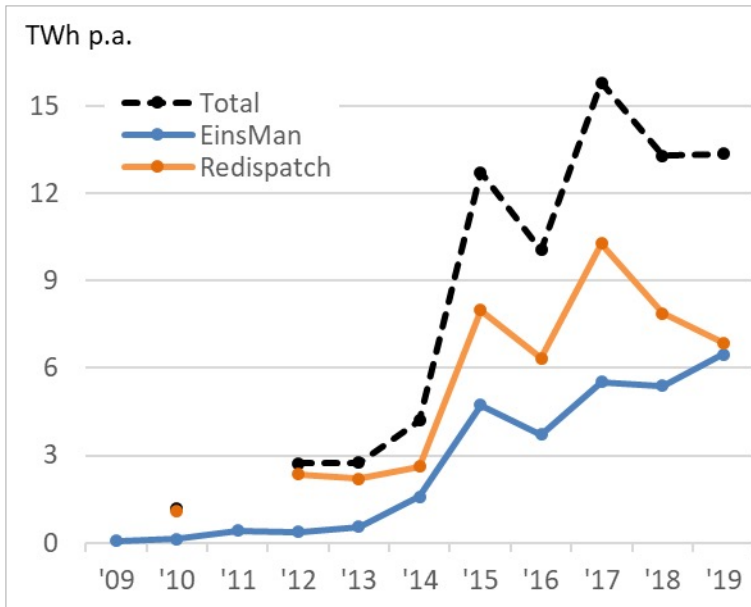# Redispatch of Loads

Integrating flexible loads into grid congestion management
by means of capacity-based payments
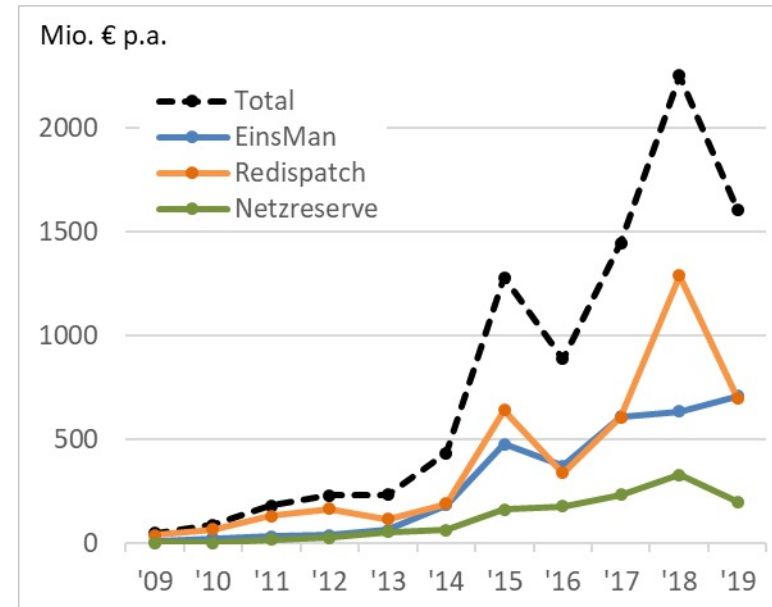
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Congestion management in Germany

TWh p.a.

- Total
- EinsMan
- Redispatch

Mio. € p.a.

- Total
- EinsMan
- Redispatch
- Netzreserve

The volume of congestion management increased about 5-fold since 2012.

The costs for congestion management increased similarly.

Status quo: Obligatory cost-based redispatch of generators

Today: Redispatch in Germany is mandatory and cost-based

- Mandatory for generation and storage units >100 kW

- Compensation of costs and foregone profits

- Idea: Make units economically indifferent to redispatch, to avoid strategic behavior

Limitations

- Whenever variable costs cannot be estimated reliably, cost-based redispatch reaches its limits

- This is the case whenever the willingness to pay is hard to estimate

- Flexibilities like storages and other units that earn a significant part of their revenue on other markets (intraday, balancing energy, heat)

Loads for redispatch!

