EuroPEX
Association of European Power Exchanges

EuroPEX Position Paper on Cross-Border Congestion Management and Market Coupling

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EuroPEX is a not-for-profit association of European power exchanges that represents the interests of the exchange based wholesale markets for electrical energy with regard to developments of the European regulatory framework for wholesale energy trading and provides a discussion platform on a European level.

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Introduction

1. The creation of a truly competitive Internal Electricity Market (IEM) requires the full integration of the participating national and regional markets. The challenge now is twofold. On the one hand, interconnection capacity should be expanded where it is currently inadequate to support the increasing volume of cross-border commercial transactions fostered by the liberalisation of the European electricity sector. On the other hand, congestion should be managed efficiently in order to minimise distortions and allocate the available capacity to its most valuable uses.

2. Indeed, given the difficulties of building new capacity, efficient congestion management provides the more readily attainable route for reaping the benefits of the IEM. Furthermore, the prices from efficient market-based congestion management solutions provide the right investment signals for the optimal strengthening of the European network.

3. Cross-border congestion management is therefore an essential ingredient in the construction of the IEM. The issue was first addressed at the 3rd meeting of the European Electricity Regulatory (Florence) Forum in May 1999 and has since been discussed at all the subsequent meetings, attracting significant attention, resources and efforts. In 2003 the Commission issued Regulation n. 1228/2003 on conditions for access to the network for cross-border exchanges in electricity.

4. Regulation n. 1228/2003 requires that network congestion problems are addressed with non-discriminatory, market-based and preferably non-transaction based solutions. It calls for netting capacity requirements of power flows in opposite directions over the same interconnector in order to use lines to their maximum capacities. Furthermore, the Regulation requires individual market participants allocated physical capacity to inform the concerned Transmission System Operator (TSO) of any such capacity which they do not intend to use, so that it can be reattributed to the market in an open, transparent and non-discriminatory manner.

5. The requirement for market-based solutions to cross-border congestion management, introduced by Regulation n. 1228/2003, restricts the choice of eligible methods to implicit auctions/market splitting and explicit auctions. The capacity netting

requirement signals the preference for implicit auctions since the current explicit auctions of options do not allow netting.

6. Market splitting and implicit auctions have been successfully used to manage congestion in the Nordic market since 1993. This has helped establish a regional market covering several countries and bid/price areas. It has facilitated the development of strong financial markets providing ready access to risk management tools, while ensuring that the physical system, including all transmission capacity within the region, is used efficiently.

7. Besides the long-standing Nordic experience, at the time Regulation n. 1228/2003 came into force, (unilateral) implicit auctions had already been in use for many years to manage cross-border congestion on all Spanish borders[1]. Subsequently, a similar mechanism was introduced to manage congestion on part of the interconnection capacity along the Italian borders.

8. In the meanwhile, work on widely implementable congestion management solutions based on implicit auctions, which started long before Regulation n. 1228/2003 was issued, came to fruition. At the 11th meeting of the Florence Forum in September 2004, as the Commission presented a first draft of the Congestion Management Guidelines, **EuroPEX and ETSO jointly proposed the Flow-Based Market Coupling (FMC) concept**. This concept combines:

   i. network modelling based on physical power flows, to maximise the cross-border transmission capacity that can be made available without compromising system security; and

   ii. the "coupling" of separate, organised day-ahead markets to manage the congestion between their respective control areas through a decentralised, implicit auction-like procedure jointly managed by Power Exchanges (PXs) and TSOs.

   Additional features of the FMC concept included the possibility for market participants to submit price-difference (firm[2] capacity) bids.

[1] In fact, unilateral implicit auctions on the Spanish borders were introduced in 1998.

[2] In this context, firmness relates to the commitment of the bidding party, if the bid is accepted, to use the assigned capacity to nominate cross-border power flows.

9. The FMC concept has inspired several iniatives:

   i. The Trilateral Market Coupling (TLC) mechanism has been developed for solving congestion problems between the control areas of France, Belgium and the Netherlands, and it is now in the implementation phase. The mechanism does not currently use a load-flow representation of the network, which could be a forthcoming development.

   ii. In Germany, the Open Market Coupling approach, based on an implicit auction mechanism integrating capacity (price-difference) bids, has been proposed and undergone scrutiny by the German Regulator.

   iii. Other regional schemes based on market splitting or implicit auctions are under development, including the creation of an Iberian electricity market and its coupling with the French market, and the coupling of the Dutch and Nordic markets through the NorNed cable, expected to become operational by 2008. These developments will effectively create a set of "coupled" electricity markets stretching from Portugal to the North Cape[3].

