Chapter 2

The liberalization process and the development of power exchanges

The EU legal framework of the liberalization process and the role of electricity trading with respect to the creation of a single European electricity market are presented in this chapter. First, the main aspects of the EC treaty and of the electricity Directive 96/92/EC are discussed. The developments in the implementation of the Directive are analyzed in terms of third party access, market opening and unbundling. Then the role of electricity trading in general and of power exchange specifically is outlined and the reasons for the emergence of power exchanges and their differences with power pools are presented. Finally, an organizational model of the European electricity markets, including power exchanges, is presented. The different types of markets, the role of the transmission system operator and allocation methods for interconnector capacity, are delineated in the model based on practical historical developments.

2-1 The European legal framework

2-1-1 EC Treaty

The trading of electricity in Europe is subject to the general rules of the EC Treaty. This Treaty has been amended several times but electricity, and energy in general, has not been one of its main concerns. The origins of the EC Treaty trace back to the Treaty of Paris[1] which was signed in 1951 and which laid the foundations for a supranational coal regime with the establishment of the European Coal and Steel Community (ECSC). Following this Treaty, the European Atomic Energy Community (EAEC) was created with the Euratom Treaty[2]. The ECSC and the EAEC were responsible for the common coal and nuclear policy. The European Economic Community (EC) was established in 1957 with the Treaty of Rome[3]. The objective of the EC was to create a common market. The EC Treaty included additional provision for agriculture and transport but nothing about energy and *a fortiori* for electricity. The process toward a common market was accelerated in 1987 with the entry into force of the Single European Act[4], which amended the first three Treaties and established the objective of an internal market by the end of 1992. Finally, further amendments were made in the Treaties of Maastricht[5] (1992) and Amsterdam[6] (1997). In general electricity is subject to two main principles of the EC Treaty. One, electricity is subject to the rules governing the free movement of goods, persons, services and capital. Two, the electricity industry is also subject to the EC competition law, in particular those provisions related to cartel and market abuse.

In 1985, the creation of an internal electricity market was regarded as too difficult to pursue by the European Commission (McGovan *et al*, 1989). This view changed in 1988 when the Commission presented a communication on the

[1] Treaty establishing the European Coal and Steel Community (1951), 261 UNTS 167
[2] Treaty establishing the European Atomic Energy Community (1957), 298 UNTS 167
[3] Treaty establishing the European Community (1957), 248 UNTS 91
[4] The Single European Act (1987), OJ L 169
[5] Treaty on the European union, OJ C 224 1 (1992), 31 ILM 247
[6] Treaty of Amsterdam, OJ C 340/01 (1997)

internal energy market[7]. The general principles of a single European "internal market", rather than many separate markets for goods and services, were established in the Single Electricity Act (EU, 1987). In this document, the single market is defined as the backbone of economic integration. The aim of the single market is to increase European economic growth by opening up national markets to competition, and thus improve overall competitiveness and raise standards of living. Following this general document, the European commission published a working document on the internal energy market (EC, 1998) which was explicitly aimed at fully integrating the separate national electricity markets throughout Europe.

The conditions for price transparency towards large electricity and gas consumers are defined in 1989in the Directive 90/377/EC. This Directive was the first step toward the liberalization of the electricity industry. However this price transparency Directive was too weak to create competition in the electricity sector. The European Commission then decided to establish a new Directive containing stronger measures. This was done through the electricity Directive 96/92/EC.

2-1-2 The EU Directive 96/92/EC

The EU Directive 96/92/EC[8] (hereafter the Directive), liberalizing the electricity sectors within EU members States was agreed in 1997, after nearly ten years of debate. The EU directive defines common rules for the generation, transmission and distribution of electricity (articles 1-2-3). The Directive covers the gradual establishment of a single internal electricity market by opposition with 15 liberalized national electricity markets[9]. First, Member States are obliged to open their national electricity market at least a minimum share of it. This means that eligible customers must be able to choose their supplier. The generation activity is totally free to promote competition as is the construction of transport lines.

[7] EC Commission: the Internal energy market, COM (88) 238
[8] Directive on common rules for the internal market in electricity 96/92/EC OJ L27 of 30.01.1997

Finally the operation of the transmission network has to be independent from generation and distribution, at least in management terms, in order to insure transparency of the market and avoid discrimination.

The Directive removes the monopoly any incumbent may have for the construction of new power plants to promote full competition in the generation sector. The Directive gives two options for member states between, an *authorization* and/or *tendering* procedure for the construction of new generating capacity (articles 4-5-6). Under the first option, member states have to define public criteria and procedures. Then companies willing to build new power plants have to go through an open and impartial procedure to decide whether they are allowed or not, to build their unit. Under the second option, a specific authority designated by the Member State defines the needs for new investments and solicits tenders. The tenders are then assessed using an impartial procedure.

In relation to transmission (articles 7-8-9), each Member State must directly specify (or require undertaking which own transmission to do so) a transmission operator and the main role of the system operator is defined, i.e. generation dispatch and determination of the use of the interconnectors. This part of the Directive implies that the system operator must dispatch power plant on a non-discriminatory basis between incumbents and new entrants. The goal of separation between generation and transport is to insure transparent and fair access to the network in order to avoid discrimination and cross-subsidization between consumers (eligible and captive).

Distribution must follow the same principles as transmission with regard to non-discrimination (articles 10-11-12). The Directive specifies that, in particular cases, the tariff to supply customers may be regulated. The important difference for distribution is that Member States may impose requirements on distribution companies in order to meet specific public service obligations. Even if this notion

[9] European Commission (2001), *Completing the internal energy market*, March 2001

is not clearly defined it must fall into three categories: security of supply, quality/price of supply and environmental protection.

