

  $P_{\mathrm{L}} = P^2 \cdot \frac{R}{U^2} \rightarrow$ linear marginal costs

- Elastic demand
- Scarcity
  - Where is the threshold?
  - Surplus revenue
- Jump → shifting effects, over-curtailment
  - Other curves
    - Price above marginal cost inefficient
    - Where is the threshold?

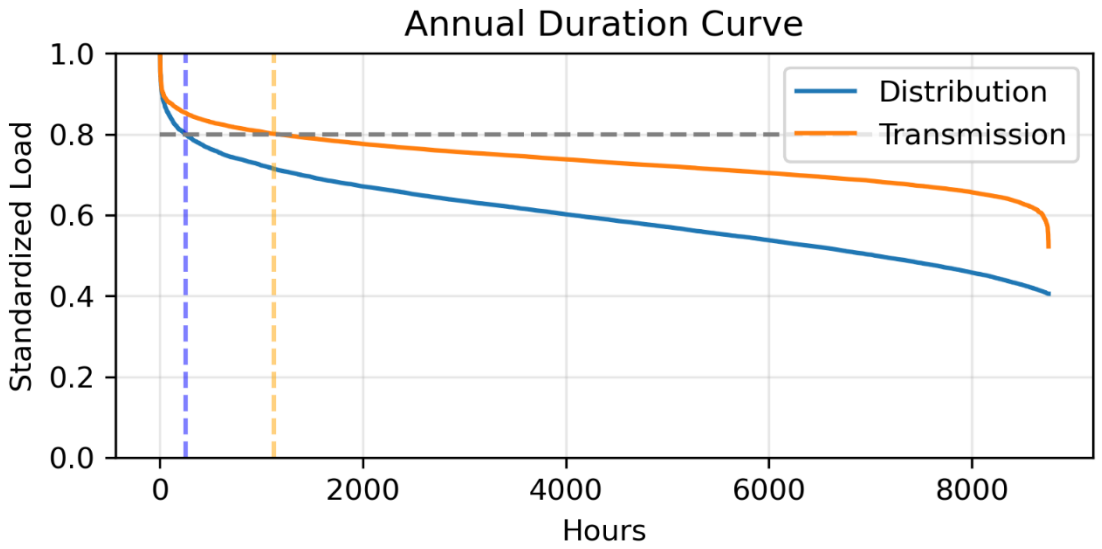




Design options – determination of rate

Which factors have to be considered when determining the amount of the grid fee?

- Cost recovery
  - Recover the variable cost of the system operator (e.g. 20%, Simshauer 2015)
  - Possible definition of threshold by definition of peak hours
  - Example: 20% top load values
    → two-tier rate
    (based on: Haro 2017)
  - values can be changed / added



Design options – process

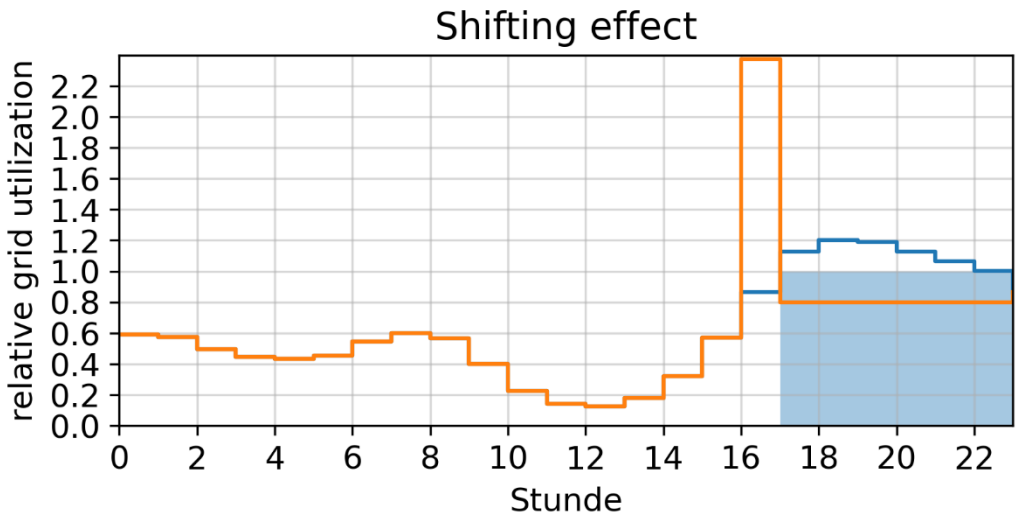
- Fairness
  - Fair design (potentially inefficient system)
    - Consumer vs. prosumer, Household vs. industry
    - Avoid possibility of de-solidarization
  - Ensure fairness through other means
    - Base price, taxation
- Covered voltage levels
  - Installed flexibility: mostly distribution
  - Congestion as of today: mostly transmission
  - TSO and DSO signals could be counteracting
    - Superposition of signals: top-down vs. bottom-up
- Timing
  - Grid utilization is a result of market activities is a result of grid tariffs is a result of grid utilization is a result of market activities is a result of grid tariffs is a result of grid utilization…
    - As close as possible to market closing
    - As soon as possible before market opening
  - Shifting effect
    - Real-time coordination

Challenges and decisions in modeling

- Amount-setting
  - Cost reflectivity: How elastic is demand?
    - Bias free models
    - Modelling of constant elasticity difficult
  - Cost recovery: Which base price to set?
    - Interdependency
      base price – dynamic price
- Fairness
  - Consumer groups
- Superposition
  - Linked TSO and DSO signals
- Computational expenses

Evaluation of effectiveness

- Simultaneous triggering of load shift
  - Shifting effect
- Distortion of market equilibrium
- Exemption of storages and electrolyzers from grid fees (e.g. in Germany)
- Digitalization
  - Ability of customers to use signals
  - Ability of SOs to generate signals



Conclusion

Efficient activation of so far unused flexibility

Challenges:

- Design: determination and calculation of rate, embedding grid signal in overall energy system
- Modelling: bias, computational expenses
- Implementation: digital infrastructure & regulatory framework

Contact

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