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Internal Discussion Note

CHARACTERISTICS OF CONGESTION MANAGEMENT METHODS

Background

In the congestion management guidelines agreed by the Florence Forum and inserted as an Annex to the draft regulation it is stated that:

> Network congestion problems should be addressed with market based solutions. More specifically, congestion management solutions are preferred which give appropriate price signals to the market parties and the TSOs involved.
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> Network congestion problems should preferentially be solved with non-transaction based methods, i.e. methods that do not involve a selection between the contracts of individual market parties.
>
> The system of market splitting, as used in the Nordpool area, is the congestion management procedure that meets this requirement.

This note, using a very simplified example, seeks to examine the effects of different capacity allocation mechanisms and their impact on the market price of electricity in connected countries.

A key concept used in the note is that of "economic rent or surplus". An interconnector between two countries allows the exploitation of price differences between two countries through arbitrage. This gives the potential for gaining "economic rents". The main differences between the different congestion management mechanisms relate to the distribution of these "economic rents".

Assumptions

There are two countries: A and B and both have demand of 1000MW

Country A has three generating stations with the following characteristics:

	capacity	unit price/MWh[1]
Aa.	400	25
Ab.	400	30
Ac.	500	40

The price prevailing in country A is therefore €40/MWh since this is the price required to bring 1000MW of generation to supply to the market

Country B also has three generating plants

	capacity	unit price/MWh
Ba.	700	30
Bb.	200	45
Bc.	200	50

This leads to a price of €50/MWh in market B.

Currently Country A, has a surplus available of 300MW at a price of €40/ MWh. This could be used to reduce prices in Country B. However let us suppose that capacity of only 150MW is available in the interconnector.

There are various ways of dealing with the issue of scarce capacity:

- explicit auctions (used in many MS)
- implicit auctions
- market splitting. (used in Nordel between MS and within Norway)
- redispatching
- counter trading (to be used within UK, post NETA)

Explicit Auctions

The difference in price between the two countries corresponds to the "economic rent" available from the use of the interconnector i.e. €10/MWh.

Currently there is 300MW of spare capacity in Country A. However **ALL** the generators in country A will be keen to bid for access to the Country B market since they will get up to €50/MWh instead of €40/MWh.

The most likely outcome, therefore, is that capacity in the interconnector is bid up to a price close to €10/MWh Generator Ac would probably be prepared to bid the highest

[1] For simplicity it is assumed that marginal cost equals unit cost. This is, of course, not likely in practice.

amount as it has unused capacity (say €9/MWh). They will then offer electricity into Country B at €49/MWh, and the generation set in Country B becomes:

	capacity	unit price/MWh
Ba.	700	30
Bb.	200	45
Ac.	150	49
Bc.	200	50

Following the use of the interconnector, the price in Country 2 will fall but only to €49/MWh.

Features of explicit auctions

The example above depicts a simple, winner takes all auction. Other auction design possibilities are available which might lead to different, for example:

- restrictions can be placed on the proportion of capacity held by each generator,
- prices for capacity could be determined by the lowest bid instead of generators paying "prices as bid".

However auctions do have some common features

i. Auctions can be prone to gaming. Some generators may not require interconnector capacity at all but still try to bid up the price to damage their competitors. This is particularly true if the exporting country has spare capacity and marginal costs are low (see Annex).

ii. Depending on the design of the auction, the economic rents available will tend to be collected by TSOs as a result of the auction. If these are split evenly between the two connected countries to reduce network charges then the difference in final electricity prices will probably not be significantly eroded

iii. Auctions require two separate transactions for potential exporters which may also be a disincentive.

iv. Auctions do not require a common balancing mechanism in the two countries, whereas alternatives do require significant harmonisation of balancing rules.

vi. TSO rents can be used for expansion but the amounts collected are unlikely to give a clear signal of the optimal amount of capacity increase.

