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THE ACHIEVEMENT OF THE EU ELECTRICITY INTERNAL MARKET THROUGH MARKET COUPLING

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Abstract

The achievement of the internal market for energy is going ahead in the EU 15 since a model is emerging for “coupling the national markets for electricity”.

For about 15 years the EU 15 was made up of national markets open to each other through rules of access to the grids while organized market pricing was kept national. The main exception was in the Nordic countries (Sweden, Finland and Denmark plus Norway –not a member of the EU). In this region the coupling of national markets is obtained through a single Power Exchange being a common subsidiary of the Nordic transmission system operators (TSOs). This single PX runs a single Day Ahead market pricing zone when the grid is not constrained and splits itself into different pricing areas when structural constraints arise. This model is known as “market splitting”.

The Netherlands, Belgium and France did later create a less centralized single pricing mechanism by “coupling” their three national PXs with a common pricing algorithm coordinating the price formation among the three national exchanges. The empirical success of this new model has validated it as an EU model for other regional markets.

A counter-model has been experimented between Germany and Denmark. It consisted of a coupling of “volumes” linking the quantities offered and demanded in the two exchanges while keeping the price formation in these two markets separated. That experiment failed and started to work again only when elements of price coupling have been introduced.

Having now three workable models of market coupling, the European Union (at least EU 15) should be able to successfully achieve one layer of its internal market soon. However, several further questions are kept open such as how to successfully bridge several regional markets all over the EU 15 or how to integrate more and more PXs having different regulatory frames. A centralized approach (known as CMU) is advocating creating a single pan-European trading entity by a mandatory restructuring of all existing PXs plus a clubbing of all TSOs and the extensive harmonization of all existing national regulatory frames. An alternative approach is the one known as PCR (“Price Coupling of Regions”). It allows building a less demanding common pricing mechanism to coordinate existing PXs in a decentralized network. It is permitting grid access and trading to keep a national flavour when requested by particular local preferences.

Keywords

Market Coupling; Market Splitting; Power Exchange; Electricity Internal Market; Day Ahead Market

Introduction

Power trading of any kind (financial and physical) in the EU has reached the threshold of annual consumption (over 8 million GWh traded in 2007 for a 2.7 million GWh level of consumption)[1]. In terms of physical exchanges 10% of total trade and 30% of consumption is traded on Power Exchanges (PXs). The traditional market for PXs [2] is an auction organized every day around midday to execute orders for the delivery of electrical energy the next day[3]. Some PXs have also started organizing trade before the day-ahead stage (e.g. financial "futures" products) and after the day-ahead stage ("intra-day"), but the focus in this paper is on the coupling of the "traditional" day-ahead PX market. The day-ahead coordination of generating units with expected demand has always been a key feature of the electricity sector, even at the time of vertically integrated monopolies. It is because this is a rational requirement of any efficient combination of the variety of generation technologies embedded into the various plants as well as a way of diminishing the costs of keeping plants ready to generate while not generating yet at their optimal capacity. However the core problem we are facing today is not learning how to open local wholesale markets inside a formerly monopolized industry anymore. It is now time to enlarge the existing local or regional markets, to consistently open all of them to each other, to align them all into an EU-wide set of "seamless" markets acting as close as possible as if they were a single internal energy market (Oggioni and Smeers 2010).

For about 15 years the EU 15 was made of national markets open to each other through rules of access to the grids while organized market pricing was kept national (Glachant and Lévêque 2009). The main exception was in the Nordic countries (Sweden, Finland and Denmark plus Norway –not a member of the EU) –see Moen, J., (2010). In this region the coupling of national markets is obtained through a single Power Exchange being a common subsidiary of the Nordic transmission system operators (TSOs). This single PX runs a single day-ahead market pricing zone when the grid is not constrained and splits itself into different pricing areas when structural constraints arise. This model is known as "market splitting".

The Netherlands, Belgium and France later created a less centralized single pricing mechanism by "coupling" their three national PXs with a common pricing algorithm coordinating the price formation among the three national exchanges. The empirical success of this new model has validated it as an EU model for other regional markets.

A counter-model has been experimented between Germany and Denmark. It consisted of a coupling of "traded volumes" linking the quantity offered and demanded on the two exchanges while keeping separated the price formation on these two markets. That experiment failed and worked again only when some elements of price coupling were introduced (Meeus 2010).

Now having three workable models of day-ahead market coupling, the European Union (at least the EU 15) should soon be able to successfully achieve that part of its internal market building (Everis and Mercados 2009). However, several further questions are kept open. How can several regional markets all over EU 15 successfully be bridged? How can more and more PXs having different regulatory frames be integrated? A centralized approach (known as CMU "*Central Matching Unit*") advocates creating a single pan-European trading entity by a mandatory clustering of all existing PXs plus a clubbing of all TSOs and the extensive harmonization of all existing national regulatory frames. An alternative approach to coupling is the one known as PCR ("*Price Coupling of Regions*"). It allows a

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1 The 2008 review of EU wholesale energy markets, available at: http://ec.europa.eu/energy/gas_electricity/studies

2 Leonardo MEEUS, *Why (and How) to Regulate Power Exchanges in the EU Market Integration Context?* (FSR Working Paper Series – 2010/12)

3 Delivery implies a commitment to withdraw from or inject into the network a certain amount of electrical energy during a certain hour in a certain zone.

common pricing mechanism to be built that coordinates the existing PXs while keeping a decentralized frame, permitting grid access and trading to keep a national flavour when requested by particular local preferences as it is notably the case in Spain and Italy.

