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Flow-based market coupling: Stepping stone towards nodal pricing?

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Outline

- Introduction
- FBMC advantages w.r.t. ATC/NTC
- FBMC disadvantages w.r.t. nodal pricing
- Nodal pricing advantages
- Nodal pricing (potential) disadvantages
- Conclusions

Introduction

Background

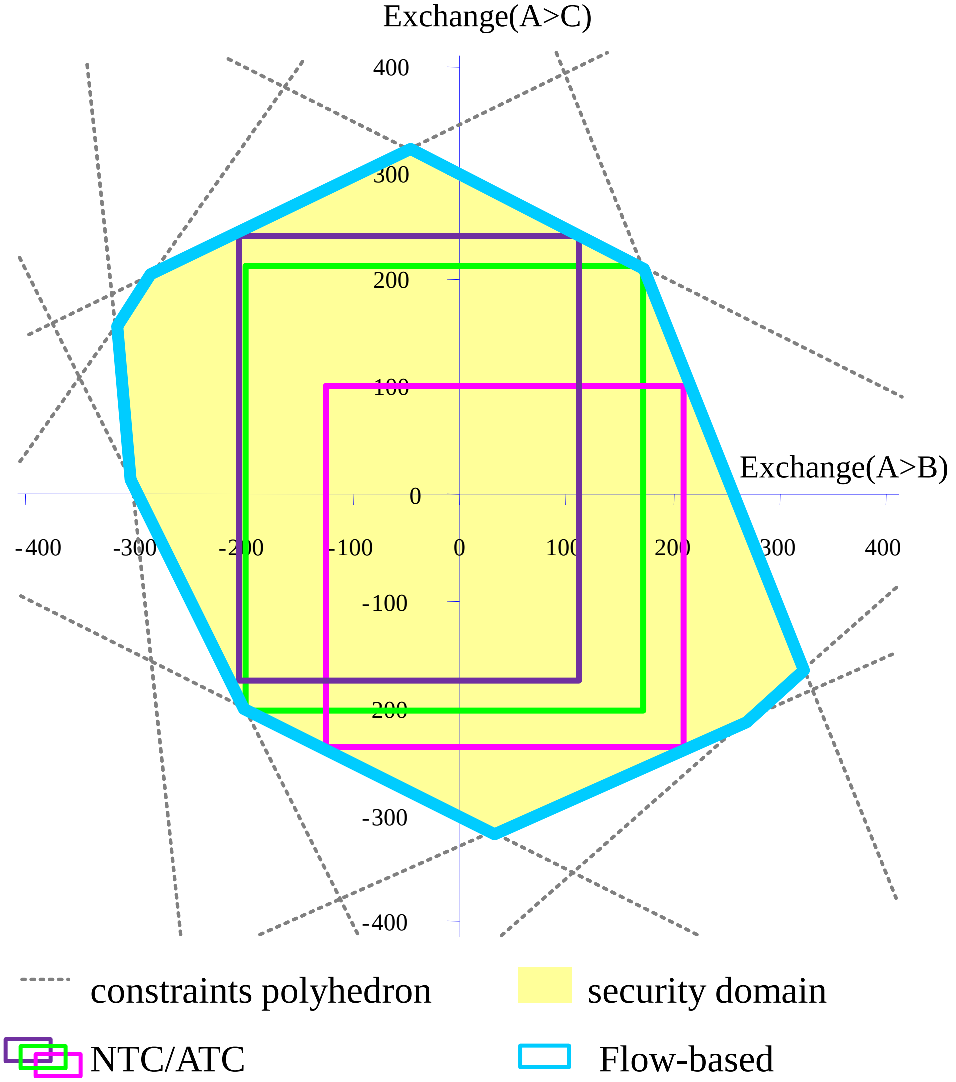
- EC Competition Energy Sector Inquiry (2007): main causes for the lack of competition across EU electricity markets include inefficient use of existing network capacity
- Congestion management important given barriers for network reinforcements

Starting point of analysis:

- Maximise social welfare
- Trade-off between efficiency/social welfare and equity is left to politicians (EU and national)