Given the call for separation of activities, the Directive also mandates unbundling and transparency of accounts (articles 13-14-15). Hence, companies with generation, transmission and distribution activities must present a separate balance sheet for each activity. The objective of this accounting unbundling is to avoid any cross-subsidization between different type of activity.

The central aspect of the Directive is the model of third party access (articles 16-17-18). The idea is that owners of the network are obliged to allow producers and consumers to have access to their network to trade in accordance with the objectives of transparency and non-discrimination. The Directive includes three models: negotiated third party access (nTPA), regulated third party access (rTPA), and the single buyer model. In the first model (nTPA), consumers and producers must be able to negotiate access to the network with the system operator. For this purpose, the system operator had to publish, in the year following the implementation of the Directive, average access prices for the previous year as a guide to potential new players. In the second model (rTPA), the prices for accessing to the network are regulated and not subject to negotiations. Prices must be publicly available. The system operator may refuse access to the network for technical reasons but such a refusal must be supported by a valid explanation of why access was refused. Finally, in the "single buyer model" a nominated entity acts as the only purchaser for all electricity[10]. This model was included after pressure from France to support competition in electricity generation. The member states were free to choose amongst the different models.

The Directive specifies the extent of market opening (article 19), this is defined as the percentage share of the electricity market that should be opened to

[10] See chapter 3

competition and defines thresholds for market opening (40 GWh by 1999, 20 GWh by 2000 and 9 GWh by 2003). These thresholds represent minimum requirements for market opening of 26% in 1999, 28% in 2000 and 33% in 2003.

Box 2-1: The New Directive 2003/54/EC

On 26 June 2003, the European Commission published Directive 2003/54/EC concerning common rules for the internal market in electricity, and Regulation No 1228/2003 (See Box 10-1). The New Directive is required to be implemented into national law not later than 1 July 2004 and the Regulation is applicable from that date. Directive 2003/54/EC replaces Directive 96/92/EC, which paved the way for liberalization of the electricity markets of European Community Member States. This Directive establishes common rules for the generation, transmission, distribution and supply of electricity. The Directive, which amend and recast the earlier electricity Directive, includes provisions for the legal unbundling of the transmission and distribution system operators, consumer protection and the establishment of independent national regulatory authorities. Moreover, the new Directive aims to reduce the risk of market dominance and predatory behavior and to ensure non-discriminatory transmission and distribution tariffs and network access. Furthermore, it establishes provisions for the unbundling of transmission and distribution operators and establishes labeling requirements for electricity suppliers regarding CO2 emissions and radioactive waste from electricity production and the contribution of each energy source in a supplier's fuel mix. The major changes in the new Directive are the following:

Article 3:
Public service obligation is enlarge to universal service obligation, i.e. all consumers should have the right to be supplied with electricity at a reasonable, easily and clearly comparable price.
Articles 4-5:
Members States shall monitor security of supply.
Articles 6-7:
Members States no longer have choice between different approaches for new generating capacity, they must apply an authorization procedure. However if it does lead to sufficient capacity, the tender procedure can be use as a backup. Moreover, tender can be also use for renewables.
Articles 8 to 12:
Stricter unbundling is required for transmission system operators, in particular TSOs need sufficient decision rights to decide on new investments. TSOs are responsible for "balancing".
Article 20:
Third party access (TPA) must be regulated. Moreover national regulators have to approve at least the methodology of price setting.
Article 21:
Full market opening by July 2007.
Article 23:
Member states have to introduce a regulator. Amongst other things, regulatory authorities will be responsible for fixing or approving the methodologies used to calculate or establish the terms and conditions for connection and access to networks, including distribution tariffs.

2-1-3 The implementation of the Directive 96/92

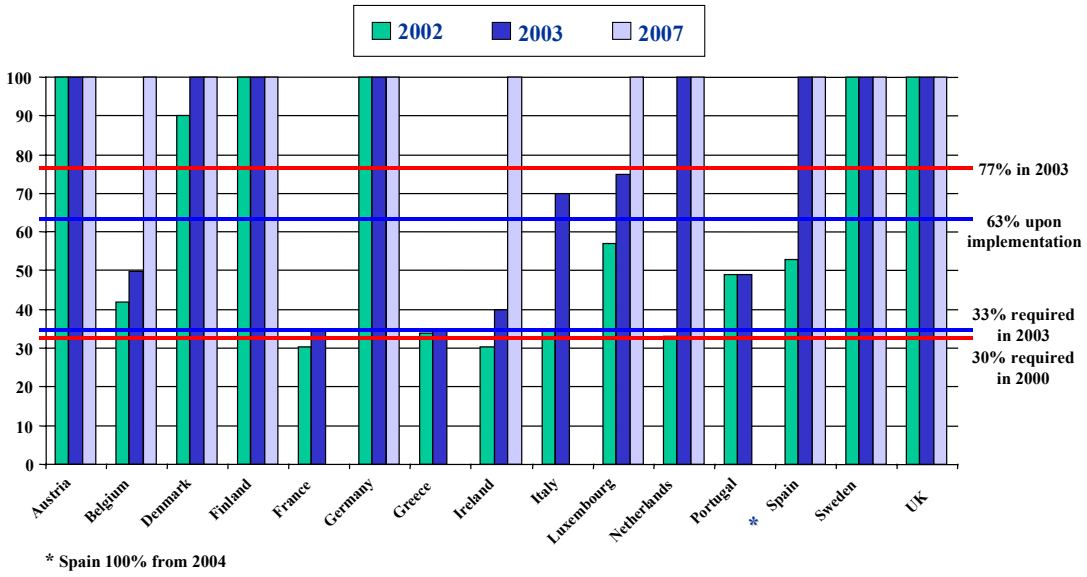
The Directive was implemented into national legislation using different approaches and different paces (Hancher, 1997). However the most important options of the Directive were chosen in a similar way throughout the Members States resulting in similar arrangements (Bergman *et al* 2000, Glachant 2001). In this section we focus on three major aspects of implementation of the directive: third party access, market opening and the transmission system operator[11].