1 – Market Coupling as a Preferred Way of Achieving the Day-Ahead EU Internal Electricity Market

As shown at Florence School of Regulation[4], market coupling is about eliminating cross-border trade inefficiencies by internalizing capacity allocation and the arbitrage between energy prices into the auction procedures of Power Exchanges that organize trade nationally.

Traditionally the debate in the literature has mainly been about explicit versus implicit auctioning. Bohn et al. (1983) demonstrated that implicit auctioning leads to a welfare-maximizing situation. Chao and Peck (1996) in turn showed that explicit auctioning does not necessarily reduce welfare, if there is continuous trading of electricity and cross-border capacities contracts. Gilbert et al. (2004), Parisio and Bosco (2008) and Ehrenmann and Neuhoff (2009) analyzed the difference between explicit and implicit auctioning under imperfect competition, and concluded that implicit auctioning reduces market power. Hobbs et al. (2005) showed the opposite can be true, arguing that abusive behaviour is more difficult to monitor in implicit auctions.

Whatever the academic debate is or has been (Erhrenmann and Smeers 2005), the European experience is increasingly evidencing the inadequacy of coupling markets through an “explicit” auctioning method, which is to explicitly allocate cross-border capacities to traders before their actual price arbitrage between the different national electricity markets. Newbery and McDaniel (2002) observe that the prices that are paid in the explicit auctions for rights to trade between France and the UK are significantly lower than the revenue that could be made with cross-border trade. Similar results can be found in Neuhoff (2003) for the explicit auctions between Germany and the Netherlands and in Purchala et al. (2004) for the explicit auctions in the Benelux region. Zachmann (2008) confirms these findings with a detailed statistical analysis of the lack of price convergence in Europe. Frontier Economics and Consentec (2004), Turvey (2006), Kristiansen (2007a & b), Creti et al. (2009), and CRE (2009) study the utilization of the cross-border capacities and observe for different borders and periods that cross-border trade is often in the direction of the average price difference, even if the hourly price spread is frequently in the other direction. As a result, the scarcely available cross-border capacities are currently underused, and frequently also misused increasing price spreads instead of reducing them.

2 – Market Coupling through Volume Coupling or Price Coupling?

Theoretically, electricity markets linked with an interconnection may be coupled either through the coordination of the volumes of use of the interconnection capacity or through a wider mechanism combining price and volume coordination. The former is known as “volume coupling” or “dome coupling” and the later as “price coupling” (while it also couples volumes).

The main EU experience of volume coupling is the one of the Kontek Cable, as studied by FSR[5]. In operation since 1995 it connects East Denmark (today part of the Nord Pool exchange zone) with Germany. In 2005, Nord Pool implemented implicit auctioning for the first time on the Kontek Cable by extending its market platform into Germany and thereby competing for liquidity with the German EEX.

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4 Leonardo MEEUS, *Implicit auctioning on the Kontek Cable: third time lucky?* (FSR Working Paper Series – 2010/49).

5 Leonardo MEEUS, *Implicit Auctioning on the Kontek Cable: Third Time Lucky? (op.cit).*

In 2008, implicit auctioning was implemented for the second time on the Kontek Cable, replacing the first implementation. Nord Pool closed its German market platform, and began cooperating with EEX by creating a joint venture called the "European Market Coupling Company" (EMCC). The cooperation involves a coordination procedure, which starts with EEX and Nord Pool sending their order books to EMCC. EMCC consequently calculates the optimal utilization of the Kontek Cable. EEX and Nord Pool then update their order books, i.e. the importing Power Exchange introduces a price taking supply order, and the exporting Power Exchange introduces a price taking demand order. Finally, EEX and Nord Pool independently calculate their prices on their respective markets.

This second implementation of implicit auctioning on the Kontek Cable only lasted for 10 days. The stakeholders then took just over a year to prepare a third implementation of implicit auctioning on the Kontek Cable, delaying the launch date several times. FGH/IAEW (2009) explains that the original intention was only to change the algorithm, but testing with the improved algorithm provided unsatisfactory results so that the coordination procedure itself was also modified. In 2009, the third implementation of implicit auctioning that is still running today was finally launched. According to FGH/IAEW (2009), EMCC is now assisting Nord Pool with the price calculation for East Denmark so that there is a degree of price coordination between EEX and Nord Pool, which was not the case in the previous two implementations.

The two main conclusions of the FSR study performed by L. Meeus are following. 1° the first implementation of implicit auctioning on the Kontek Cable integrated the pricing of the cross-border capacities with the pricing of the energy contracts auctioned by Nord Pool. The second implementation went a step further by optimizing the clearing of the Nord Pool and EEX order books, but the Power Exchanges continued to calculate their own prices independently. The third implementation went another step further by partly coordinating the pricing of the Power Exchanges, but it is only Nord Pool that coordinates, while EEX simply continues to calculate its own price independently. 2° The main evidence of the empirical analysis is that the third implementation still has inefficiencies with a annualized loss of welfare of about 0.5M Euros, but it does significantly outperform the previous two implementations where this loss was respectively of the order of 10M and 28M Euros per year. The third implementation that is still running today therefore did turn out to be lucky, but in this third implementation the pricing of the involved Power Exchanges is partly integrated. In other words, the stakeholders abandoned the pure "volume coupling" or "dome coupling" approach they believed to be a viable alternative to the institutionally more difficult to implement "price coupling" approach. This is an important lesson learned for the many ongoing initiatives to implement implicit auctioning in Europe.