10. Given this background, this document presents EuroPEX's position on congestion management in the IEM and on the related institutional and governance issues.

[3] The detailed harmonisation requirements for the overall coupling arrangements, in particular with respect to TLC and the NorNed connection, are currently being discussed among the involved parties.

Congestion management in the IEM

11. ***Implicit auctions represent the most efficient method for short-term congestion management***. As real time approaches, it becomes increasingly difficult for market participants to coordinate their energy and transmission capacity positions if these are defined on separate markets, as it is the case with explicit auctions. Experience shows that explicit auctions do not guarantee the efficient utilisation of interconnectors, as cross-border capacity may remain under-utilised even when market prices in neighbouring areas diverge; or energy may even flow in the "adverse" direction, from the high-price to the low-price area. By integrating capacity allocation and energy trading, implicit auctions overcome these inefficiencies, provide consistent price signals and ensure that the available transfer capability is fully used, subject to demand.

12. Moreover, implicit auctions, by considering only net flows, automatically net the capacity requirements of energy flows in opposite directions on the same interconnector. The same result cannot be achieved with explicit auctions of optional[4] Physical Transmission Rights (PTRs). At present, all interconnection capacity rights that are issued in Europe have an optional format, and therefore cannot be netted[5].

13. Implicit auctions promote liquidity in the participating spot markets. By allocating the interconnection capacity through spot markets, implicit auctions encourage market participation, especially by those agents who wish to trade electricity across congested borders[6]; and a wider participation increases market liquidity. Moreover, implicit auctions prevent the hoarding of interconnection capacity - which may restrict access to markets across borders - and support liquidity sharing among the participating spot

[4] In this context, optionality relates to the possibility for the holder of the PTR not to use the assigned capacity to nominate cross-border power flows.

[5] Instead, the price-difference bids which are envisaged as a possible, though not essential, feature of the FMC concept involve an obligation to use the assigned capacity and the corresponding rights can therefore be netted.

[6] Even though, in implicit auctions, participants do not have to declare the cross-border nature of their transactions, but effectively nominate the cross-border flows by separately bidding opposite positions on two spot markets.

markets, promoting competition, trustworthy price signals and liquidity, for the benefit of all markets, but more significantly of those which are currently less liquid.

14. Implicit auctions typically operate on day-ahead markets, where they allocate and price interconnection capacity taking advantage of the best available information on fundamental conditions for the following day. As with any short-term allocation and pricing procedure, implicit auctions expose market participants to risks deriving from the variability of the price of interconnection capacity. However, ***in an efficient wholesale electricity market design, the day-ahead electricity market and the implicit auction for the allocation of interconnection capacity should be complemented by other instruments and markets, which provide opportunities for hedging electricity price risk***.

15. Electricity derivatives based on prices in different areas separated by (potential) congestion may be used to provide an adequate hedge for the risk associated with the variability of the price differential between these areas. The use of electricity-based derivatives for hedging price-differential risk depends on the existence of sufficiently liquid markets for these instruments on both sides of the congestion. Hedging opportunities may also be provided by Financial Transmission Rights (FTRs). Regulation and market forces in the different jurisdictions should determine which of these instruments best suits the local requirements.

16. ***EuroPEX believes that an approach based on short-term implicit auctions*** complemented by ***long-term hedging instruments for the price (differential) risk offers the most efficient solution to congestion management in the IEM***. This approach combines the advantages of implicit auctions with the possibility for market participants to hedge their price and price-differential risks effectively.