Third party access (TPA) is one of the important points of the EU Directive. Hence it offers three ways to insure non-discriminating conditions for access to the network: regulated third party access (rTPA), negotiated third party access (nTPA) and the single buyer procedure. With the exception of Germany which choose nTPA, and Portugal and Italy who opted for the single buyer procedure, all countries have chosen rTPA. Moreover, the countries that have chosen the single buyer model are now moving toward rTPA.

Members States have opened their market to different extents. Some countries like the United Kingdom, Germany, Sweden and Finland have opened their market at 100%. Spain, Italy, Belgium, The Netherlands, Denmark and Luxembourg have opted for an opening schedule, that is much more rapid than that imposed by the Directive. Finally, Greece, Ireland and France have opened their markets to meet minimum requirements. The level of market opening achieved in 2002 is illustrated in figure 2-1. The first bar gives the level of opening of markets in 2002 while the second and third one gives the situation for 2003 and 2007 according to current plans of the Member States. Such figure shows the important differences between Member States in terms of market opening.

[11] The shortcomings of these indicators are discussed in chapter 10. For instance, while the German market is totally open by law and the French market open at the minimum threshold, in France it is quite easy to have access to any eligible customer while in Germany it is much more complicated for new entrants. This is due to the complexity of German's transmissions fees, stand-by charges and exit fees, most of which require negotiation.

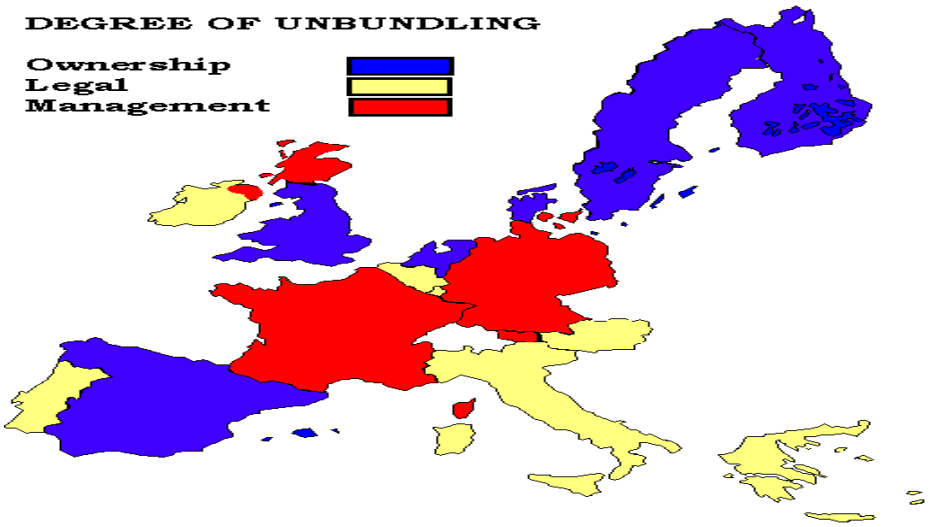
Figure 2-1: Market opening 2003



Source: European Commission, 2003

Since the autonomy of transmission system with respect to producers was an essential condition for compliance with the obligation of transparency and non-discriminatory access to the grid, most Members States have created an independent transmission system operator (TSO). However, the level of autonomy differs and can be differentiate in three categories: ownership, legal and management. Thus, the United Kingdom, Finland, Sweden, Spain, Denmark, Austria, the Netherlands, Portugal, Greece, and Italy have appointed a separate legal entity as the transmission system operator. Belgium, Germany, and France have appointed TSO, which are independent in management terms. In France, the TSO has management autonomy while in Germany the unbundling is limited to separate accounting (figure 2-2).

Figure 2-2: Unbundling



Source: European Commission, 2003

These three aspects, third party access, market opening and unbundling, represent the main criteria for implementation of the directive. It is interesting to note that while article 2 of the Directive defines a large number of concepts like for instance, generation, transmission or ancillary services, the term market is not defined. The Directive 96/92/EC grants a lot of freedom to Members States with respect to market organization. The Directive only lays down the general conditions that should be in place to assure the creation of a single electricity market but refrains from designing a concrete market organization (Schulte-Beckhausen, 2001). The Directive dictates the main principles for the development of competition through vertical separation (i.e. unbundling) of previous integrated monopolies, remove barrier to entry into production and distribution etc but leaves each country with the freedom to decide modalities and to design their electricity markets in details. Hence, the European Member States are radically changing the structure of their electricity industries following the Directive without strong guidelines on how to organize the details of their markets.

The second report from the Commission to the European Council and the European parliament on the state of the energy markets recognized that the directive only provided a general framework for the creation of a single market but that the creation of trade facilitating mechanisms is essential for the success of market liberalization. However no indications were given about the design of such "trade facilitating mechanisms" nor for the trading of electricity in general[12].

2-2 The role of electricity trading

2-2-1 Electricity as a commodity

In Europe, without any specific recommendations in the Directive the choice has been made to use an "energy only"[13] approach for electricity. Hence, as for any product, trading in electricity consists of the buying and selling of electrical energy. Trading in electricity has existed since utilities companies were formed, the main difference between trading in electricity then and now is that consumers are free to choose between suppliers. Finally, since electricity cannot be differentiated, all electrons are physically the same, it is defined as a commodity.

This "commodization" of electricity applies mainly to the wholesale level. The wholesale market for electricity can be seen as the direct result of the separation between transport and production. This new status as a commodity has led to the development of novel types of contracts for electricity trading. These contracts can either be sold on the bilateral market or on an organized market. They can also be physical contracts (for delivery) or financial contracts (hedging). However, all of the contracts share four characteristics: a defined period, a defined amount of electricity, a defined location and a price. Other characteristics can differ widely. For the purpose of this chapter we will focus on the physical

[12] The different draft amendments of the Directive from the European Commission and related works of the association of system operators (ETSO) and the association of regulators (CEER) are discussed in chapter 10.