3 – Market Coupling through Price Coupling?

One can couple markets in two different ways: volume coupling and price coupling. They mainly differ in the way they produce prices.

With volume coupling, the coordination of volume and price calculation is limited because it operates mainly through quantities. "Volume coupling" permits two "couplers" to stay more independent when coupling. First the capacity of interconnection is calculated by TSOs and communicated to the coupling actor. Second, the allocation of this global capacity for cross-border flows is made according to the balance of supply and demand in each trade zone and the constraints on the interconnection. Third and lastly, the trade zones determine their zonal prices separately taking into account the cross-border import / export volume attributed to them by the quantity allocation mechanism.

In a price coupling regime, the calculation of cross-border volumes and prices are coordinated in a single mechanism; volumes and prices are calculated at the same time and in a compatible manner. This guarantees the robustness of the results of calculation. Prices and volumes correspond to the same and single logic. That process avoids price or flow discrepancies (exports from a high price zone to a low price zone, or price differences when there is no congestion). This is why price coupling is appealing today as a way to allocate interconnection capacity and manage interconnection scarcity as to "merge" wholesale markets' operations by expanding the size of the reference price making area.

4 – Unbundling Issue: Coupling Markets between Transmission System Operators and Market Operators

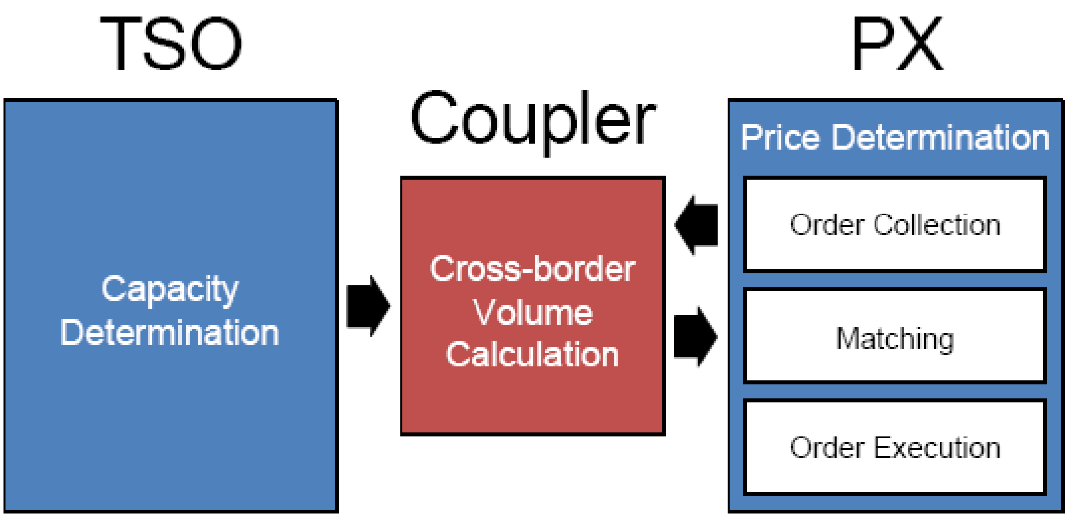
Price coupling results from the cooperation of two different actors: the transmission system operators (which own and operate the grid monopoly[6]) and the market operators (which own or operate the market platform being the PX). The market operator can be owned by the TSO. This does not change the fact that they have to separate their businesses for due reasons, being mainly the unbundling of the monopolized activity from the market-based business. It also becomes a conflict of interest when the TSO is a big market player (buying to the energy market millions of MWh for grid losses; or buying or selling congested interconnection capacity through a de facto monopoly of cross-border energy transfer). This separation of businesses does not ask for a full independence of all their activities because the grid capacity allocation still has to be deeply coupled with the market price calculation.

However, while TSOs are needed to calculate the available capacity, they do not need to allocate it by themselves. In the case of the Kontek cable, volume allocation is performed by a third party who was a joint coupler named "European Market Coupling Company" (EMCC) –see Fig. 1 below. In the case of a typical "price coupling" the volume allocation is realized by the PX itself as single market operator –see figure 2 below.

There is an important distinction to be made there. TSOs should have been able to allocate capacity in the volume coupling model because it is a legitimate function of the TSOs as long as they comply with the non-discrimination, efficiency and transparency requirements. They actually created another entity (EMCC) because of other business considerations. On the opposite side, in a price coupling model TSOs cannot directly allocate capacity to market participants because that allocation is then integrated into the price mechanism and that mechanism is the core of the PX activity as a market platform.