Market Splitting/ Implicit Auctions

Under this system the TSO fixes the price for using the interconnector on the basis of a comparison of electricity prices offered by the generators. Each generator in both countries nominates an amount it wishes to supply into the combined A&B market

and the lowest price it is willing to offer electricity into the market. The bids would be as follows:

	capacity	unit price/MWh
Aa.	400	25
Ab.	400	30
Ba.	700	30
Ac.	500	40
Bb.	200	45
Bc.	200	50

The TSO then calculates the system price that would prevail under unlimited interconnector capacity. This would be €40/MWh since at that price the required 2000MW is available.

However this implies export of 300MW from Country A and there is insufficient capacity. The TSO then recalculates the price in each market taking into account the connectors and its constraints. In Country A, with exports, demand is now 1150MW, however given the generation set

	capacity	unit price/MWh
Aa.	400	25
Ab.	400	30
Ac.	500	40

this has no effect on the price, which stays at €40MWh

For country B, demand is still calculated at 1000MW but the imported generation amount is added to the generation set as follows:

	capacity	unit price/MWh
Ba.	700	30
Ac.	150	40
Bb.	200	45
Bc.	200	50

The price in Country B would then fall to €45/MWh as Bb becomes the marginal producer. Generator Bc would no longer be required.

The TSO would receive a rent equal to €5 on each unit of electricity transmitted through the connector. This is because whatever the price in Country B, generators only receives the system price of €40/MWh. This means the TSO buys at electricity in Country A at €40 and sells into Country B for €45.

Implicit Auction

An implicit auction is similar to market splitting. With this method, the TSO levies a surcharge on the prices offered by generators in Country A who wish to sell in Country B such that enough of these bids are priced out of the market.

Provided that the TSO knows the details of all prices offered they can calculate exactly the required surcharge. In the example, the appropriate surcharge is something a little over €5. This would relegate generator Ac behind Bb in the Country B market and give the following outcomes.

Country A

	capacity	unit price/MWh
Aa.	250	25
Ab.	400	30
Ac.	350	40

Country B

Aa.	150	30
Ba.	700	30
Bb.	150	45

Markets are split in the same way, however the successful exporter is now the lowest cost company in Country A rather than the marginal producer. As with market splitting Aa receives the system price of €40/MWh with the TSO gaining €5/MWh as economic rent.

Features of market splitting and implicit auctions

i. Market splitting and implicit auctions are much less prone to gaming since the generators are not bidding for economic rents from higher prices in one market but simply to sell at a common system price.

ii. The economic rents will be shared between customers in the high cost country and TSOs under market splitting. Final electricity prices will be closer together than for explicit auctions. No economic rents are available to generators.

iii. These mechanisms do not require two separate transactions by exporters but they do require a common balancing mechanism in both countries.

iv. TSO rents can be used for expansion but, as with explicit auctions, the amounts collected are unlikely to give a clear signal of the optimal amount of capacity increase.

Redispatching and counter trading

As with market splitting, the first step is for generators in both countries to nominate an amount it wishes to supply into the combined A&B market and the lowest price it is willing to offer. The bids would be as follows:

	capacity	unit price/MWh
Aa.	400	25
Ab.	400	30
Ba.	700	40
Ac.	500	40
Bb.	200	45
Bc.	200	50

The TSO then calculates the unconstrained system price, which would be €40/MWh since at that price the required 2000MW is available.

Counter trading

In this mechanism, the TSO must buy and sell electricity to balance demand in each country. Thus in market B, the TSO needs to buy in 150MW of capacity. The lowest price that capacity will be available is from Bb at a cost of €45/MWh. In Country A the TSO will need to sell back 150MW to generators, the highest price offered will be €40 by generator Ac. The resulting output in the two countries will be as follows:

Country A

	capacity	unit price/MWh
Aa.	400	25
Ab.	400	30
Ac.	200	40

Country B

Ba.	700	30
Ac.	150	40
Bb.	150	45

In this approach there is no market splitting and the system price of €40/MWh applies to all generation in both zones. However the TSO will suffer a cost of €5/MWH for each transaction that is constrained.

Redispatching

Under re-dispatching, there are no bids but the TSOs must then assess the extent to which the nominations of generators are in excess of the available capacity and decide, on some basis, which generators would be constrained.

