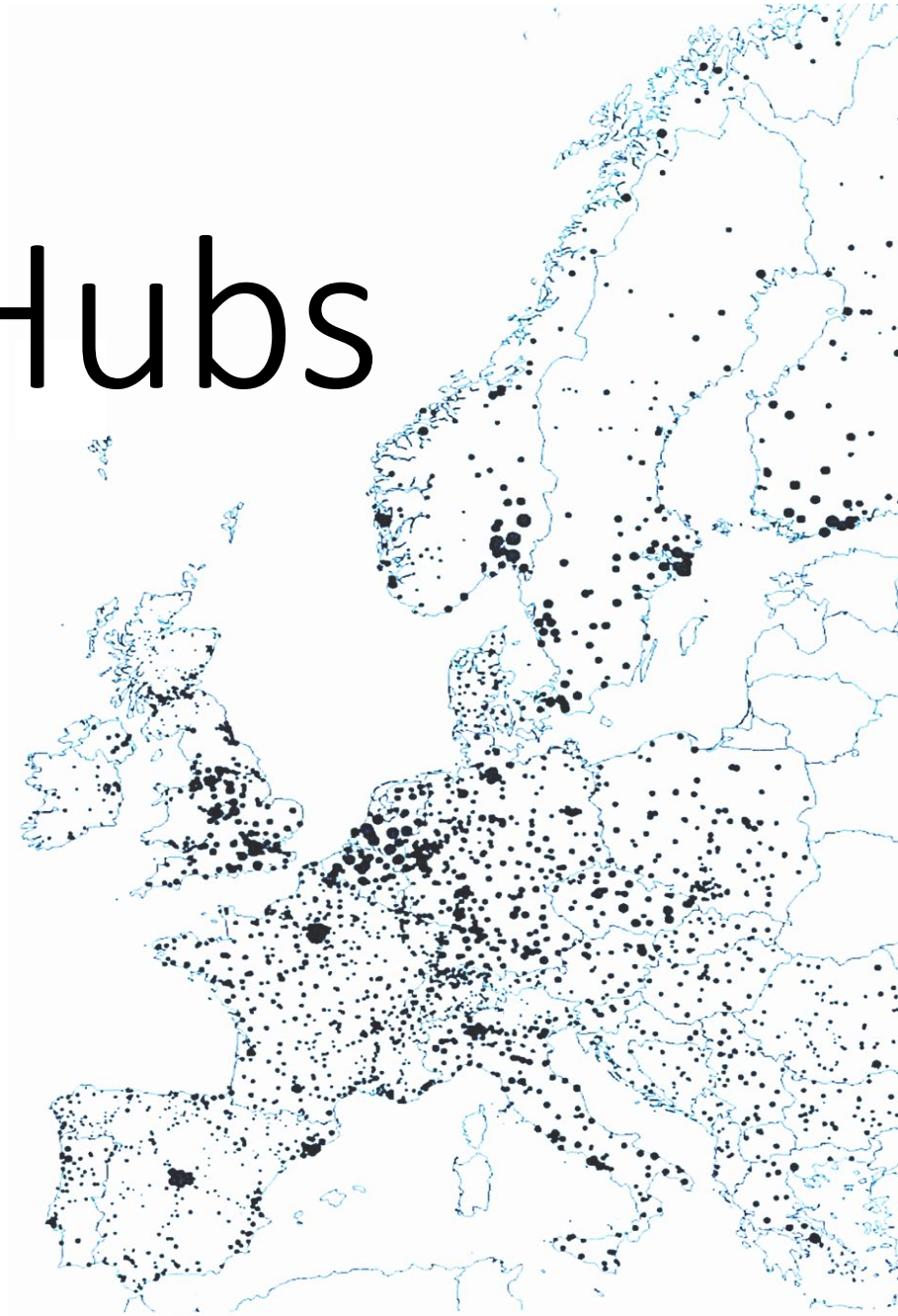
Dispatch Hubs



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Hertie School

Redispatch markets

Market-Based Redispatch in Zonal Electricity Markets

The Preconditions for and Consequence of Inc-Dec Gaming

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Abstract – In zonal electricity markets such as Europe's, system operators rely on out-of-the-market measures to relieve network congestion within bidding zones. One such measure is "redispatching" power plants, i.e. increasing the output of a station downstream of the congestion while lowering production of an upstream plant. Traditionally, generators have often been legally obliged to participate in redispatch and were subsequently compensated for costs incurred. In recent years numerous proposals have been made to organize redispatch through voluntary markets, including one by the European Commission. In this paper, we introduce a simple graphical game-theoretical model of a locational redispatch market within a one-zone electricity market. We solve the model explicitly by determining optimal bidding strategies and the Nash equilibrium. We show that market parties anticipate the redispatch market and bid strategically in the zonal market – this is the so-called increase-decrease game. As a result, grid congestion is aggravated, producers extract windfall profits, financial markets are distorted, and perverse investment incentives emerge. Despite claims to the contrary, we show that such gaming is possible absent any market power, i.e. under perfect competition. At the root of the problem is an inconsistent setup of power markets: combining a zonal with a locational market yields undue arbitrage opportunities that rational firms exploit. We conclude that such inconsistent market design should be avoided.