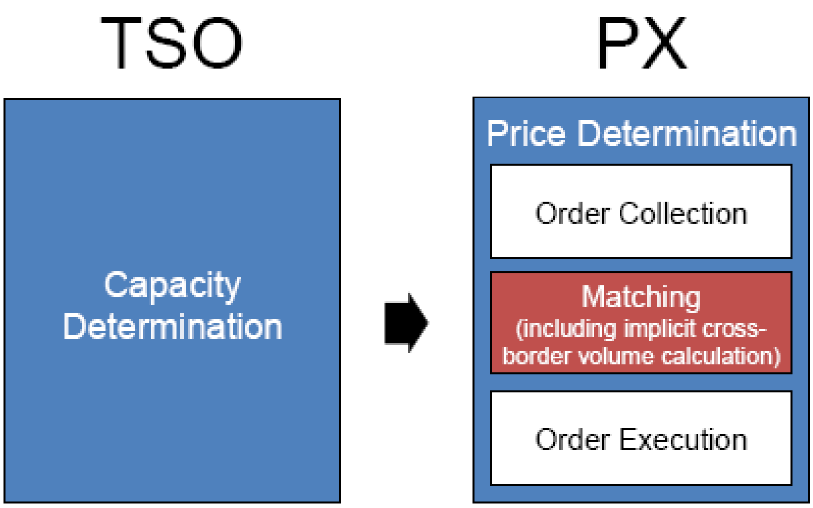
[6] If the operator of the grid does not own it, it is called "System Operator". It is or has been the case in Scotland and Italy. It is frequently the case in the market-based parts of the electrical system of the USA.

Figure 1. Transmission System Operator and Market Operators in the Kontek volume coupling



(Source: EPEX conference at the Florence School of Regulation - 2010)

Figure 2. Transmission System Operator and Market Operator in a price coupling

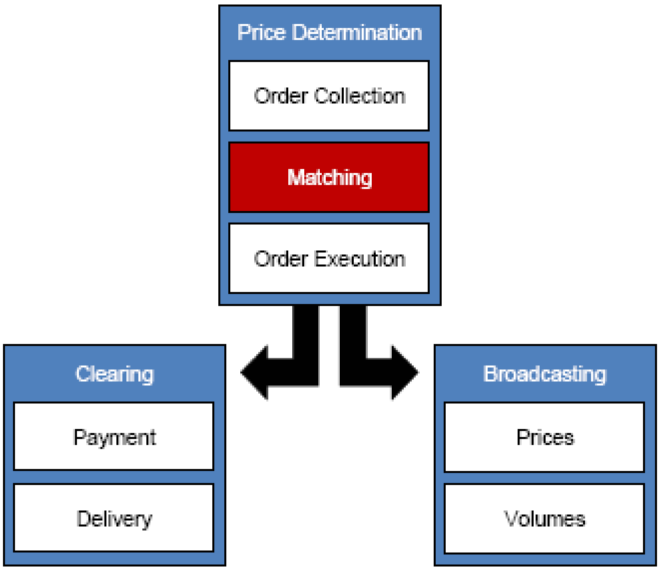


(Source: EPEX conference at the Florence School of Regulation - 2010)

5 – Governance Issue: Coupling Markets among Market Operators

PXs perform at least three basic market functions: they "produce" regular prices; they broadcast them as price references; they perform the clearing of the corresponding market orders. To produce regular prices PXs need to collect orders and to match them according to a predetermined algorithm. They then execute the resulting orders of buying and selling. Being produced in a regular, predetermined manner, these energy prices can become market references and be broadcasted to market actors and analysts. It is one of the more important differences with bilateral trading which cannot easily produce reference prices. Furthermore PXs centralize the market clearing with a designated counter-party which eliminates the financial risk of default born in bilateral trade. This entails a financial activity of margin appeal and of payment through bank transfer which is a very substantial part of the actual business of PXs.

Figure 3. Basic functions of PXs as Market Operators



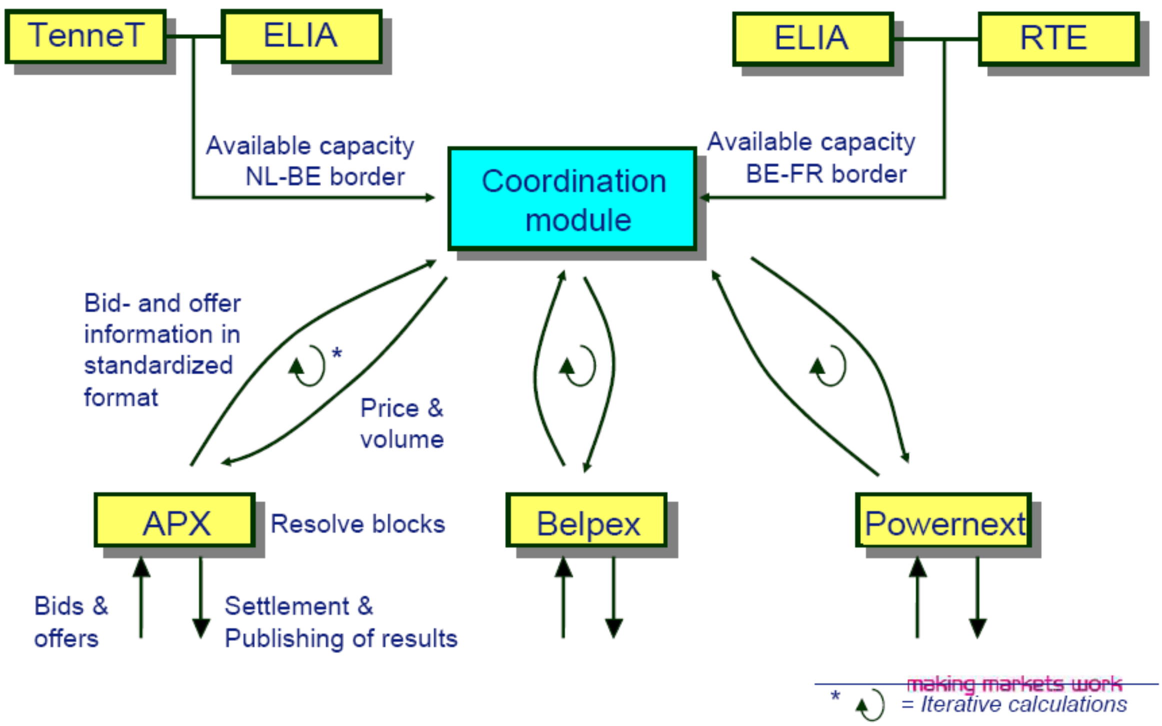
(Source: EPEX conference at the Florence School of Regulation - 2010)

What do PXs share in this set of complementary activities when they implement a “market coupling” scheme? That question touches the core of the coupling governance issue.