[13] In contrast to markets where energy, transport and ancillary services are considered (e.g. markets which take into account capacity cost and spinning reserve). In "energy only" markets, players bid only energy prices. The primary income source for recovery of capacity cost is the difference between the market price and the generators' marginal costs. When ancillary services are procured separately, generators can earn additional revenue like capacity payments.

trading of electricity, as opposed to financial trading.

2-2-2 Physical trading

The physical contracts can differ between long-term i.e. from one year up to ten, forward i.e. using current or forecast price with delivery in the future, and spot i.e. very short term, mainly day ahead. Since electricity cannot be stored, this range of contracts is necessary to keep supply and demand in balance. Consumers buy in advance using long-term and forward contracts to cover their consumption. Nevertheless, players also need additional daily, and even hourly, contracts to fulfill their consumption requirements because real consumption is not completely predicable.

Table 2-1: Trading volumes, 1999-2000

	Total trading volume, TWh			Trading as a multiple of physical consumption	
	1999	2000	% Change	1999	2000
Nordic region	1364	2072	52%	4.0	5.9
Germany	220	972	342%	0.5	2.0
UK	401	655	63%	1.2	1.9
Spain	168	181	8%	1.0	1.0
Netherlands	26	79	200%	0.3	0.8
Italy	4	10	150%	0.01	0.04

Source: Prospex Research Ltd

In most European countries, these contracts are negotiated on a bilateral basis, however due to the transaction cost related to spot trading, spot markets are usually organized by a power exchange. It does not mean that spot trading cannot occur on a bilateral basis, but that for this kind of contract power exchanges are generally preferred by market participants. In most countries power trading is growing at an impressive rate. The Nordic region so far is the most important in terms of absolute volume. In this region, the total volume traded represents more than five times the physical consumption in 2000. Nevertheless, the traded volumes within others European countries, such as Germany, the United Kingdom and the Netherlands are increasing very quickly

(table 2-1). The aggregate of these volumes may soon overtake the Nordic market.

2-3 The emergence of power exchanges

The nature of electricity does not allow the possibility of true electricity spot markets, i.e. markets for immediate delivery (IEA, 2001). However, organized electricity markets such as power pool and power exchange are substitutes for a real-time spot market. In this section we identify the origins of power exchanges, which can be explained by looking at power pools. Power pools and power exchanges share many characteristics and drawing the line between these two categories of marketplace is confusing[14]. Hence, the differences between power pools and power exchanges are explained and finally an analysis of the reasons for the emergence of power exchanges is provided.

2-3-1 The forerunner of power exchanges: power pools

The term “electricity power pools” has a different meaning with regard to electricity markets and neither a standard definition nor a clear distinction are available in the literature. In this section we identify the main characteristics of a pool contrasting them with those pertinent to power exchanges described in the next section. We identify two categories of power pools: technical pools and economic pools.

“Technical” pools or “generation” pools have always existed. Vertically integrated utilities used a pool system to enable a better central optimization of generation with respect to cost minimization and optimal technical dispatch. These technical pools have been used for years by integrated utilities. In such a system the power plants were ranked on merit order based on costs of production. Hence, generation costs and network constraints were the determining factor for dispatch. Trading activities were limited to transactions between utilities from different areas. Long-term contracts for export were the principal trading activity

supporting international trade, a weak level of interconnection capacity however limited this activity.

"Economic" pools (hereafter power pool) have been created to facilitate competition between generators. Hence they have mainly been created as a public initiative by governments willing to introduce competition in generation. This system has been used worldwide. For instance, in England and Wales, Spain, California, Alberta, Chile, Argentina and in the United States in Pennsylvania, New Jersey and Maryland (PJM) where the power pool system has been promoted as a good way to achieve competition and to implement liberalization.

The most important characteristic of power pools is that they take into account numerous technical characteristics, like for instance availability of power plant and unit commitment. Hence, players in a pool can only be generators. The existence of side payments is a fundamental aspect of power pools (box 2-2) and represents one of the main differences between a power exchange as defined below and a power pool. In a pool, generators bid based on the prices they are willing to run their power plants and on others variables. Because power pools attempt to take into account a lot of technical aspects, bids to power pool are very complex. This means that due to the nature of the bids submitted to power pools the price determination mechanism involves a complex optimization calculation leading to a low level of transparency.

[14] For instance, the most famous power exchange is called "Nord pool"

Box 2-2: The first organized marketplace: The England and Wales power pool

The English/Welsh pool was created in 1990, on a basis of privatization, creating a system to permit trading for wholesale power. The pool was a compulsory day-ahead last price auction with non-firm bidding, capacity payments for plant declared available and firm access rights to transmission. Electricity was bought and sold on a half-hourly basis. The pool was a one-sided market because including sellers was considered to be impossible. Hence, the system operator estimated the demand for each half-hour. Each bidder submitted a whole schedule of prices and quantities. The unconstrained system marginal price (SMP) was defined by the intersection of the half-hourly forecast demand with the aggregate supply function provided by generators. The price paid to generators i.e. pool purchase price (PPP), was the SMP plus a capacity payment. The capacity payment came into play when there was a significant loss of load probability (LOLP) on the system, in other word when the market was tight i.e. super peak periods. The LOLP was calculated from the margin between available capacity and forecast demand. The price paid by the supplier i.e. pool selling price (PSP), was calculated by taking into account the actual production of generators per half-hour period together with additional cost for ancillary services and system constraints.