17. However, on several EU borders compliance with the provisions of Regulation n. 1228/2003 is currently attained through explicit auctions. EuroPEX therefore recognises that, ***at least during a transitory period, congestion management solutions in some jurisdictions may have to be characterised by a combination of short-term implicit auctions and the explicit allocation of long-term PTRs.*** In any case, to preserve the benefits of short-term allocation through implicit auctions (i.e., netting, full utilisation of capacity), the allocated long-term PTRs would have to

include use-it-or-lose-it (UIOLI) or use-it-or-sell-it (UIOSI) provisions[7]. Nomination should then occur before the day-ahead market so that any unused capacity (after netting of nominations) is made available for allocation through the implicit auction. The capacity reserved today for day-ahead explicit auctions should also be made available for implicit auctions.

18. The implementation of implicit auctions can be extended to intra-day markets, provided that these markets are auction-based[8]. If continuous trading is used instead, the cross-border capacity could still be used to couple different markets, but specific allocation mechanisms would have to be defined[9].

19. Finally, implicit auctions can accommodate day-ahead price-difference bids[10].

7 The UIOSI provision is a key enhancement to the UIOLI provision. The UIOSI provision effectively transforms any un-nominated PTR into a corresponding FTR, as it confers the holder the right to receive (if positive), or the obligation to pay (if negative), the difference between the spot prices in the destination and origin areas, as defined by the path and direction of the PTR. UIOSI rights are more flexible than purely physical rights and give the market the ability to transition to purely financial contracts when it is ready to.

8 This is the case, for example, of the unilateral intra-day implicit auctions, which have been operating on all Spanish borders for the last eight years.

9 For example, Elbas, the intra-day continuous trading market operating in the Nordic region, is assigned any remaining capacity on the interconnections between Denmark, Sweden, Finland and Eastern Denmark to Germany (Norway does not participate in the intra-day market) after the day-ahead implicit auction and use this capacity to support cross-border intra-day trading.

10 These are bids for capacity with a firm obligation to use it.

EuroPEX Vision for Congestion Management in the IEM

20. On the basis of the above considerations and the experience gained with the recent developments, ***EuroPEX has defined its "vision" for efficient congestion management within the IEM,*** which could serve as a reference for evolving the current regional solutions towards a EU-wide approach. The model is based on:

    i. ***day-ahead flow-based market coupling*** to manage cross-border congestion, allocate interconnection capacity and define prices for the different areas; and

    ii. ***Financial Transmission Rights*** and/or, ***electricity-based derivatives***, to enable hedging of price risks, including cross-border differentials.

21. Rather than prescribe a uniform design for the market coupling solution, EuroPEX believes that different variants could coexist within a single overall framework. Within this common framework, different areas or clusters of areas could adopt different approaches, reflecting local situations or practical consideration. Over time these arrangements might be expected to evolve and eventually converge, but this is not a prerequisite.

22. An essential feature of the common framework is a central algorithm that computes the cross-border flows between each of the price areas and the implied prices for each area. Beyond this core requirement, however, the market coupling solutions applied to a particular area could differ along two dimensions:

    i. ***the degree of optimality of the calculated volume*** flows compared to the most economically efficient values; and

    ii. ***the degree to which the calculated area prices are harmonised***.

23. The degree of optimality of the calculated volume flows depends on whether the central algorithm has ***all*** the necessary information to determine the optimal result and the central algorithm ***fully*** reflects the specific products and matching rules applied by the different PXs. To the extent that not all information is available centrally or the algorithm does not fully reflect local rules, the calculated flows will not be optimal and the implied prices will be inexact. This might mean, for example, that some beneficial trades that could have been matched are not. The degree of optimality is a

spectrum: the deviations could be persistent or occasional, and the magnitudes could be very small (few kWs) or large (many MWs).

24. Incomplete information may be sent to the central algorithm because of practical considerations. It may be that some approximation can reduce the data requirements and complexity of the central algorithm, while still producing near optimal results. Alternatively, it may be that some elements of the matching process are better undertaken locally using information not available to the central algorithm – for example, applying updated foreign exchange rates at the very end of the process to convert prices into non-Euro currencies.

25. It is anticipated that the product definitions and rules offered by the different PXs will gradually become more standardised, and systems will be developed to handle larger data flows and calculations, so that the degree of optimality will improve - and eventually be optimal (or virtually optimal) everywhere. Nonetheless, a less optimal (or 'loose') coupling may facilitate the initial joining of markets together, or the linking of regional market clusters.