PXs can share all their portfolio of activities and then functionally merge. They so function as a single entity. It has always been the case among Nordic countries (Norway and Sweden, then Finland and Denmark) which share a unique market platform created and operated in Norway under Norwegian law and regulation. That PX is known as “Nord Pool”. The fact that this single market platform is Norwegian is tempered by the fact that its only shareholders are all the Nordic TSOs. They all are in this manner formally associated with the life of their single market platform.

This centralized market coupling approach has not been retained when The Netherlands, Belgium and France entered into a “Trilateral market coupling”. Each PX has kept its independence from the two others by retaining most of its business segments separately and by only closely coordinating the ”matching” activity (see figures 3 and 4).

Figure 4. Structure of the Trilateral Market Coupling between the Netherlands, Belgium and France



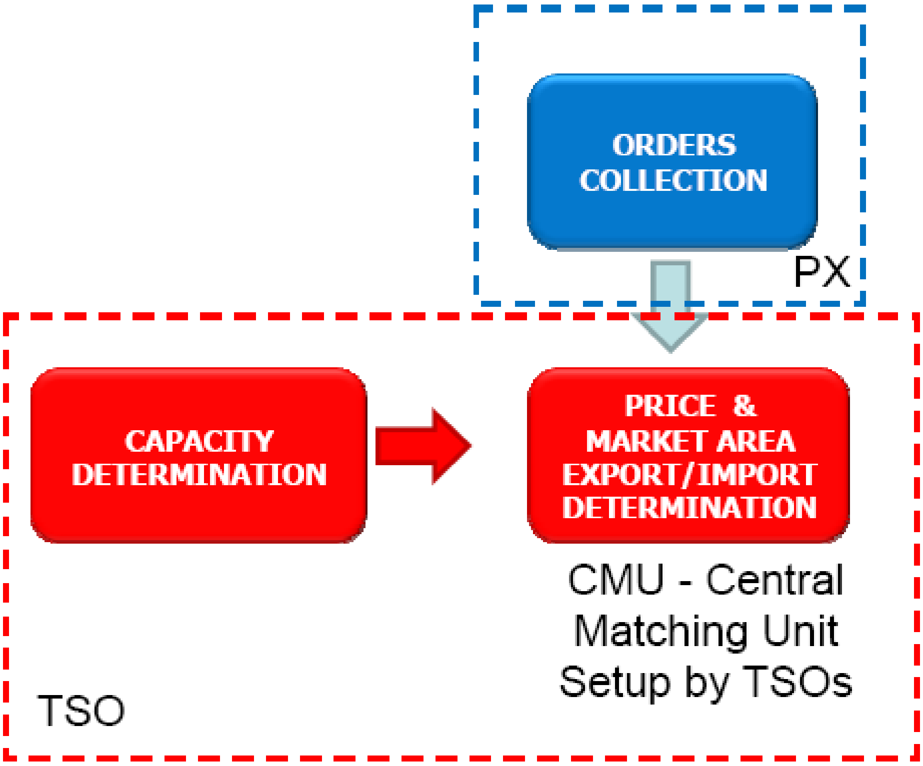
Note: Tennet, Elia and RTE are TSOs respectively in the Netherlands, Belgium and France. APX, Belpex, Powernext were PXs operating in the Netherlands, Belgium and France. Today Powernext has merged its business with the German EEX and create a common subsidiary named EPEXSpot operating in France, Germany, Austria and Switzerland while coupling with only France for the moment.
(Source: APX conference at the Florence School of Regulation - 2010)

6 – The "Last Mile Coupling Model": Central Matching Unit (CMU) vs. Decentralized Coupling of Regions (PCR)

The opposition between centralized and decentralized approaches of market coupling is still lively and is still legitimate. Both approaches obviously have pros and cons (Sihvonen-Punkka A. 2010).

The centralized approach promises a pan-European restructuring of all market operation of interconnections. PXs could remain as offices collecting orders which are transmitted to a central matching unit. That CMU realizes the central matching of demands and offers, allocates the cross-border capacities to market zones, calculates prices and volumes all across countries in a coherent manner giving birth to a unified pan-EU pricing zone and price reference. Few academics could resist such a promising proposal. However such a "bing-bang" approach is far from being institutionally feasible and it is its main deficiency. In the USA, FERC (the federal regulator) did in fact damage the reform process by trying to impose a rationally centralized model of market design for the entire country too early. In the EU today only a very strong pressure exerted top down could make this model happen and it is why it will not happen. Fifteen years of market-based electricity system operation (first European package in 1996) have consistently structured agents' interests, investments, business plans, market strategies, etc. Countries have built local or regional legal and regulatory frames and designated regulatory or financial authorities in charge of this or that aspect of market and grid activities. How to erase all of this at once to create at the EU level a new single entity? How to merge core business interests and assets of existing PXs (algorithms, data base, IT systems, customer base)? How to legally expropriate the PXs of their core business if they don't cooperate voluntarily? How to ask for a unified approach of all TSOs? Who will bear the legal, financial and commercial risks of operation failures? How to escape the national legal and regulatory frames to put the operation scheme at a "European only" level? How to legally frame and monitor the business operation at the EU level_while we do not have any solid pan-European regulatory institution (Vasconcelos 2005: the EU regulatory gap), etc? The number and gravity of the issues at stake suggest that the CMU model is not yet a feasible option in the EU.