This paper builds on research undertaken with Consentec, Connect Energy Economics, Ecofys, Fraunhofer ISI and Stiftung Umweltenergierecht in the project "Untersuchung zur Beschaffung von Redispatch" for the Federal German Ministry of Economic Affairs and Energy (No. 055/17). Project findings are published as Neon & Consentec (2018, 2019), Connect Energy Economics (2018), and Consentec et al. (2019). This paper does not constitute a project deliverable. We thank Kristin Walter, Nils Saniter, Christoph Maurer, Bernd Tersteegen, Marco Nicolosi, Barbara Burstedde, Markus Graebig, Eva Schmid, Frauke Thies, Simeon Hagspiel, Samuel Glisman, Mike Hogan, Anselm Eicke, Tarun Khanna, Christoph Neumann, Catrin Jung-Draschil, Bernhard Hasche, Fabio Genoese, Charles Payement, Fabian Joas, Gerard Doorman, Philip Baker, Julia Radecke, Joseph Hefele, Christian Winzer, Rebecca Lordan-Perret, and SCCER CREST and Strommarkttreffen seminar participants for inspiring discussions and helpful comments.

Voluntary markets for redispatch

The idea: voluntary markets for redispatch

- System operators buy upward / downward redispatch
- Generators, consumers, storage owners can participate – voluntarily
- They are compensated based on bids when activated (€/MWh)
- These markets must be (near) nodal in spatial granularity

Proposals come by different names

- Flexibility markets, smart markets, market-based redispatch, redispatch markets

The hope: Redispatch markets …

- … incentivize consumers and decentralized assets to participate
- … turn networks into smart grids – coordinate everything from heating to batteries
- … help avoiding expensive and complicated grid expansion
- … save zonal European wholesale markets

Problems of market-based redispatch

Locational market power

- Some generators/loads are much more effective at solving any given congestion than all others
- Usual problems of market power: inflated prices at cost of rate payers
- Mandatory redispatch with cost compensation essentially is a way of mitigating market power

Inc-dec gaming / strategic bidding

- Repercussions on the zonal electricity market
- This is different from exercising market power! (but mutually enforcing)
- I will focus on this in the following

Inc-dec gaming: the essentials

Two-stage market

- First stage: zonal spot market
- Second stage: locational redispatch market

Generators in the oversupplied region

- Anticipate they will be paid for ramping down – if they are available (i.e., producing)
- Bid below variable cost (underbid) in spot to be eligible for downward redispatch

Generators in the scarcity region

- Anticipate they will be paid for ramping up – if they are available (i.e., not producing)
- Bid above variable cost (overbid, “withhold capacity”)

In other words: generators have an incentive for strategic bidding

- … creating a number of problematic consequence, e.g. it aggravates congestion

Consequences of inc-dec gaming

Congestion is aggravated

- Higher redispatch volume

Windfall profits

- Profits of generators increase, consumers pay more (mostly through grid fees)

Problematic for hedging

- Financial zonal markets do not provide good hedge (RDM will become “lead” market)

Perverse investment incentives

- “Ghost” plants which are built but never produce

Two market stages with differing locational resolution: Inconsistent

- Feedback effects / repercussions: spot is *not* independent from redispatch market

Conclusions and recommendations

Market-based redispatch is likely to have severe side effects

- Increased congestion, windfall profits, distorted financial markets, perverse investment incentive
- If congestion can be predicted (which, in Germany, is the case)
- Large effects: in 2030 redispatch volume approx. +200-600%, costs +200% (model-based estimate by Consentec)

Mitigating inc-dec through regulation seems infeasible

- Redispatch markets reward behavior that puts the system under stress
- The incentive problem is fundamental

It's a trade-off

- Market-based RD has benefits (integrate loads) and costs (market power, gaming)

We recommend refraining from activation-based redispatch markets

- At least in Germany for the foreseeable future

What can we do instead?

What can we do instead?

A fundamentally different electricity market: Nodal pricing

- No incentives for inc-dec gaming (but other problems)
- Only transmission grid
- Long term

Integrate loads to redispatch: capacity-based, longer-term contracts

- Hybrid: generation redispatch may remain mandatory/cost-based
- Loads: Voluntary participation
- Parties need to be economically indifferent w.r.t. being activated – hence participation incentives must stem from longer-term capacity contracts
- Activation is limited in frequency
- This would strongly reduce incentives for inc-dec (but has its own problems)
- Many tricky design questions (e.g., availability)

What can we do instead? (cont'd)

Alternative locational incentives

- Steer generation, storage, consumer investments to the "right" location in the grid
- Deep connection charges, locational grid usage charges, support schemes, …
- These incentives do not incentivize gaming (but have their own problems)

Time-variant and location-specific (distribution) grid fees

- I think we cannot electrify transport and heating without (something like) this
- But those signals will never be based on real-time demand/supply/grid conditions