In addition to the pool, generators and suppliers usually signed bilateral financial contracts to hedge against the risk of pool price volatility. These contracts called contract for differences (CfD) specified a strike price and volume. These contracts were settled with reference to the pool price. If the pool price was higher than the agreed price on the CfD, the producer paid the difference to the consumer, if it was lower, the customer paid the difference to the producer.

The pool faced many criticisms. Price setting was extremely complex requiring at least nine different bid parameters, involving a rulebook of over six hundred pages, to describe the price calculation methodology. Capacity and availability payments rewarded generators for making plants available, not for operating them. Bids were not cost reflective due to the existence of baseload " must run" plants, which were bid for a zero price. The lack of transparency in the price determination process put consumers at disadvantages when negotiating forward contracts cover against pool prices. The non-firm nature of the day-ahead market transferred costs and risks of plant failures from the generators to the customers, through energy uplift payments. The participation on the demand side was limited to a few very large industrial consumers. The pool was replaced by the New Electricity Trading Arrangement (NETA) in 2001 as a result of the deficiencies outlined above.

2-3-2 What is a power exchange?

An electricity power exchange provides a spot market, mainly day-ahead, for electricity, which like any other market matches demand and supply for each hour, while providing a public price index. It can be viewed as a competitive wholesale spot trading arrangement that facilitates the selling and buying of electricity (Skytte, 1999). Power exchanges are " energy only market" since they do not take into account any technical aspects like transmission constraints or capacity payments. Hence power exchanges are defined for a region (or hub). Bids on an exchange only contain quantity and prices for a particular period. An exchange is absolutely neutral toward the market because its rules apply to both sides of the transactions. A power exchange is therefore a voluntary marketplace in competition with the classic bilateral market also called over the counter (OTC).

Competition in an electricity power exchange's spot market occurs by generators, distributors, traders, and large consumers submitting bids for buying and selling electricity. Each sale bid specifies the quantity and the minimum price at which they are willing to supply the energy. Conversely, each buy bid specifies the desired quantity and the maximum price at which they are willing to buy the energy. The power exchange matches supply and demand along with publishing a market-clearing price[15].

In practice, there are some overlaps between the characteristics of power pool and power exchanges. For instance, the California power exchange was mandatory during the first three years in order for it to develop liquidity (Calpx, 1999). The Nord pool, is a voluntary exchange at the national level but is mandatory for cross-border trade[16]. In the Netherlands the Amsterdam power exchange is a voluntary power exchange but is mandatory for players who obtain

[15] See chapter 5
[16] See Nord pool, www.nordpool.no/eng/htm

interconnector capacity on the daily auction[17]. Table 2-2 shows the main differences between a " pure" power pool and a " pure" power exchange.

Table 2-2: Characteristic of power pools and power exchanges

	Initiative	Participation	Participants	Demand Participation	Type of Bid	Bilateral market	Side payments
Power Pool	Public	Mandatory	Generators only	No	Price/Quantity /capacity/unit commitment...	No	Yes
Power Exchange	Private	Voluntary	Generators, Traders, Large consumers, Distributors	Yes	Price/ Quantity	Yes	No

2-3-3 Why power exchanges?

In countries where no "official" power pool has been set up, different kinds of privates entities, e.g. generators, distributors, traders, large consumers, stock exchanges, system operator etc or a combination of them, have promoted the creation of power exchanges. The idea is that because electricity is a homogeneous product, standardized contracts can be traded on organized marketplaces. Since such an initiative was not forbidden by any law or by the European Directives many project have emerged in response to different motivations.

Market participants, generators, distributors, traders and large consumers, have expressed the need for organized marketplaces to facilitate short term trading and reduce transactions costs for this type of trading. First they were looking for a place where they could buy or sell electricity at any time. Second, market participants wanted a transparent price index for benchmarking their bilateral transactions and hedging purpose. Third, power exchange represents another option for electricity procurement. Fourth, the existence of an anonymous

[17] See chapter 5

marketplace is an important advantage in a competitive environment since players do not have to reveal their position to any other market participant. Finally, power exchanges reduce credit risk since all transactions are covered by the exchange's clearinghouse.

Stock markets are another type of party who are motivated by the creation of power exchanges. Their knowledge of stock trading and especially of commodity trading can be leveraged for electricity trading. The motivation here is financial, they see trading of electricity as a new kind of service that they can offer. Moreover, the ultimate goal for these institutions is to develop financial trading based on the spot market because volumes of financial trading (as in Nord pool) can largely exceed physical consumption, which means important commissions for the marketplace.

Finally, from a system operator point of view, power exchanges also present interesting advantages. By aggregating spot transactions, power exchanges are a clear interface for economic transactions. Instead of having to deal with a lot of small spot bilateral contracts, the system operator only receives aggregate supply and demand from the power exchange. Moreover, like in Scandinavia, power exchange can help to solve technical problems[18]. For instance, power exchange can provide solution for congestion management. Finally, the system operator may also use the power exchange for its own needs (transmissions losses).

[18] See chapter 9 for detailed description.

Box 2-3: The first power exchange: Nord pool

Nord pool is a power exchange open to all players in the Norwegian-Swedish-Finnish-Danish electricity market. It began in Norway then was extended to neighboring countries. It operates under a license that gives it the right to organize the trading of electricity. In contrast to the England and Wales pool participation is voluntary allowing players to choose between the power exchange and bilateral trading. There were 281 participants in the different markets operated by Nord pool in 2000. Nord pool operates a combination of four markets.

Elspot is the physical day-ahead spot market. Prices are determined in a double auction system (supply and demand) for each hour of the day. This price is used as the reference price for settling financial power contracts but is also used as a benchmark for bilateral transactions.

Elbas is a short-term physical delivery market. It allows players to adjust their position (taken previously on Elspot) during the day right up to two hours before delivery. It allows players to reconsider their position after the result of the spot market.