Integrating loads into congestion management would be desirable

- Reducing the cost of redispatch

- Using otherwise curtailed renewable electricity (in North of DE)

- Interruptible loads could substitute grid reserve power plants (in South)

- Reduce the need to extend the transmission grid

But: only if it is more economic than the alternatives

- Using loads for redispatch is no end in itself

- Only makes sense, if it replaces more expensive alternatives

Three types of loads

Interruptible loads in the South

- Electricity intensive industry (metal, paper, chemical)
- High full-load hours and willingness to pay ("would prefer to run all the time")
- Real curtailment – no catch-up effect later (if plants run full-load)

"Additional usage" P2X loads in the North

- Electrolysis, electrical heat production in district heating systems
- Low to medium full-load hours and willingness to pay
- True additionality – no catch-up effect (i.e. substitution of fossil heating)

Load-deferral on both sides of the constraint (North/South)

- E.g. thermal applications (heat pumps, industrial cooling), e-mobility
- Real deferral – opposite to the redispatch activation is done to "catch up" later

Cost-based compensation not possible for loads

Cost-based redispatch is not an option for loads

- The regulator would have to know the willingness to pay of loads

- The willingness to pay is the equivalent to the variable costs on the generation side

Hard to objectively estimate willingness to pay

- Willingness to pay of **industrial loads** strongly depends on current production, market prices for inputs and outputs, the business cycle, staff availability, etc.

- Willingness to pay of **electric cars** depends on plans of the driver the next morning: Going on holidays vs. staying at home

- Willingness to pay of **P2X loads** might be possible to estimate robustly (e.g. electrolysis)

Voluntary redispatch

Idea in 2015: Redispatch market with activation payments

- Voluntary redispatch based on short-term price formation

- Loads could be integrated

- Analyzed in a project for the Germany ministry (2017-20, report), two problems:

- Problem 1: Market power – possible to solve

- Problem 2: Incentives for congestion-aggravating behavior (inc-dec gaming)
  – no clear solution in sight

Alternative idea: Voluntary redispatch based on capacity-based payments

- Hope: Long-term contracts might limit inc-dec incentives

- Voluntary nature enabling loads to participate

Two challenges

Strategic incentives

- How to ensure that incentives to aggravate congestion are minimized?

Availability requirements

- How to make sure, only those units get the capacity-payments that help?

Proposal

Key parameters

Activation payment: Wholesale price

- Loads should get or pay exactly the wholesale electricity price
- This avoids strategic incentives – because loads are better off being un-strategic
- But it means loads don't want to be activated
- Thus, compensation must come from elsewhere: Capacity payment

Capacity payment: Fixed-price per available hour

- A fixed per-MW payment for available capacity per hour (regardless of activation)
- Availability dependent: Interruptible loads must be running to be eligible
- "Additional usage" loads must not be running (or not at full capacity) to be eligible

Keep existing cost-based redispatch of power plants in parallel

- Limits market-power and serves as price-cap

Capacity-based redispatch suitable – for some loads

Capacity-based redispatch is suitable – but only for some loads

- Not for all kinds of loads

Case 1: „Peak load" in South

- Loads in the South that are rarely shed (industrial loads)
- Replacement for grid reserve (reserve power plants for grid purposes)
- Strategic incentives from the capacity-based payments are low – much lower than through equivalent activation-based payments

Case 2: Demand-side management: Load deferral („delayed load")

- Loads on both sides of the constraint, which just defer their consumption (e-mobility, heat pumps)
- Strategic incentives from capacity-based payments cancel out

…but not for all

„Additional usage" loads in the North

- Would have to be activated frequently to generate economic welfare
- If so: high capacity-payment necessary
- Willingness to pay must be near the level of wholesale prices to generate welfare
- Therefore, significant strategic incentives – these loads would frequently ramp down just to be called to ramp up

Electricity market bids would be distorted by hourly capacity-payments

- Distortion of bids: Loads would often refrain from consumption (to be eligible for payment)
- Real welfare impact (not only distributional)
- Aggravates congestion

Conclusion

Value of loads for redispatch

- By using otherwise curtailed electricity
- By substituting grid reserve power plants
- Useful only if it increases economic welfare - no end in itself