26. The degree to which the calculated prices are harmonised depends on a number of possible factors. 'Fully harmonised' prices occur when the published area prices can meet certain ideal properties. For example, in a network model based on Available Transfer Capacities, prices across an uncongested interconnector should be identical, and power should always flow to an area with a price equal or higher than the source.

27. Full price harmonisation is only possible where the individual PXs use the implied prices calculated by the central algorithm. This approach is referred to as "price/volume-based coupling" for this reason. Alternatively, where the local PX calculates its own price(s), using the cross-border flows from the central algorithm as an input, this may result in prices that differ from the implied prices defined by the central algorithm, leading to price discrepancies (for example, power flowing to a lower price area, resulting in negative congestion revenue). This approach is referred to as "volume-based coupling".

28. There are several possible reasons why locally calculated prices may differ. For example:

    i. the local PX may use a different algorithm than the central algorithm to deal with some market aspects, such as the management of block bids[11];

    ii. at the provided level of import/export, the price in one market may well be indeterminate (i.e., a range of prices is possible). In this case, a fully harmonised price would have to be set with reference to the adjacent market. If prices are set locally, however, the local PX (which does not know the price in the adjacent market) will apply a local rule (such as the midpoint of the possible range) and the resulting price may diverge from those in adjacent markets; or

    iii. the calculated flows are non-optimal due to loose coupling, as commented above.

29. The potential inconsistencies between the implied prices produced by the coupling algorithm on the one hand, and the prices defined by the PXs and used for settlement on the other, may raise concerns about the efficiency of a congestion management methodology which includes only volume-based coupling. Nord Pool Spot's market splitting approach is an example of price/volume-based coupling. The TLC mechanism also employs price/volume-based coupling.

30. However, volume-based coupling may be preferable in other situations. It may be simpler to implement, and the price discrepancies may be relatively insignificant. In particular, volume-based coupling may be easier in terms of governance and regulation. For example, in a volume-based approach the local PX is still ultimately accountable for the price(s) in its area. This may be considered an important feature by national regulators.

31. In contrast, price/volume-based coupling means that the PXs are dependent on the central algorithm not only to calculate the cross-border flows, but also to determine prices in their market areas – a fundamental function for any PX. This creates a more difficult governance challenge than volume-based coupling: how to fairly and

[11] Block bids require special methods to handle them, and exchanges have developed different approaches, suited to their circumstances, that can produce different results.

efficiently manage the arrangements given the vital interest many parties have in them[12].

32. The materiality of the price discrepancies under volume-based coupling may also be relatively small. The effects of different block bid handling could be mitigated if similar matching algorithms were adopted, and blocks are less of a problem in some markets anyway. The effect of price indeterminacies will also tend to be lessened in very liquid markets.

33. EuroPEX's proposed market-coupling solution can also incorporate price-difference bids, involving an obligation to use any assigned capacity. In the case of price/volume-based coupling, the same prices are used as those published by the PXs. In the case of volume-based coupling, the price-difference bids would need to be matched on the basis of the implied prices calculated by the central algorithm, which may differ from the area prices published by the PXs (this could raise some concerns if the PX prices are too different from the implied prices).

34. A number of specific issues regarding this vision, related for example to technological and institutional aspects, are still to be defined. It is clear however that any market coupling solution would require a certain degree of centralisation of functions with respect to the common central algorithm.

35. Other aspects, though not necessarily centrally managed, would be subject to some degree of harmonisation, including the timing of PX operations and the exchange of data between PXs. More specifically, PXs would have to coordinate their timeframes for collecting bids (converging towards a common market "gate closure" time at 12 noon CET, for example), for exchanging information and for publishing market results.

[12] There are nonetheless significant governance issues in a volume-based coupled solution – a PX would probably still not have complete autonomy over its matching rules or products.

Governance of Market Coupling

36. Institutional and governance issues are key to the development of an integrated congestion management approach for the IEM. This section outlines a proposal for the institutional and governance framework for the EuroPEX congestion management vision.

37. ***PXs would play a key role in any approach to cross-border congestion management based on implicit auctions.*** In fact, the spot markets they operate provide the liquidity essential for implicit auctions to efficiently allocate interconnection capacity. PXs can also contribute their knowledge of participants' preferences with respect to traded products. Furthermore, PX clearing allows anonymous and firm transactions.