FBMC advantages over NTC/ATC method

- More efficient network utilization due to simultaneous network capacity calculation and allocation
- Higher security of supply due to explicit instead of implicit consideration of parallel flows
- More transparency on network constraints



Source: CWE MC Flow-Based Forum July 2011

FBMC disadvantages w.r.t. nodal pricing

Important hurdles for efficient congestion management remain:

1. Discrimination of intra-zonal transactions compared to inter-zonal transactions
2. Increasing intra-zonal congestion costs
3. Lengthy and time-intensive renegotiations of periodic zone adjustments
4. Incomplete network representation limits trading capacity

1. Implicit priority for intra-zonal transactions to inter-zonal transactions (1)

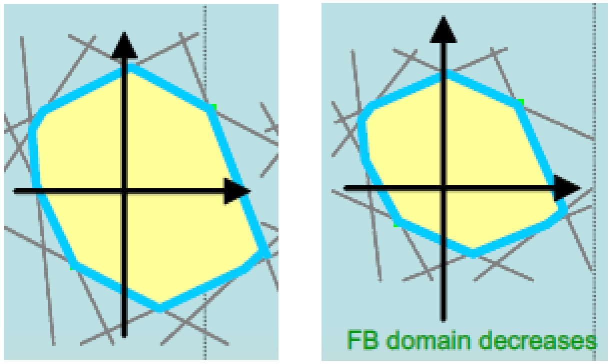
- Power Transfer Distribution Functions (PTDFs) are determined for all critical branches
- NE = net export position for each bidding area (positive = export, negative = import)
- RAM = remaining available margin for day-ahead flows
- For each time step, for each critical branch PTDF * NE needs to be smaller than or equal to RAM

$$\begin{bmatrix} \\ PTDF \\ matrix \\ \\ \end{bmatrix} \cdot \begin{bmatrix} NE_{BE} \\ NE_{DE} \\ NE_{FR} \\ NE_{NL} \end{bmatrix} \leq \begin{bmatrix} RAM_1 \\ RAM_2 \\ \vdots \\ RAM_p \end{bmatrix}$$

Source: CWE Enhanced FBMC feasibility report

1. Implicit priority for intra-zonal transactions to inter-zonal transactions (2)

- Critical branches include intra-zonal lines that are critical to cross-border exchanges
- Net position limited to XB connections → All intra-zonal transactions are both not priced and allowed as long as no intra-zonal congestion occurs
- Intra-zonal transactions can reduce size of the security of supply domain (=FB domain) through PTDFs



Source figures: CWE Enhanced FBMC feasibility report

- Inter-zonal transactions with lowest contribution to social welfare are deleted by optimization algorithm when congestion occurs

→ Intra-zonal transactions are preferred to inter-zonal transactions

2. Increasing intra-zonal congestion costs (1)

- Deployment of less efficient intra-zonal congestion management market clearing methods like redispatching and countertrading
- Disadvantages of methods based upon redispatching and countertrading
  - Usually socialisation of costs to consumers i.e. no incentive for producers to take into account their contribution to congestion costs in production decisions

    → Gaming ("inc-dec" game) possible
  - Reservation of flexibility (power generation and demand response) for congestion management beforehand → flexibility not available for wholesale market (even when more efficient)

2. Increasing intra-zonal congestion costs (2)

- "Intermediate, zonal representations are able to solve part of the congestion management issue, but typically then focus market participants on exploiting intra-zonal congestion …", Baldick et al.

ERCOT

Year	2006	2007	2008	2009
Intra-zonal congestion costs	$190m	$169m	$191m	$179m
Inter-zonal congestion rent	$60m	$60m	$400m	$130m

California

Year	2006	2007	2008
Intra-zonal congestion costs	$207m	$96m	$174m
Inter-zonal congestion rent	$56m	$85m	$176m

Source: Baldick et al. (2011), Optimal Charging Arrangements for Energy Transmission: Final Report

- ERCOT and California zonal markets before introduction of nodal pricing showed intra-zonal congestion costs which are often higher than inter-zonal congestion rent
- Note that congestion rents i.e. difference between total market cost and generation costs are typically (much) higher than congestion costs i.e. additional fuel cost for redispatching