Eltermin is a financial market for electricity, which does not involve physical delivery. This market is used for risk management and allows players to trade futures and forward contracts. Futures contracts are settled daily while forward contracts are settle at the end of the contract. The contracts have different time horizons, i.e. days, weeks, seasons, and years. This allows participants to hedge price risks for up to three years.

Eloption is a financial market for options. This market complements Eltermin by offering other kind of financial products.

The success of Nord pool can be explained by four factors. First the industry structure is very fragmented. The largest player in the market owns less than 25 % of production assets. Such a structure obviously facilitates competition. Second, large amount of hydropower allows storage and flexibility in production. Third the structure of the network is relatively simple compared to continental Europe, which facilitate widely congestion management. Finally the level of collaboration between system operators, governments and regulators is very high in contrast to the many conflicts of interest between continental European countries.

2-4 The "European" model: a hybrid model

2-4-1 Historical developments in Europe

The creation of organized electricity markets such as power pool and power exchanges started in Europe in **England and Wales** in 1989. The liberalization process in England and Wales was not guided by European Directives but by the then established government of the United Kingdom led by Margaret Thatcher (Vickers and Yarrow, 1991). The main motivation for this reform was the low performance of the existing system based on a monopoly structure (Green and Newbery, 1992; Green, 1996; 1998). The UK Electricity Act (1989) defined the basis of this reform. The two main aspects consisted of removing the Central Electricity Generating Board (CEGB) previously a vertically integrated monopoly for both production and transport, and the creation of the Pool (see box 2-2). Three companies were created: National Power, Powergen and Nuclear Electric. The pool began operating in 1990 and was the first organized market for wholesale electricity in Europe. The British experience provides an essential reference, it was the first one to undergo market restructuring and it remains the most radical in scope (Nicolas, 1998). In March 2001, the Pool was abolished and replaced by the New Electricity Trading Arrangements (NETA). Just before the introduction of NETA, several power exchanges were expected. In June 2003, only two were active, the automated power exchange (APX) and the United Kingdom power exchange (UKPX).

In January 1991, **Norway** implemented an electricity market reform following the decision of the Norwegian Parliament (Hjalmarsson, 2000). The main principle of the reform was to separate the different parts of the electricity value chain to differentiate functions that had a natural monopoly character from functions, which could be open to competition (Midttun, 1997). Hence, functions that had a natural monopoly character (transmission and distribution) become subject to specific regulation, while others were open to competition (production and trading). A market for physical and financial trading was created. One of the main differences with the UK Pool was the optional character of the spot market

(Shuttleworth and McKenzie, 2002). **Sweden** and **Finland** adopted similar market reforms to Norway in 1996. The Nordic power exchange was then created regrouping the three countries. In 2001, the market share of the Nordic power exchange's spot market was approximately 25% of the total annual Nordic consumption (380TWh).

With strong national political support, **Spain** was the first continental country to create an organized market for electricity (Arocena, 1998). In 1997, the Electric Sector Act and Royal Decree 2019/97, created the market operator Compania Operadora del Mercado Espanol de Electricidad (OMEL) to manage the electricity market and run the organized market. This organized market is officially called a power exchange, however the existence of capacity payments means this market falls into the power pool category (Shuttleworth and McKenzie, 2002). The Spanish electricity market began operation in January 1998, with day-ahead trading. The Spanish power "exchange" is directly run by the system operator. It operates day-ahead trading and intra-day trading for adjustments. The Spanish power "exchange" is a voluntary market but in practice bilateral trade is discouraged due to the lack of capacity payment on the bilateral market in contrast with the power exchange. Hence in 2001, 96 % of Spanish consumption was traded on this market. This market is widely isolated from the rest of Europe due to limited transmission capacity with others markets.

In the **Netherlands**, the restructuring process of the Dutch electricity industry began in 1989 with the Electricity Act (Arensten *et al*, 1966; Brunekreeft, 1997), but the main changes happened after the white paper of 1995 and the 1998 Electricity Act. The Amsterdam Power Exchange (APX) was launched in May 1999, on the initiative of international traders, energy distribution companies, electricity generators, industrial end users and exchanges to facilitate spot trading. The APX trading system is based on the Nord pool's model. From the beginning the APX has been an international marketplace due to its geographical situation. The Netherlands are strongly connected to Belgium and Germany and

the creation of the power exchange facilitates arbitrage with neighboring countries. Typically, German and Belgium players sell on the APX since the prices in the Netherlands are usually higher. These arbitrages were facilitated by the decision of the Dutch electricity regulator (DTe) to allocate part of the interconnector capacity directly to the APX (250 MW in 1999, 900 MW in 2000). Such allocation procedures ceased with the introduction of an auction for interconnector capacity in 2001. However, in order to continue to allow the APX to carry cross-border trade and insure a minimum level of liquidity, the regulator decided to force players who obtained interconnector capacity at the daily auction to use the APX. Hence, the APX, with the help of regulatory support, has seen a large part of it traded volume coming from Germany and Belgium. In 2001, 8 % of Dutch consumption was traded on the APX (Lapuerta and Moselle, 2001).

In **Germany**, the entire electricity market was opened to competition in 1998. The German market is the largest market in Europe, representing more than 20% of European consumption. The German regulatory framework was established by the Energy Sector Law of April 1998. Unlike most Members States Germany has no independent regulator, leaving the federal cartel office to act as a *de facto* regulator (Brunekreeft, 2002). Until the middle of 2000, electricity was traded only on a bilateral basis. The first power exchange (APX “Deutchland”, APXDE) was created in May 2000, on the initiative of the Dutch APX and using its model with the aim of developing a multi-hub market. In June 2000, this first initiative was followed by the launch of the Leipzig Power Exchange (LPX) backed by Nord pool, regional banks and regional governments. Like APX, LPX uses the Nord pool model. In August 2000, a third power exchange, the European Energy Exchange (EEX) was launched as an initiative of the German stock exchange. The EEX system differs from previous exchanges in that it uses an hourly auction system and a continuous trading system. The trading volumes on LPX and EEX have increased on a regular basis since their inception, however, APXDE, the third power exchange was a failure and it formally ceased operation in December

2000 after many months of no trading. In 2002, the LPX and EEX merged and created a single exchange.