Dispatch Hubs

- Small, flexible bidding zones within existing zones

Dispatch Hubs

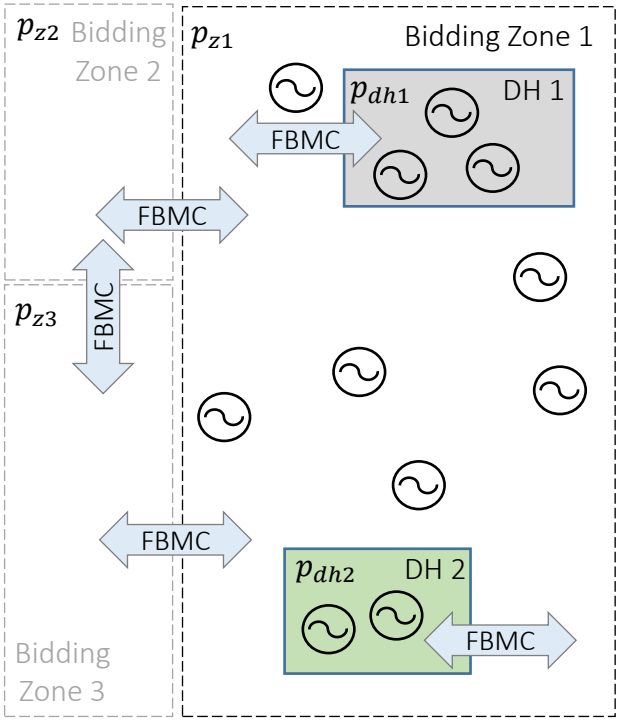
The Dispatch Hub concept

Dispatch Hubs

- A corner stone of Flex-in-Market concept
- Groups of nearby units (generation, load, storage)

A zone within a zone

- For the FBMC algorithm, dispatch hubs are like small bidding zones within existing bidding zones
- Imports/exports optimized to maximize welfare, subject to flow-based constraints, yielding a price



Increase welfare through optimization

- Reduce out-of-market redispatch exploiting the power of the FBMC algorithm
- Capture the impact on all critical network elements
- Replacing sub-optimal proxy rules (e.g.: 70%) by optimization
- Closing the gap between markets and physics

Why Dispatch Hubs?

The advantages of Dispatch Hubs vs. the status quo

- Economically optimal use of critically network elements
- Self dispatch (in most cases)

The advantages of Dispatch Hubs vs. market splitting

- Various distributive concerns are addressed (industrial consumers in the South of Germany, RE generators in the North)
- Dispatch Hubs allow more frequent and flexible reconfiguration (if compensated)

Two variants of dispatch hubs

There are two variants of Dispatch Hubs

- Market Bids
- Redispatch Potential

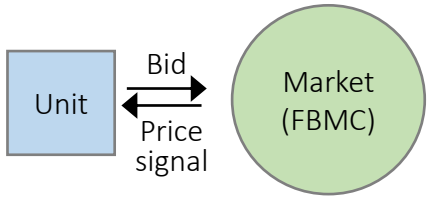
Both are identical from the market coupling perspective

- Both variants are treated identically by the FBMC algorithm
- Dispatch Hubs are handled as any other zone
- Integration of hubs into zone works through wholesale market coupling

But they differ from a market party (unit) perspective

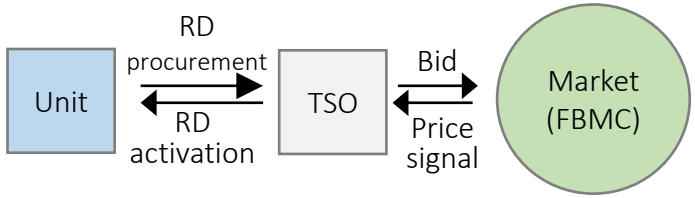
Two variants of dispatch hubs (cont'd)

Variant 1: Market Bids



- To market parties, it looks like a new zone
- Units are removed from their previous zone and placed in DH
- Units submit bids to NEMO
- An equilibrium DH electricity price is determined from the market clearing algorithm
- Units are exposed to this price (p_{dh})

Variant 2: Redispatch Potential



- To market parties, it looks like redispatch
- Units stay in their zone, facing the zonal price (p_z)
- TSOs serve as an intermediary between market parties and Dispatch Hub
- TSOs bid expected redispatch supply curves ("potential") into wholesale market
- Units may not even realize they are in a DH, they just see the redispatch process, setting up a Dispatch Hub is a "backend" reform
- Redispatch procurement may continue as today (or be organized differently)

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STUDY

Dispatch Hub Compensation Schemes

Study on profit impacts and strategic incentives of alternative compensation schemes for Dispatch Hubs in the Flex-in-Market concept

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Conclusions: Where do we stand?

Market-based redispatch / flexibility markets with energy remuneration

- I think the idea is dead
- Inc-dec gaming implies this cannot be a sustainable market design

Dispatch hubs

- A promising idea, but not without problems
- No help for distribution networks

Voluntary redispatch with capacity-based remuneration

- Can work, but not without pitfalls

Price-based incentives

- Time- and location-specific network fees (or other price components)
- To me the most promising avenue