3. Lengthy and time-intensive renegotiations of periodic zone adjustments (1)

- Bidding zones need to reflect actual congestion pattern to highest extent possible for efficiency reasons

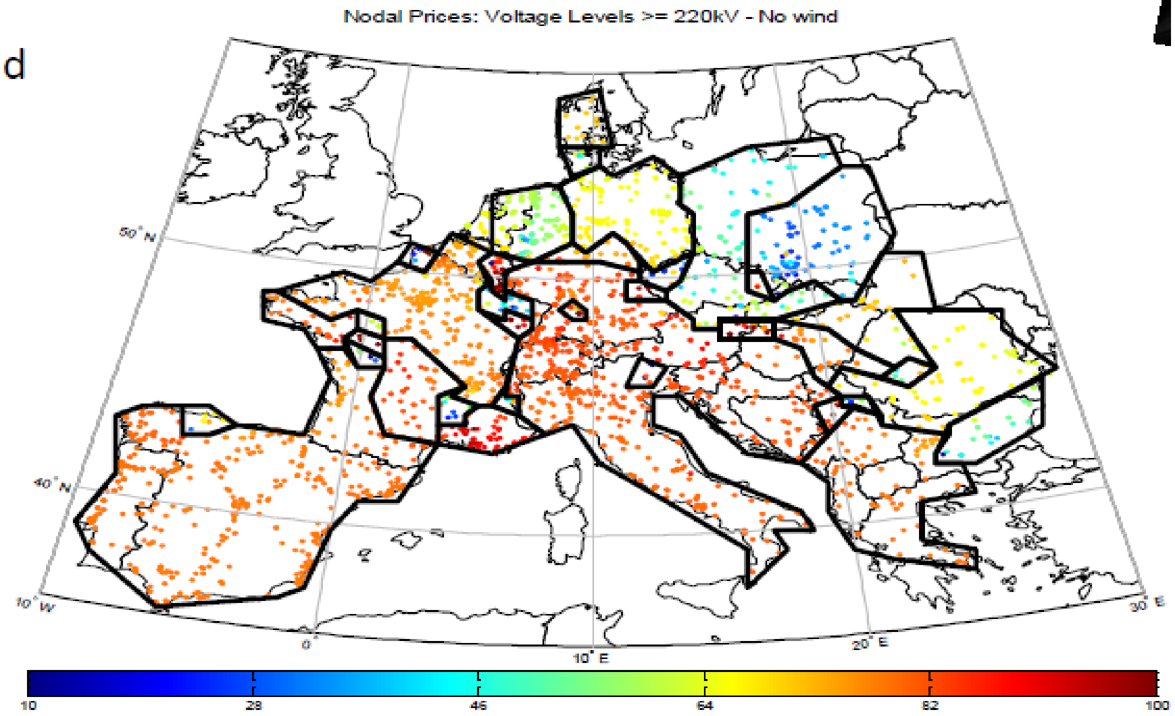
- More frequent changing congestion patterns due to increase of intermittent RES-E

- Adaptation of bidding zones not trivial
  - Large consequences for producers located nearby zone borders