Often redispatching has been carried out depending on the nature of the terms under which generators had access to the constrained part of the network. In particular some generators had non-firm access and would be constrained off first. Other generators with firm access were entitled to compensation if their output was not transported and constraints on these would be avoided by the TSO.

Such arrangements are now considered to be discriminatory and re-dispatching would normally be expected to be based on economic precedence. This requires some

knowledge of the cost structure of each generator's output. Given that the TSO is likely to be reliant on generators for this information, such an approach to re-dispatching becomes almost identical to counter trading.

For both counter trading and redispatching the TSO has a cost rather than an income from this type of arrangement with the amount depending on the nature of the connection agreements with generators.

Features of Counter Trading and Redispatching

i. Under counter trading all economic rents are passed to customers in the high cost country. Instead of collecting rents, the TSO suffers costs as a result of the constraint. This gives a clear economic signal to the TSO about the seriousness of the constraint. High constraint costs are a signal to upgrade the network

ii. Counter trading removes the difference in final electricity prices in the two regions. If TSOs recover the constraint costs evenly from system users, the system price that emerges is likely to be between the two prices under market splitting.

iii. Counter trading requires a common balancing mechanism in both countries, whereas, in theory redispatching merely requires knowledge of generator's costs. However, in practice there is little difference between counter trading and re-dispatching on the basis of economic precedence.

v. These mechanisms provide no funds to the TSO to upgrade the network.

vi. If re-dispatching is not based on economic precedence the access terms granted to different generators will determine the distribution of rents. If some generators have firm access they will tend to collect all the economic rent arising from cost differences between the two countries and there will be less price equalisation.

Conclusions: Overall Assessment

All of the mechanisms have the potential to improve the allocation of generation resources. However the outcome in terms of price differences between different countries, and the allocation of rents between different market players gives varying signals to market players and this will affect the dynamic performance of the market, in terms of pressures on market players to become more efficient.

Price signals to generators

A single system price gives the clearest price signal to generators as to whether their facilities are economic or not at the level of the combined market. Different prices in different markets enables inefficient plant to continue.

- Counter trading/redispatching (economic precedence) is likely to give the clearest signal in this regard.

- Market splitting/implicit auctions is the next most preferred mechanism

- Explicit auctions, which may be manipulated by market actors, or redispatch mechanisms based on different conditions of access are less likely to deliver more uniform electricity prices. This is particularly relevant in the European context since the greater excess capacity exists, the more tendency exists in explicit auctions to drive price for interconnector capacity to high levels.

Price signals to TSOs concerning upgrading

Both counter-trading and market splitting provide a clear signal on the extent that capacity is not sufficient. With market splitting, this is in terms of the differences in price prevailing between countries. For counter trading the costs directly incurred by TSOs in balancing the markets will be a clear indicator of the cost of constraints.

Under auctioning large price differences may persist as long as capacity is insufficient, then as enough capacity is made available the price of capacity and the differences between countries will fall abruptly to zero. There is clear signal about the extent to which capacity is inadequate.

EXPLICIT AUCTIONS WITH LOW MARGINAL COSTS

Assumptions

There are two countries: A and B and both have demand of 1000MW

Country A has three generating stations with the following characteristics:

	capacity	unit cost/MWh	fixed	variable
Aa.	400	25	15	10
Ab.	400	30	15	15
Ac.	500	40	30	10

Without interconnection, the price prevailing in country A is still €40/MWh since this is the price required to bring 1000MW of generation to supply to the market.

Country B also has three generating plants

	capacity	unit price/MWh	fixed	variable
Ba.	700	30	15	15
Bb.	200	45	20	25
Bc.	200	50	30	20

This leads to a price of €50/MWh in market B.

Currently Country A, has a surplus available of 300MW at a price of €40/ MWh. This could be used to reduce prices in Country B. However let us suppose that capacity of only 150MW is available in the interconnector.

Under explicit auctioning the "rent" now available from using the interconnector is much higher, particularly for a generator with spare capacity. Generator Ac might now be prepared to bid €39/MWh since its variable cost is only €10/MWh and a price of €50/MWh is available in Country B. This will still mean that Ac offers electricity into Country B at €49/MWh and the result is the same as in the simple version.