Capacity-payment as participation incentive

- We propose a capacity-based payment
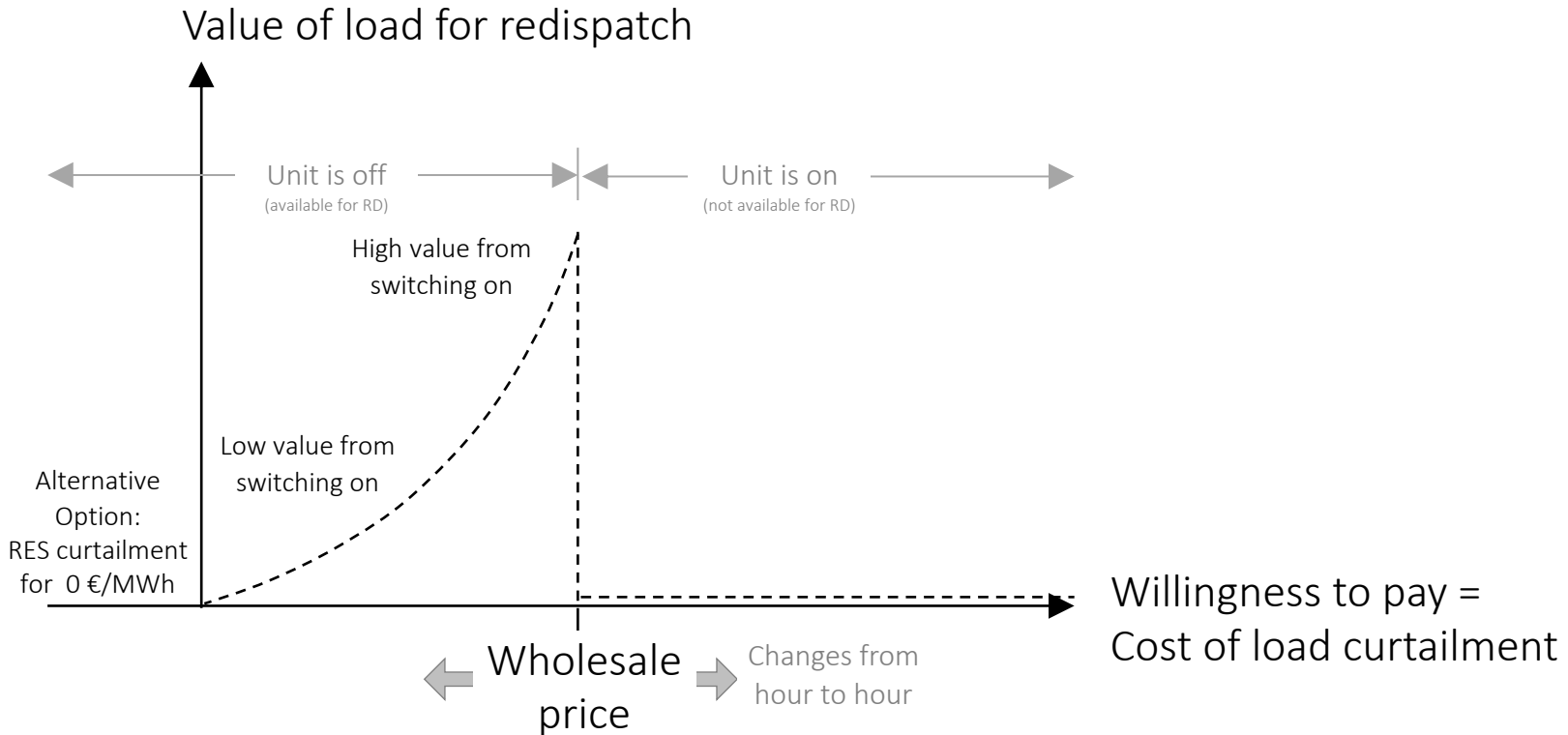- Aim is to avoid strategic incentives from activation-based payments

Feasible for some loads

- „Peak load" in South: Industrial loads, curtailment in few hours per year
- Demand-side management: Load deferral („delayed load")

Not feasible for Northern "additional usage" loads

Backup

Value of "additional usage" loads for redispatch (North)

Value of load for redispatch

Unit is off
(available for RD)

Unit is on
(not available for RD)

High value from
switching on

Low value from
switching on

Alternative
Option:
RES curtailment
for 0 €/MWh

Willingness to pay =
Cost of load curtailment

Wholesale
price

Changes from
hour to hour

Availability as precondition for capacity payments?

Some units are not available for redispatch („wrong dispatch state")

- Load in the South that currently does not consume electricity
- Load in the North that consumes at full load
- There are three main ways to define the capacity product

Nameplate capacity market – capacity payment independent of actual availability

- Windfall profits

Capacity requirement – at least X% availability as requirement

- Excludes some of the best units

Availability market – paying for each available hour

- Seems to be the best approach
- But: comes with strategic incentives, too

Strategic incentives

Incentives for strategic, congestion-aggravating behavior

- Loads in the South switch on only to be interruptible (available for redispatch)
- Loads in the North shuts down only to be available for "additional usage" redispatch

Activation price should ideally not provide strategic incentives

- Whenever activation is economically attractive for loads, incentive for congestion-aggravating behavior arises (inc-dec gaming)
- Conservative activation price: Wholesale electricity price (last liquid intraday price)
- Then, participation incentive must come from capacity payment

Capacity-payment should ideally not provide strategic incentives

- If only available capacity gets capacity payment, there is an incentive to make yourself available – that also aggravates congestion
- This does *not* for deferred loads – as the capacity payment cancels out