    → Hence, only adaptation foreseen in case of **structural** congestion

Bidding zones in case of no wind

No wind

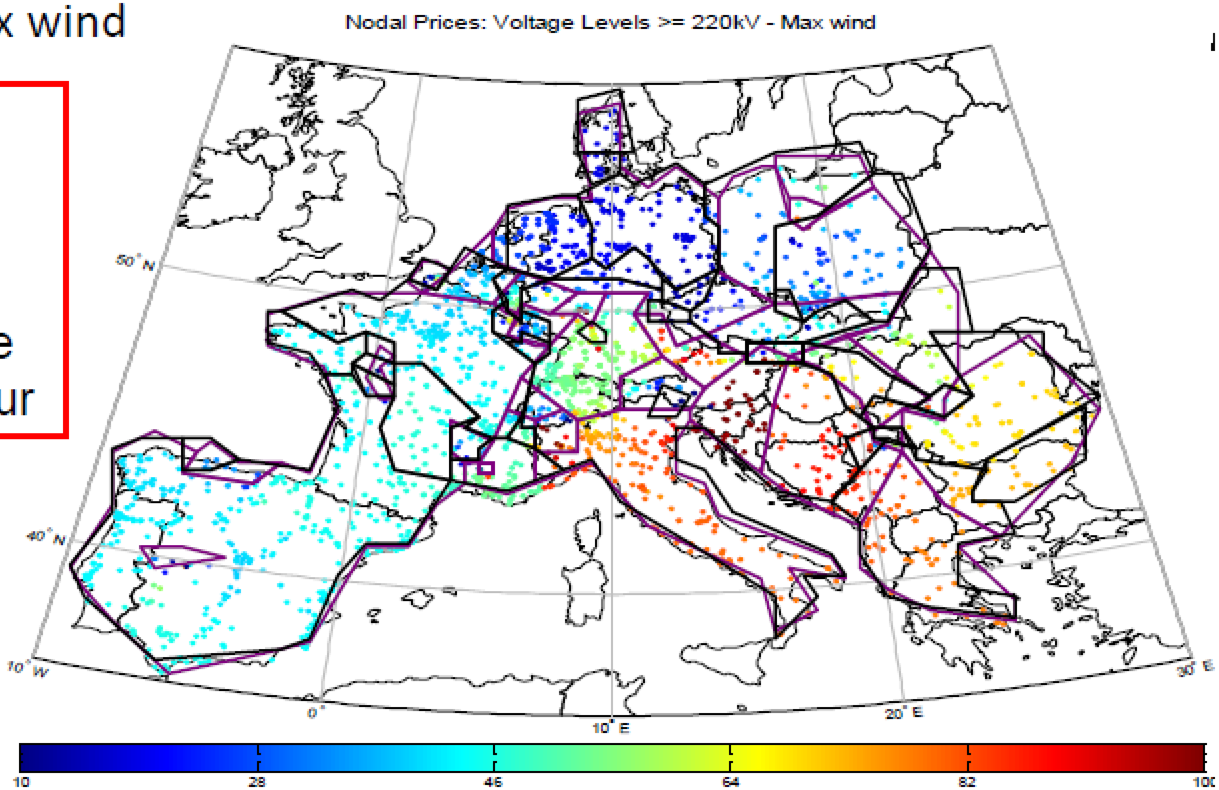


IEE Reshaping project, presentation Neuhoff

Bidding zones in case of max wind

Max wind

Suitable zones in congested network can change hour by hour



IEE Reshaping project, presentation Neuhoff

3. Lengthy and time-intensive renegotiations of periodic zone adjustments (2)

- Definition of structural congestion in Article 2 of draft ENTSO-E CACM network code: congestion in the grid that a.o.
  - is stable over time, i.e. does not change its geographic position in the network under short term influences; and
  - is frequently reoccurring under common circumstances
- Article 35: biennial evaluation of bidding zone delineation foreseen

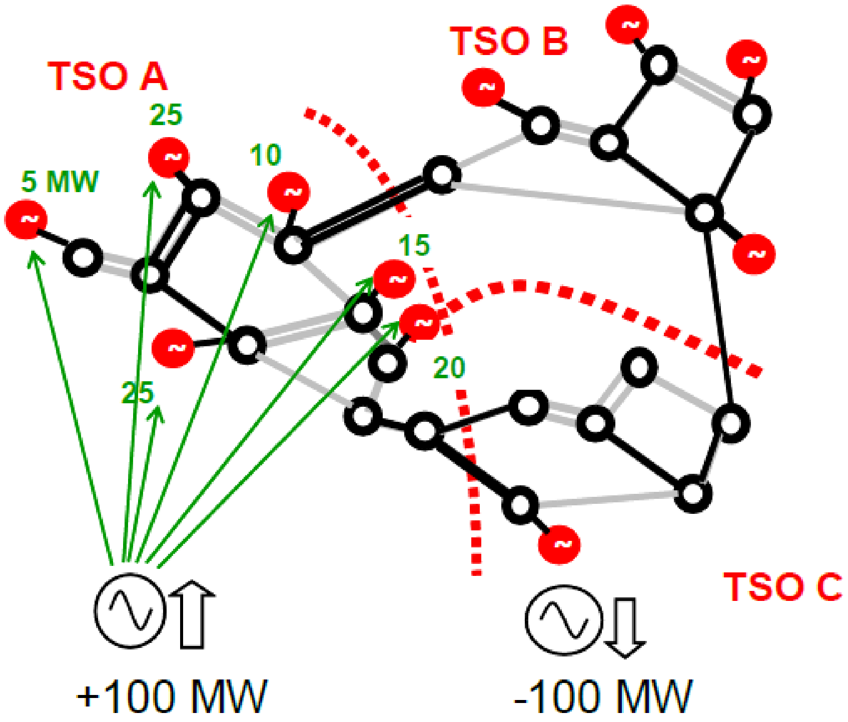
- EU&US lessons: long, time-consuming legal procedures to prevent adaptations of bidding zones; Svenska Kraftnat case, Miguel constraint
- Several US markets switched from zonal to nodal pricing (PJM, ERCOT, CAISO)

