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TSO-DSO-PX Interactions

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Overview

1. Background
2. Why (increased) interaction between DSOs and TSOs (and PX)
3. Challenges & constraints to interaction
4. Coordination options
5. Comparison of interaction options
6. Congestion management at the DSO level (let‘s see if we get here)
7. Conclusions

Background

- We organized 2 Workshops on the topics TSO-DSO-PX interactions (part of FPM series: www.diw.de/fpm)
  - Stakeholders from TSOs, DSOs, regulators, market participants and researchers
  - Chatham house rules
- Here: short summary of the summary of the workshop reports
  - Workshop reports not a verbatim protocol
  - But rather our own analysis after the discussion with stakeholders

Changing environment for TSOs and DSOs

1. Increasing electricity demand (Dena: ~+40 to +100%)
2. Increasing share of generation connected to the distribution grid
   - Most PV, large share of wind
   - Due to low capacity factor → multiplication of generation capacity
3. Previously uncorrelated demand patterns from individual households and firms exhibit increasing correlation (EVs, electric heating. Esp. with RTP)
4. Demand connected to distribution grid can provide increasing share of flexibility

Challenges & Constraints

- Coordination of TSO and DSO request of flexibility
  - If competing: how to allocate resource
  - If aligned: how to allocate costs
- Locational information on available flexibility
  - Aggregation vs localisation?
- Liquidity and local market power
  - Reduce
  - Mitigate
- Centralisation vs Decentralisation
  - Computationally (AC-> non-linear), governance & cyber-security
- DSO ownership of flexibility resources

Coordination options

I. Static prequalification (Centralized AS Market Model)
II. Cascade market model (Local AS Market Model)
III. Shared balancing responsibility models
IV. Vertical market coupling (Common TSO-DSO AS market model)
V. Procurement (Joint or Decentralized) Coordinated by a Third Independent Party
VI. Fully integrated market clearing

Market designs from Gerard et. al. (2018) (SmartNet), Ecoyfys & Fraunhofer IWES (2017) (Agora) and by Energy Networks Association (2017)

Coordination options

I. Static prequalification (Centralized AS Market Model)
- TSO manage AS markets. Static pre-qualification by DSOs
- Closest to current market design
- Pre-qualification → Cautionary principle → Limited flexibility

II. Cascade market model (Local AS Market Model)
- Waterfall principle: DSOs select flexibility first (or checks feasibility), than passes on TSO
- Resources at D-Level procured & activated by DSOs
- TSO only procure T-level resources, ask DSOs to activate
- → potentially over-procurement as DSOs incentivised to retain reserves for own operation

Also called “DSO Coordinates”-Model, Energy Networks Association (2017)

III. Shared balancing responsibility model

- a centralized market operated by TSOs and a local market managed by DSOs, coordinated through pre-defined TSO-DSO schedules and managed separately at real-time
- DSOs responsible for balancing in their net
- →In contrast to EU regulation & goals: Balancing is usually seen as system wide property & domain of TSOs