After Germany, **France** with an annual consumption of 400 TWh represents the second largest market in Europe with a central geographic position. The transposition of the Directive into the French law took place in 2000 through the "law of February 2000"[19], one year after the deadline defined by the EU Directive 96-92-EC. Until the end of 2001 competition in France for eligible customers was on the basis of bilateral contracts (Finon, 2002). The French power exchange (Powernext) was launched in November 2001 as an initiative of the European stock exchange Euronext. Similar to APX and LPX, the initiative was supported by Nord pool.

In **Italy**, in 1999 the regulatory framework was established by the "Bersani decree" (legislative Decree 79/99). According to this decree, a "power exchange" (Gestore Mercato Elettrico, GME) run by the system operator was supposed to be set up by January 1, 2001. This target date was not met since the system operator presented its definitive plan to the Ministry of Industry only in December 2001 (Lorenzoni, 2003). The final design of this market is not yet known but a first project presented by the end of 2001 looked like a power pool where the spot market is only open to generators for supply, and demand must be specified at point of withdrawal. The important difference with the recently organized markets developed in others continental countries is that the aim of the GME from the beginning was to run a combination of markets, i.e. day-ahead, adjustment market, congestion management market, reserve market and balancing market, while all other power exchanges have first focused on the day-ahead market. Such a market would have been an exception at the European level. However in 2002, this scheme was aborted. At the time of writing, it remains to be seen what form the Italian market will take.

[19] Loi n° 2000-108 du 10 février 2000," Loi relative à la modernisation et au développement du service public de l'électricité", available at www.cre.fr

Table 2-2 Overview of electricity organized marketplaces in Europe

	Country	Initiative	Participation	Participants	Demand Participation	Type of Bid	Bilateral market	Side payments
UK Pool (until 1999)	England & Wales	Public	Mandatory	Generators only	No	Price/Quantity /capacity/unit commitment…	No only financial (CfD)	Yes
Nordpool	Norway, Finland, Sweden, Denmark	Semi private	Voluntary (Except for international trade)	Generators, Traders, Large consumers, Distributors	Yes	Price/ Quantity	Yes	No
Omel	Spain	Public	Voluntary (but encouraged)	Generators only	Yes	Price/Quantity /capacity/unit commitment…	Yes	Yes
APX	Netherlands	Private (but is now publicly own)	Voluntary (except for interconnector capacity)	Generators, Traders, Large consumers, Distributors	Yes	Price/ Quantity	Yes	No
LPX	Germany	Private	Voluntary	Generators, Traders, Large consumers, Distributors	Yes	Price/ Quantity	Yes	No
EEX	Germany	Private	Voluntary	Generators, Traders, Large consumers, Distributors	Yes	Price/ Quantity	Yes	No
EXAA	Austria	Private	Voluntary	Generators, Traders, Large consumers, Distributors	Yes	Price/ Quantity	Yes	No
UKPX	UK	Private	Voluntary	Generators, Traders, Large consumers, Distributors	Yes	Price/ Quantity	Yes	No
AUPX	UK	Private	Voluntary	Generators, Traders, Large consumers, Distributors	Yes	Price/ Quantity	Yes	No
GME	Italy	Public	Mandatory	Generators only	No	Price/Quantity /capacity/unit commitment…	No but CfD	Yes

2-4-2 The “hybrid” model

The freedom granted to member states by the EU electricity Directive and its different implementations in national law explains the heterogeneous market design of the electricity markets. Albeit each market has its own specificity, a kind of dominant model is emerging. Hence, in European countries the design of their electricity wholesale market shares some principles. These characteristics can be classified into three categories: organized and bilateral markets, role of the transmission system operator and allocation mechanisms for interconnection capacity.

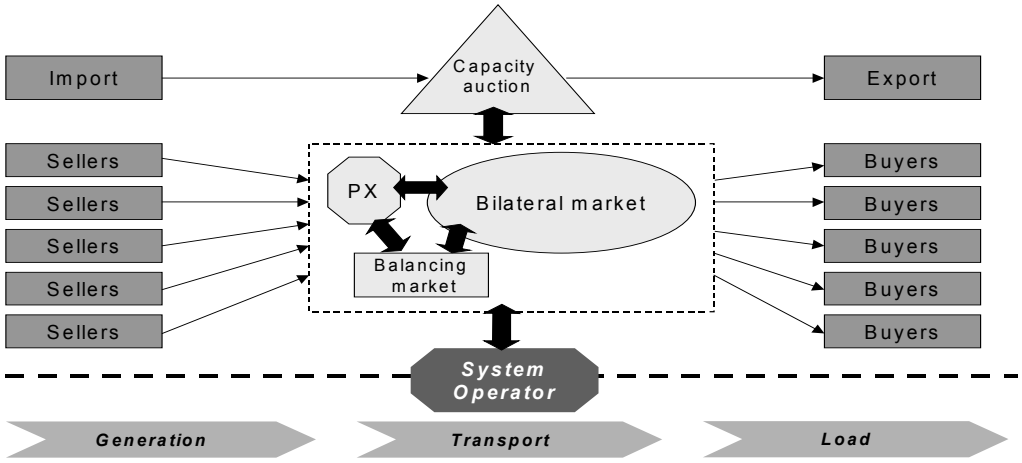
Conceptually it is useful to define an analytical framework that includes power exchanges. This is what we call the “ hybrid model”. The relationships between the electricity market and the technical system are depicted schematically in figure 2-3. The lower part shows a simplified representation of the technical system: generators feed into networks which deliver electricity to loads. The top right and left corners of the figure contain the primary actors in the electricity market, sellers and buyers. The top center box represents the electricity market where they interact. Often the interaction between buyers and sellers does not take place directly, but is mediated by traders, brokers or an organized market such as power exchanges. Hence, in most countries electricity markets are organized around four different markets while physical delivery is the responsibility of an independent system operator. These markets are a bilateral market also known as an over the counter market (OTC), one or more voluntary power exchanges (PX), a balancing market and a mechanism for allocating interconnector capacity (e.g. auction)