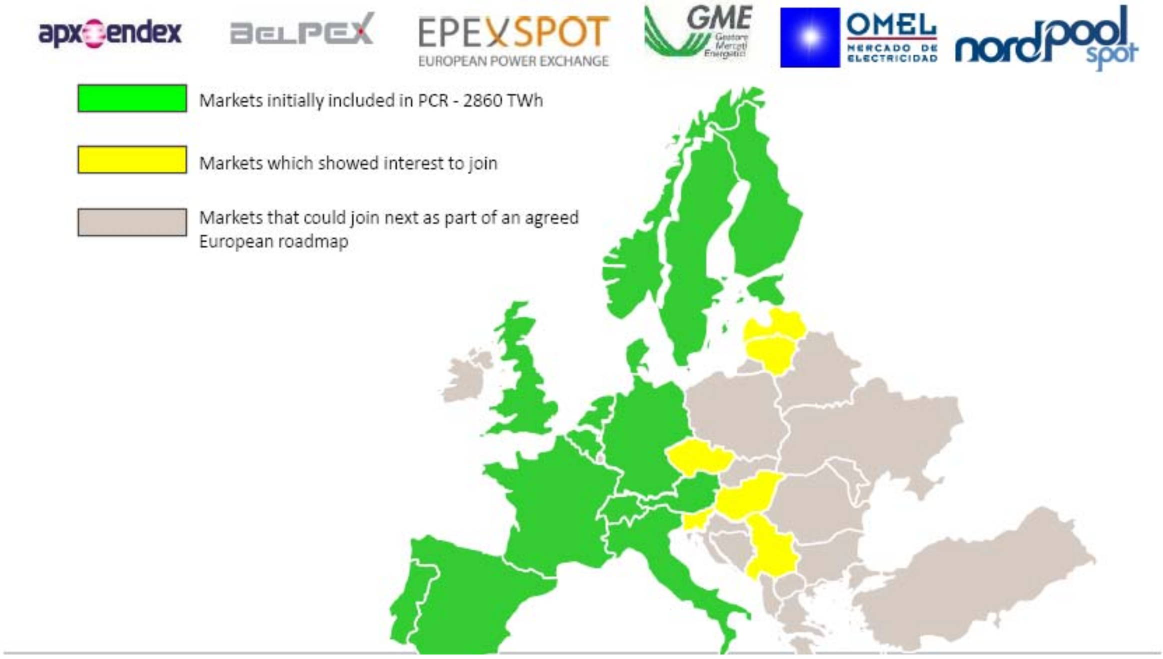
Figure 5. A scheme of pan-European centralized market coupling



(Source: EPEX conference at the Florence School of Regulation - 2010)

Then the only feasible option today is a soft and decentralized cooperation being fostered among existing PXs with the participation of TSOs. Such a project is known as "price coupling of regions" (PCR). It limits the needed cooperation of PXs to the upgrading of their matching activity in a common setting operated in association with TSOs which provide the grid capacity calculation. That PCR would be kept open to further entrants with several degrees of possible entry: some new entrant PXs using the trading system of an already existing regional PX; other entrants using their own trading system to couple but decoupling according to a common system; and lastly, others using their own trading system having already integrated all the relevant features of the "Master PX" operating as the European reference.

Figure 6. A map of PXs looking for a "Price Coupling of Regions"



(Source: EPEX conference at the Florence School of Regulation - 2010)

7 – The Need for a "Price Coupling for Regions"-like Model to Accommodate the Specificities of the Italian Market

The Florence School of Regulation used to distinguish two types of PXs in Europe because one can expect them not to behave the same way in the operation of their typical exchange tasks[7]. They are:

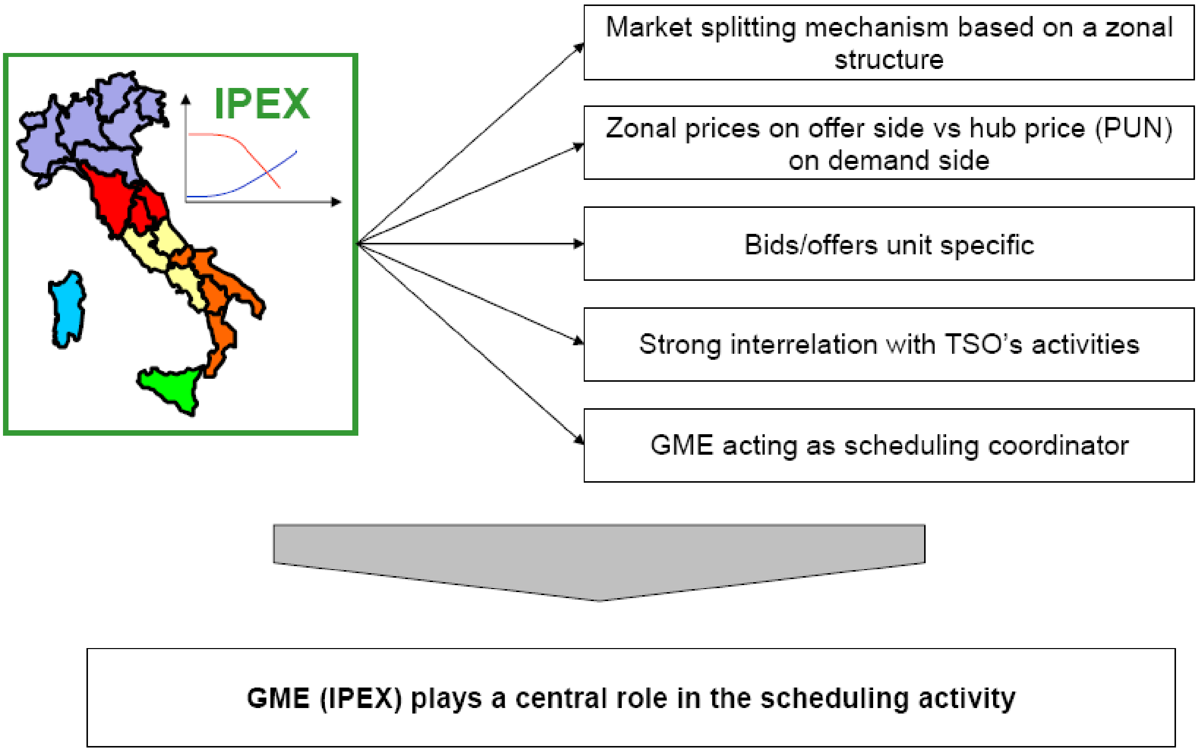
- *Merchant PXs*: being for-profit market institutions whose income depends on the users they have (i.e. user registration fees, and annual membership fees) and the volume of trade executed by the PX for its users (i.e. commissions on the traded volumes). Merchant PXs are mostly private initiatives that compete with other exchanges and bilateral or over-the-counter markets (OTC). Providing trade services is their core business.
- *Cost of Service (CoS) Regulated PXs*: being not-for-profit or regulated-profit market institutions whose income depends on approved costs for approved tasks. CoS Regulated PXs are typically public initiatives that perform several tasks. For instance in Spain, OMEL has the additional task of allocating capacity payments, which is a public incentive scheme designed to promote generation adequacy. In Italy, ILEX has the additional task of managing internal congestions in the country and scheduling plants. In Greece and Ireland too, the CoS Regulated PXs are dispatching power plants.

Then some typical features of the Italian wholesale market call for a special examination when choosing a model of market coupling (see Fig.7). First of all, Italy operates an internal market splitting mechanism with a zonal structure. Secondly, that mechanism is "zone based" for the pricing of offers while being "nationwide hub-based" for the pricing of demand. Thirdly, bids and offers are unit specific and not at the company level. Fourthly, GME acting as a scheduling coordinator of generating units has a strong interaction with the TSO Terna and performs tasks being only performed by TSOs

7 Leonardo MEEUS, *Why (and How) to Regulate Power Exchanges in the EU Market Integration Context? (Op.cit.)*

in some other countries. At least for these reasons Italy would find it more difficult to enter into a centralized model of market coupling (like CMU) than to collaborate to a decentralized "price coupling of regions".

Figure 7. The main features of the Italian Wholesale Market (IPEX)



(Source: GME conference at the Florence School of Regulation - 2010)

Conclusion

After 15 years of organized wholesale markets being mainly conceived and managed at the national level (except in the Nordic countries) the EU is on the verge of achieving the first very continental common market platform through the coupling of day-ahead markets.

The model of coupling through volumes experienced by Germany and Denmark having performed less that the price coupling models, the EU is very likely to embark on a general price coupling model. Two different views exist on the best way to implement price coupling in the EU: the centralized approach and the decentralized approach. However, whatever the theoretical quality of the centralized approach still is, today the only institutionally feasible price coupling model is the decentralized one. This is because existing market platforms cannot be forced to renounce certain activities at the core of their business interests because there is no convincing TSOs' management capability at the EU level to conceive and operate such a market centralization and because such a key market platform cannot be left in a European regulatory vacuum to the sole interested TSOs whatever their legitimate intentions are.

In this actual state of our European electricity industry, the only feasible option seems to be today the decentralized approach name "price coupling of regions". It promises to be in full operation as soon as 2011 – 2012. For Italy this model of price coupling is also the easiest way to contribute to the coming day-ahead EU achievement while keeping many key features of its existing wholesale market.