38. Given that, as indicated, some essential functions would be best managed centrally, EuroPEX believes that ***market coupling should be supported by the establishment of a Central Coupling Office*** (CCO). The CCO would be responsible for:

    i. developing and maintaining the central market coupling algorithm; and

    ii. using the algorithm to compute the implicitly auctioned cross-border capacities, the efficient energy flows between the different coupled market areas and the resulting implied equilibrium price in each of these areas.

39. ***The governance of CCO would have to reflect the combined contributions and responsibilities of TSOs and PXs in market coupling-based congestion management.*** For example, it should recognise that, among other things, TSOs:

    i. are responsible for ensuring that bottleneck/cross-border capacity allocation complies with security requirements; and

    ii. support market coupling by determining the available bottleneck/cross-border capacities, and by defining power transfer distribution factors for the flow-based approach which are consistent with the appropriate security standards;

    while PXs:

    iii. are responsible for price formation and for ensuring the orderly and fair operation of markets;

iv. support market coupling by providing the liquidity in the day-ahead markets;

v. are best placed to determine which bid products should be made available in each jurisdiction; and

vi. can provide effective settlement and clearing services.

Both TSOs and PXs (depending on the local regulatory arrangements) are responsible for fulfilling the regulatory requirements. These regulatory provisions should, as far as possible, be harmonised across the different jurisdictions involved so as to provide a common framework for the operation of the CCO.

40. The CCO would operate on the basis of information and data received from TSOs and PXs. More specifically:

i. TSOs would provide the bottleneck/cross-border capacity of each interconnection, as well as the power transfer distribution factors required to implement a flow-based approach. TSOs would also channel to the CCO any price-difference capacity bids submitted by market agents; while

ii. PXs would provide the net demand/import-export curves compiled on the basis of the hourly bids and offers submitted by market agents, as well as the individual block bid (or other special product) data, in anonymous form.

41. On the basis of the market coupling results, the CCO will inform:

- each PX of the power flows into and out of its market area(s) and of the implied price(s) which emerge from the coupling algorithm;
- each TSO of the capacity bids which have been accepted and of the overall resulting energy flow through/at each interconnection.

42. The relationship between the CCO and the TSOs and PXs would be based on the CCO's governance structure as well as on contractual arrangements. An appropriate ownership structure for the CCO should also be defined[13].

[13] The ownership structure of the CCO should not necessarily coincide with its governance. Separate ownership and governance structure are not uncommon for some key entities in the electricity sector. This is for example the case with some TSOs and PXs, where stakeholders (grid users and market participants) may have an important role in the governance of these entities, irrespective of the actual ownership structure.

The governance of the CCO and its contractual arrangements with the TSOs and PXs should ensure that the CCO enables the individual TSOs and PXs to meet ***their*** regulatory and contractual obligations. The CCO is a service provider to the TSOs and PXs, and the requirements it has to meet derive from the requirements of its TSO and PX 'clients' directly or indirectly; it is not directly regulated. As far as is practical, the CCO should seek to meet all reasonable requirements from individual TSO or PXs – provided that this does not unfairly harm or impose costs on others.

The way forward

43. ***Institutional and governance issues are crucial to progressing towards a common approach to congestion management in the IEM.*** A fully integrated IEM will take some time to develop, but substantial progress has already been achieved. The on-going discussion between stakeholders, at Florence Forum meetings and elsewhere, has substantially improved the understanding of the objectives and methods for cross-border congestion management. Regulation n. 1228/2003 defines a general framework for the development of a common approach and the Guidelines on congestion management will soon provide additional, more detailed indications.

44. The objective is to develop a common framework and to identify what convergence of institutional and operational aspects is necessary or appropriate, taking into account the characteristics and requirements of the different jurisdictions and regional markets. ***This should build as much as possible on the existing market*** arrangements ***and current coupling initiatives.*** Governance and technology issues need to be addressed too.

45. ***EuroPEX will continue to play an active role in all these respects***. The EuroPEX vision, presented in this document, is intended to represent a contribution towards the definition of a comprehensive approach to congestion management in the IEM. This vision importantly can incorporate and build upon the current arrangements and initiatives, and thereby assist in the transition to an integrated European solution.