In continental Europe[20], in Scandinavia and in the United Kingdom after NETA, the electricity markets are hybrid models combining bilateral and organized markets. This market design was chosen to give more choice for market

[20] With the exception of Spain and Italy

participants as to the way they trade electricity. This design allows electricity markets to operate as far as possible like other commodity markets whilst insuring system reliability. In this model, generators, distributors, traders and consumers can trade electricity either via OTC contracts or on a power exchange. In this chapter power exchange are defined as market places for spot trading.

Figure 2-3: The hybrid model



The bilateral market is the most important in terms of volume. It represents more than 90 % of total consumption in the Netherlands, Germany and France and 75% in the Nordic countries. Bilateral trades occur between two parties on a confidential basis. Most of the time the contracts sold in this market are tailor made, which explains why this market is very heterogeneous. The contracts can differ in many points: starting dates, duration, and delivery areas. In the Netherlands, the volume traded on the power exchange represents 8-10 % of total consumption, in France this amount is less than 1% this is mainly due to the youth of this exchange which started to operate in 2001.

Competition in an electricity power exchange spot market is driven by generator, distributors, traders and large consumers submitting bids for buying and selling electricity. The power exchanges match supply and demand and publish a

market-clearing price (MCP). The balancing mechanism, i.e. market or regulated, is the responsibility of the system operator. Every hour, all participants inform the system operator of their physical transactions. This mechanism determines the price for any deviation measured between a participant's declaration and the real flows in the grid. The interconnector capacity market organizes the allocation of interconnector capacity between two countries. When using market based-mechanisms, this market is divided into different auctions divided into different timeframes, i.e. daily, monthly and yearly auctions. The combination of these markets shapes the actual electricity markets.

The transmission system operator is an independent organization that is responsible for physical delivery and, due to the monopoly nature of this function, is regulated at national level. The TSO acts as an interface between the technical system and economic transactions in the market. The role of the TSO in the hybrid model is comparable to the role of the TSO in most markets. However there are some differences. Since the network is a natural monopoly, network operators need to be independent of market players in order not to distort competition. The primary role of the TSO is to manage the electricity grid to insure physical delivery. The TSO maintains system stability and manage the energy balance within its dedicated area. This area is defined geographically according to national or regional boundaries. To provide added system reliability and robustness, control zones are interconnected which allow transfer of power across boundaries and different areas. When actual generation and loads deviate from the amounts that were previously notified by market parties, the TSO maintains the power balance using balancing mechanisms. If the market has projected power demands well, adjustments required to balance the dispatch pattern will be small, but they are crucial for system stability. Finally, the TSO also manages congestion, maintains reliability of service and provides ancillary services for transport. These activities are centralized due to the very short time scale involved. Hence decisions made at the time of operation are controlled by the TSO while other activities made some time before the physical delivery can

be delegated to others entities, i.e. market participants, power exchanges, with the results passed on to the TSO.

The last important feature of the hybrid model is the allocation methods for interconnection capacity between countries. Cross-border trading represents a critical aspect in the development of a pan-European market[21]. Again the EU Directive provides no specific guidance. Hence, different methods for the allocation interconnection capacity coexist[22] though recent developments have shown a preference for explicit auctions. In 2001 twelve[23] different interconnector capacities were allocated via auction and one between France and Italy is in the project phase. Before liberalization, the main purpose of interconnectors between countries was system stability, the development of cross-border trading created congestion. Thus, an auction is an allocation mechanism that can be used to distribute this scarce resource. The capacity is allocated to the highest bidder. Explicit auctions separate energy flows from transmission capacity. Hence, once interconnection capacity has been secured by a market participant, the participant will need an other transaction for energy. This can be done on the bilateral market or on a power exchange. Some direct relationship may exist between the auction and the power exchange as in the Netherlands where players who have obtain interconnector capacity to import on the daily auction must obtain a related contract on the power exchange[24].

Existing markets in the United Kingdom, the Netherlands, the Scandinavian countries, Germany and France can easily be derived from this model. Given this the model will be use rather than specific countries for the analysis.

[21] See chapter 8
[22] See chapter 9
[23] Four between Germany and the Netherlands, two between Belgium and the Netherlands, two between Denmark and Germany, two between Germany and the Czech Republic and two between France and the United Kingdom
[24] See chapter 5

2-5 Conclusion

The main aspects of the EC treaty and the electricity Directive 96/92/EC which represent the legal framework of the liberalization of electricity industry in Europe have been presented in this chapter. The Directive only provides a general framework for the creation of a single market, the creation of institutional arrangements, such as organized markets, is not mentioned. Hence, without any specific recommendation various electricity power exchanges have emerged to facilitate the trading of this “commodity”. We have identified several reasons for the emergence of power exchanges and their principal differences with others types of organized markets. Finally, we concluded the chapter with a definition of an analytical framework for wholesale electricity markets, ”the hybrid model” which will be use as a reference throughout the thesis rather than referring to specific countries. This model sheds light on the double nature of power exchanges, i.e. power exchanges are organized market places institutions that forms part of the global wholesale market design.