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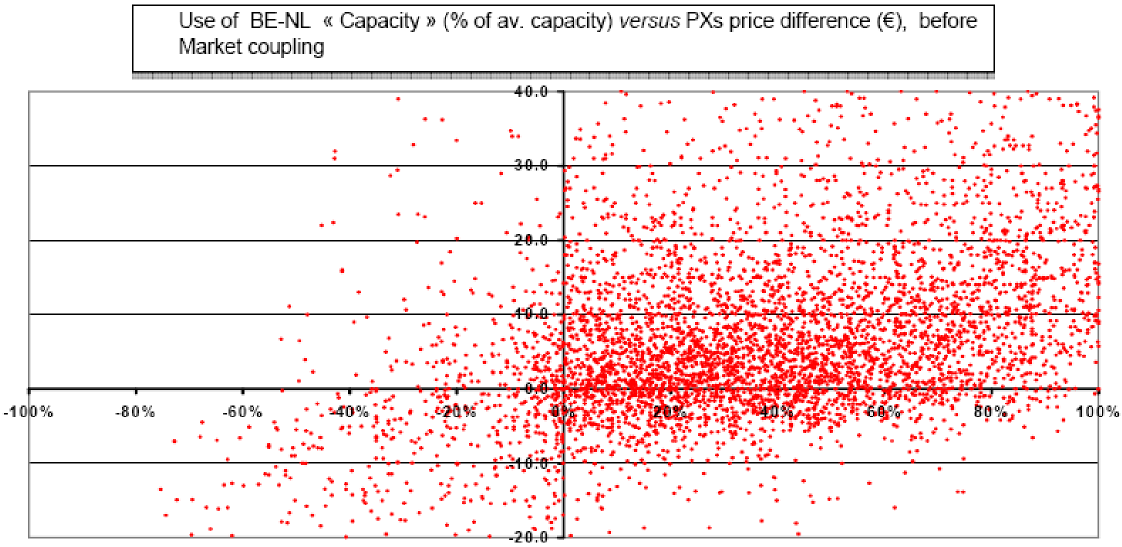
Annex N°1

Price difference (-20 to + 40 euro) vs. percentage of use of interconnection capacity (from -100% to +100%) between Belgium and the Netherlands before price coupling



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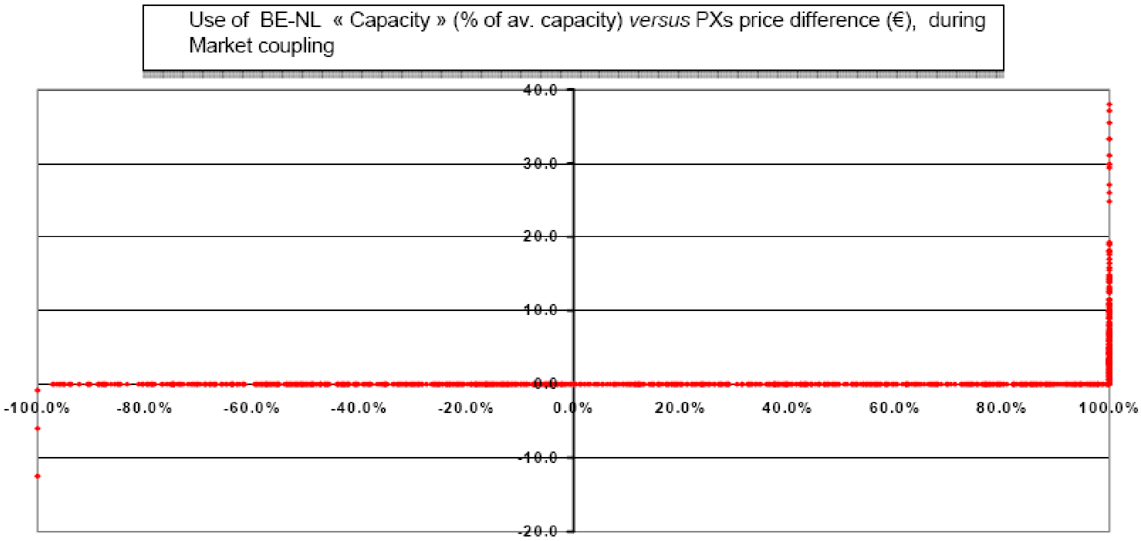
Annex N°2

Price difference (-20 to + 40 euro) vs. percentage of use of interconnection capacity (from -100% to +100%) between Belgium and the Netherlands during price coupling



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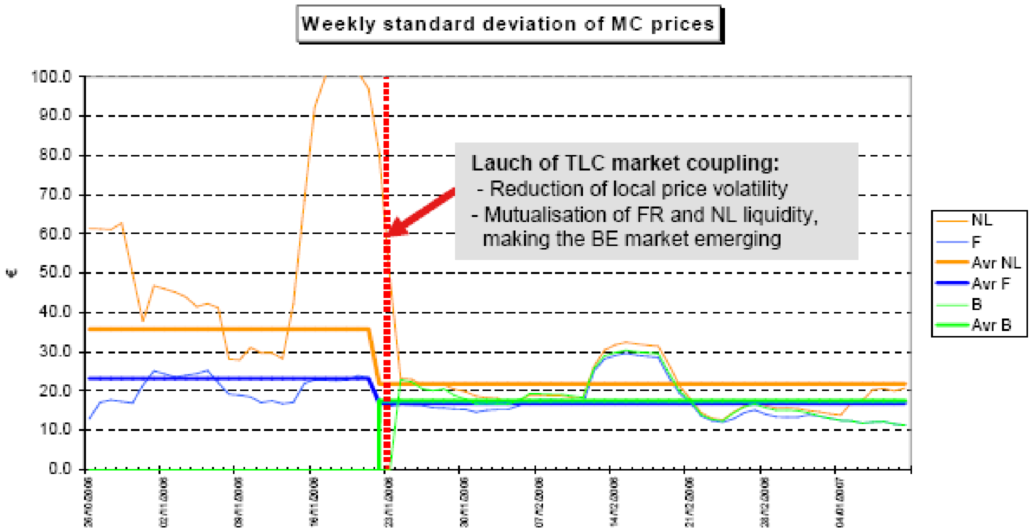
Annex N°3

Price difference between Belgium, France and the Netherlands before and during price coupling



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