→ Very unlikely that bidding zone delineation can follow actual congestion patterns in time in Europe

4. Incomplete network representation limits trading capacity

- PTDFs dependent on production forecasts
- PTDFs zonal wide instead of nodal

  → Generation Shift Keys (GSKs) for identification of impacts on critical branches
- GSKs ex-ante should match with GSKs based upon market clearing results
- Differences between both sets of GSKs due to changes in generation or demand restrict trading capacity



Source: CWE Enhanced FBMC feasibility report

Nodal pricing as alternative – advantages

- Nodal pricing: bids to buy and sell power are matched for each node in the network for each time interval, taking into account network constraints and losses
  → locational marginal price = cost of energy + cost of delivery

- Considered as first-best solution from market efficiency point of view

- Nodal pricing advantages compared to zonal pricing:
  - No discrimination of inter-zonal and intra-zonal transactions
  - More efficient treatment of intra-zonal congestion
  - Higher network granularity renders periodic zone adjustments redundant
  - Better network representation increases trading capacity

Potential disadvantages (1) - Market design issues including market liquidity

a. Nodal pricing more prone to market power than zonal pricing? Latter shifts market power within zones to congestion management

b. Higher liquidity risk of nodes compared to zones/hubs
   - Market places seem liquid however
   - Financial transmission rights (FTRs) allow for hedging of locational price differences

c. Less possibilities for self-dispatch of generators with nodal pricing? Fixed schedule bids possible with adjustment bids for price arbitrage

d. Nodal pricing requires more centralised market clearing governance solution compared to market coupling
   → less autonomy for national TSOs and PXs likely

Potential disadvantages (2) - Distributional effects

- Higher price variability with nodal pricing
  → more distributive effects compared to zonal pricing
- Price variability within countries lowers political feasibility (e.g. Germany)
- Lower prices for generation located further from load centres and/or producing at times of low demand
  → Especially disadvantageous for intermittent generation such as wind, although consistent with lower socio-economic value of wind power

- FTR allocation can be used to compensate existing producers which are negatively effected by introduction of nodal pricing

Conclusions (1)

- FBMC advantages compared to NTC method:
  - More efficient network utilization
  - Higher security of supply due to explicit instead of implicit consideration of parallel flows
  - More transparency on network constraints

- FBMC disadvantages compared to nodal pricing:
  - Discrimination of intra-zonal transactions compared to inter-zonal transactions
  - Increasing intra-zonal congestion costs
  - Lengthy and time-intensive renegotiations of periodic zone adjustments
  - Incomplete network representation induces lower trading capacity

→ FBMC is important step but important hurdles for efficient congestion management in decarbonised power system remain

Conclusions (2)

- Nodal pricing advantages compared to zonal pricing:
  - Equal level playing field for inter-zonal and intra-zonal transactions
  - Lower average energy prices due to more efficient CM within zones
  - No policy interventions required for zone adjustments
  - Better network representation increases trading capacity

- Nodal pricing disadvantages:
  - Despite FTRs market participants face probably higher liquidity risk
  - Nodal pricing requires more centralised market clearing governance solution
  - Stronger distributional effects require more mitigation measures at start

→ Clear advantages of nodal pricing warrant further development of FBMC towards nodal pricing

Thank you for your attention!

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