Coordination options

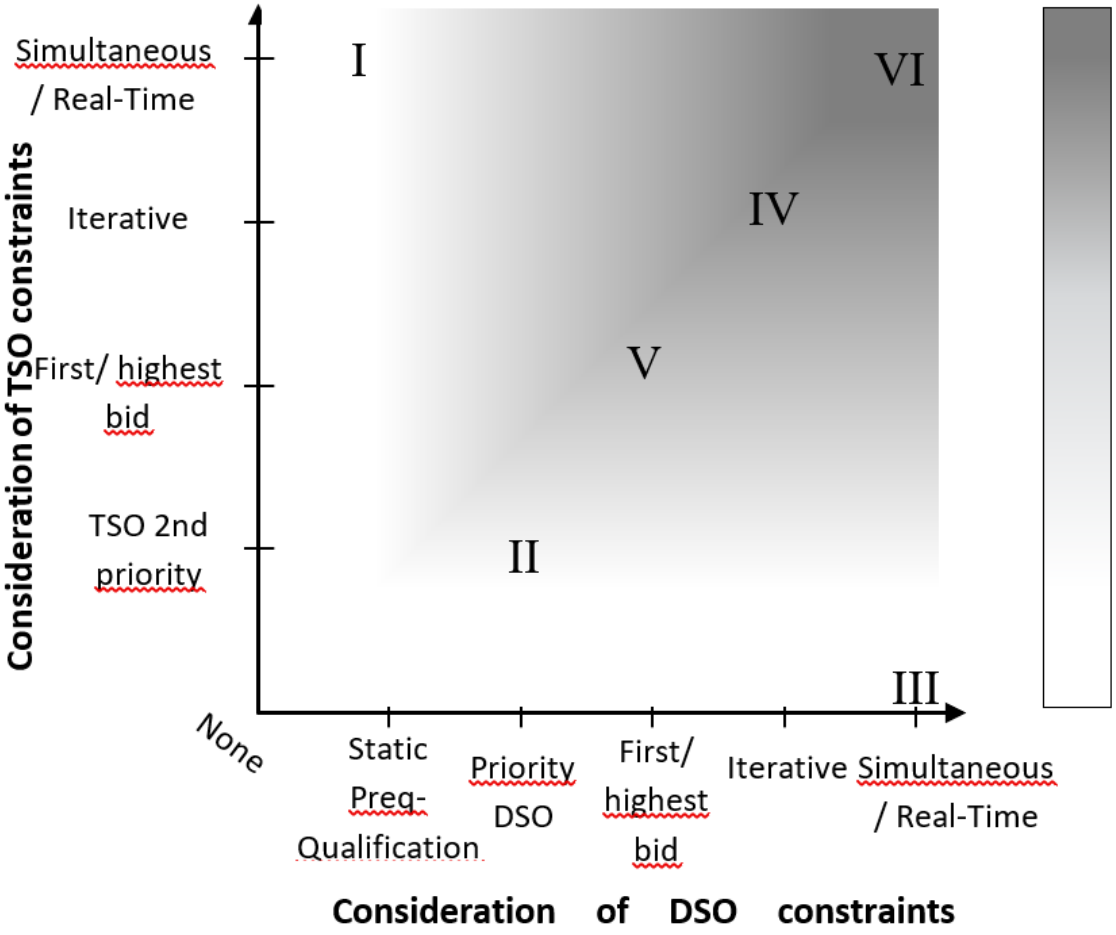
V. Procurement (Joint or Decentralized) Coordinated by a Third Independent Party / IntradayPlus

- (Continuous) intraday market enriched by locational information
- DSOs and TSOs in competition with other market participants
- If continuous mechanism → highest bidder first → not a reserve

IV / VI Vertical market coupling (Common TSO-DSO AS market model) / Fully integrated market clearing

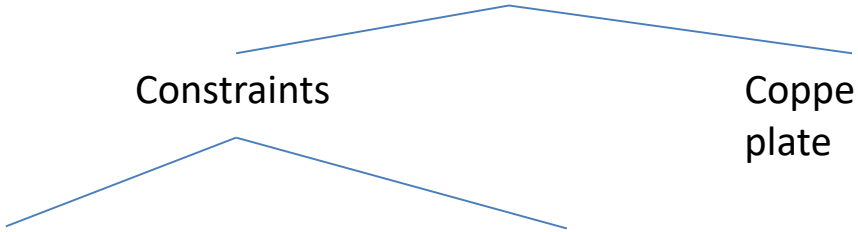
- Common procurement and activation in the same market place
- Differing levels of scope: energy, reserves & congestion management co-optimised in the same algorithm
- Differing levels of integration: iterative algorithms to fully decentralised solutions (e.g. Caramanis et al., 2016)

Comparison of coordination options



Excursion: Local congestion management

Physical situation at DSO level



Include congestion in clearing price (long-term perspective)

Local bids in local market

- Standardisation to facilitate clearing
- Unit based bidding
- Can be used for multiple services

Motivation:

- High efficiency for operation
- Correct incentives for investment

Pretended copper plate with resolution of constraint violations

- Non-firm access for EV and other new sources of demand (regulated quota)
- (Compensated) spill of wind
- Auction for long-term services
- Local bids for flexibility (e.g. via a local platform which is vertically coupled to the TSO)

Local congestion management: market power

- Linking several markets (one multi-part bid used for several markets over several time frames, can mitigate market power misuse)
- Automated market monitoring schemes (multi-part bidding can be helpful)
- Regulated price caps could be introduced in local markets (e.g. defined by wind spill costs)
- Local bids could be combined with long-term auctions for flexibility provision.

Why move to locational prices as coordination mechanism?

- Many participants, opportunity costs and heterogenuous preferences abound → markets as the natural coordination mechanism
- Allow coordination and valuation over different (but potentially co-optimised) sub-markets
- Can be the underlying for futures products → hedging and investment decisions

- But they need to reflect the same underlying physical reality (Zonal TSO market and locational DSO market leads to the inc-dec game)

Conclusions

- Higher level of TSO-DSO-PX coordination will be needed
- The more information is available and used for coordination in real-time the higher system security and efficiency
- Priority access for either SO risks inefficiencies via over-procurement and counter-activations

Vielen Dank für Ihre Aufmerksamkeit.

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Redaktion

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