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How does market coupling work in case of system stress?

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* with grateful reference to the study done by the Belgian regulator CREG

Where did Europe get to in 2014?

- In 2014 the mechanism of ATC market coupling was implemented in a large part of Europe
- In September the foreseen implementation of FB market coupling was postponed by TSOs for reasons linked to additional risk during this winter period in Belgium where generation shortage situations are expected.

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 This presentation will try to explain what those risks are and how they are related to Flowbased

What's the objective of Flow based?

- a way to better use the transmission network by taking into account the impact of trade on physical flows having to comply with operational security limitations
- The FB under implementation is based on a model of the electrical system
 - model made of zones and critical branches
- The impact of a trade can be assessed on the basis of locational information on its origin and destination – "the PTDF"



What are the key principles?

- Kirchoff: An exchange of electricity between a source and a sink takes all possible paths, with a preference for the shortest ones
- The "PTDF" express the share of a given exchange going through a particular path





"One congestion for all countries"

 A trade from D to F in competition with a trade from B to F for the use of the congested line h



With implicit auction, this leads to the following relation between prices P in the 3 different zones:

 $\frac{P(F) - P(D)}{PTDF} = \frac{P(F) - P(B)}{PTDF}_{B \Rightarrow Fonh}$



PTDF determines electricity prices but what determines PTDF's?

- PTDFs depend on the FB model through:
 - Transmission network characteristics
 - Critical Branches selection
 - Zone delimitation
 - Generation Shift Keys
 - Thus the quality of the FB model may
 - have strong effects on the conditions of competition between producers (and consumers) located in different zones
 - induce market distortion and difficultly acceptable distributive effects if not based on the physical reality



How does flow based handle Security of Supply?

• In case of:

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- Generation shortage in Belgium,
- France faces a cold wave
- The Netherlands has the export capabilities
- The interconnection between the Netherlands and Belgium is congested
- Prices vs PTDF relation:

 $\frac{P(F) - P(Nl)}{PTDF_{Nl =>FonCB}} = \frac{P(B) - P(Nl)}{PTDF_{Nl =>BonCB}}$



How does flow based handle Security of Supply?

- PTDFs NI-B/NI-F ratios for a congestion on the NI-B border vary between 1,18 to 2,14, with 1,58 as weighted average
- So, if French market players bid above 1900 € and as Belgian market players cannot offer more than 3000€,

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 Requests for imports for France will have full priority on imports for Belgium



How does flow based handle Security of Supply?





Conclusions

 In case of congestion, bid/ask selection and electricity prices are dependent of their level and their location/distance relative to the congested network element through PTDF zone to zone on the congested network element



- The further from the congested network element*, the lower the PTDFs zone to zone, the higher the allocated volume and the more competitive the price
- PTDF zone to zone are an artificial construction depending of the characteristics of the transmission network, of the model of the transmission system and in particular the zone delimitation, of CB selection and of GSKs**
- The larger the zone, and other things equal, the lower the PTDF zone to zone
- * Critical branches inside a country may also have very low PTDF involving that country
- ** The larger the zone, the more the FB model relies on a "linearization" of the electrical system around "normal" conditions

Conclusions

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- FB: electricity prices depend on bid price and on "electrical" distance to congested network element(s)
- The quality of the FB model to represent reality could negatively affect the level playing field between unequal sized zones in congested situations

FB could worsen security of supply in small countries when competing with large countries

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Backup slides



Zonal influence on PTDFs?

- Evolution of the value of the PTDF on the black line in function of the delimitation of the North zone
- Autoriteit Consument & Markt
- All other things are supposed to be unchanged (network characteristics, topology and GSKs)
- Remember: the lower the PTDF, the better!
- Lower PTDFs, but the same usage in MW of the transmission line!



 Main impacts of a better (same granularity) locational information on security of supply issues:



- Direct impact on PTDFs leading to bilateral PTDF of approximately the same value (ratio close to one) improving distributive effects and reduced artificial price competitive advantage
- Reduction of the "all of nothing" behaviour

Granularity of the locational information: 4 & 12 areas



 Example used for illustrating the impact of locational information on security of supply with FB: FB engine applied

- 4 areas = country
- B and F competing for energy in scarcity conditions from NI and D at 50€
- Congestion XB B-NI
- FB animation increases ask price in F against 3000 € in B:
 - No generation activated in NI, as PTDF on the congested network element is too high compared to exports from D
 - At a level above 1216 € (see formula slide), all generation from D is going to F
- "All or nothing" behaviour



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	Equal generation bids price in D and NI: 50€ Equal ask price in F \$6000 € € FB animation increases F ask price: against 3000 € in B Generation in NI above 3000€ More volume: +289 MW Even at 3000€ in F, still import for B Gradual B imports reduction in function of network characteristics	-1 29 MW MW	+ 1 38 MW	+88 MW
		-38 MW	=1 ∄ ऌ MW	+260 MW
		- 3 4 MW	-38 MW	-93 MW

Consumen

- More accurate locational information:
 - Reduces the all or nothing behaviour: still import possibilities for countries bidding at 3000€
 - Increases volumes in all areas leading to more competition

