Power Exchanges in the Liberalised Electricity Market

Two years after the law amending the regulations governing the German electricity sector came into force, introducing competition into the industry, trading is starting on two power exchanges, marking a new phase in the liberalisation of the German electricity market. In June, spot trading in electricity began on the Leipzig Power Exchange (LPX), to be followed in August by the European Energy Exchange based in Frankfurt am Main. Both are to be supplemented by power-derivatives markets. These exchanges are expected to provide a forum for between 20% and 25% of overall German trade in electricity. Electricity trading on such exchanges and the new electricity price indices serve to make the market more transparent and to reduce arbitrage profits at the European wholesale level. Experiences to date with the exchanges in Scandinavia (Nord Pool) or Amsterdam (APX), and with the British pool model show that the efficiency of exchange trading depends largely on the institutional arrangement and the market structures prevailing in each case. Free competition is threatened where the number of participants is inadequate and the market dominance of individual suppliers or demanders enables them to behave strategically. It is also questionable whether in the long run Germany can sustain several profitable power exchanges operating in parallel.

Enforced competition and liberalised electricity markets

In recent years the liberalisation of electricity markets in many countries has led to the breakdown of traditional monopolies and added the option of flexible and short-run forms of trading to the usually long-run supply contracts between electricity supply companies and their customers. Since as early as the start of the 1990s, electricity has been traded on so-called pools and increasingly also on exchanges in a number of countries. The preconditions for this to occur in Europe, too, were established on 19 February 1997, when the EU Electricity Directive (96/92/EC) came into force. The directive requires member States to begin to open up their national electricity markets to competition within two years. In Germany the amendment to the energy law (*Energiewirtschaftsgesetz* – EnWG) took effect on 28 April 1998, removing the protective regulations underpinning the regional monopolies of the German electricity companies, and introducing the freedom to choose supplier.

If effective competition is to be created and the desired effects of liberalisation – in particular cheaper energy supply – are actually to be achieved, a number of basic conditions must be fulfilled. These include, firstly, the ability of both existing and new suppliers to offer their products under non-discriminatory conditions. Secondly, on the demand side customers must be given the opportunity to purchase a desired product (such as 'green' or 'yellow' electricity, or an energy service) at a transparent price from a supplier of their choice. For this to occur, thirdly, the market as a whole must be sufficiently transparent with respect to prices and the quality of the goods on offer.

In contrast to other commodities traded on exchanges, a number of additional mechanisms are required in the case of electricity, in view of the facts that it must be provided via a network of electricity cables and that it cannot be stored. Yet initial fears that technical restrictions linked to the electricity grid might hamper an intensification of competition have proved unjustified so far. Progress in transmission and metering technology has in fact enabled electricity systems to be co-ordinated and optimised continuously, thus making them compatible with competition needs in both technical and accounting terms. An electricity system is an integrated circuit that follows the laws of physics, not the laws of financial contracting. All electricity generated goes into a common pool, and consumers draw energy from that pool. A closely meshed power grid with a large number of generators and withdrawal points, such as the central European electricity system, hence gives rise to questions of transmission pricing (metering, billing) rather than actual physical constraints. This is all the more so given that experiences in other countries suggest that not more than between a fifth and a quarter of total electricity transmitted will be traded on exchanges.

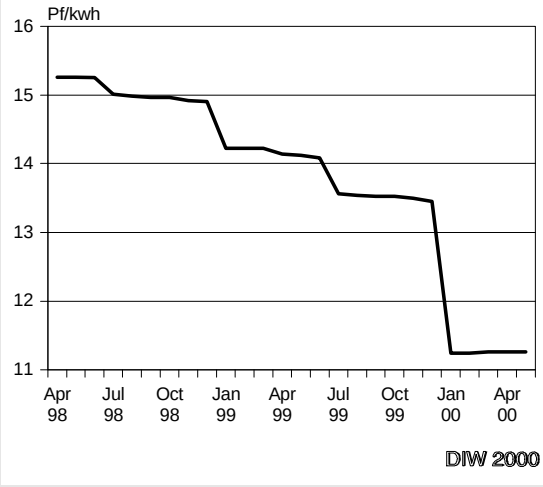
Even so, the physical characteristics of the electricity market make it necessary to balance out short-term imbalances between the electricity generated and that consumed, in order to ensure the continued quality of supply. For this reason market activity will be restricted to the extent that some electricity supply companies will continue to be subject to an obligation to supply electricity. Imbalances can, however, be equilibrated by means of a market for regulation power and the minute reserve, without this placing serious limitations on either exchange-based or bilateral trading.

The current excess capacity on the electricity market makes the creation of trading places for electricity par-

ticularly urgent. The liberalisation of the German electricity market began in the context of virtually constant electricity consumption on the demand side, and overcapacity on the supply side. This constellation meant that liberalisation unexpectedly quickly took the form of cut-throat competition and a marked fall in wholesale prices, despite the existence of restrictions on access to the electricity networks and the fact that electricity exchanges had not yet been established. This can be clearly seen from the Dow Jones/VIK electricity price index for special-contract clients in Germany (cf. figure 1).[1]

Electricity is increasingly becoming a tradable commodity. The risk incurred by consumers in meeting part of their needs at comparatively short notice – and indeed speculatively – rather than tying themselves to long-duration supply contracts at high prices, are diminishing. This is particularly true of the demand for peak-load electricity, but also applies to electricity to cover base load needs. Power exchanges can help to reduce the remaining risk even further.

Figure 1
Dow Jones/VIK Electricity Price Index[1] for Germany, April 1998 to May 2000



1 Industrial customers purchasing between 100 kw for 1 600 hours p.a. and 25 500 kW for 7 000 hours p.a.
Source: Verband der industriellen Energie- und Kraftwirtschaft (federation of the industrial energy consumers and self-producers).

Electricity exchanges as an element of portfolio management

An exchange is a market place on which standardised products are supplied and demanded regularly and anonymously. Product standardisation – for instance for a given number of megawatts at certain points in time – reduces transaction costs compared with a situation in which each individual supply of electricity needs to be re-negotiated. The exchange also assumes responsibility for the financial-technical aspects of the transaction, reducing the administrative costs incurred by market participants. In return they normally pay an annual fee plus transaction-specific contract charges. This revenue is used to finance the exchange. Each participant is then able to inform the exchange of its price and quantity preferences for given points in time. The individual supply offers and preference curves entering the exchange are aggregated to a supply and a demand function, on the basis of which the market-clearing price is determined.

In the case of traditional OTC ('over the counter') transactions, by contrast, the contracts negotiated for the sale/purchase of electricity are bilateral, specifically tailored to the needs of the two contracting parties; they are thus not standardised. The transaction costs, that is the costs incurred in obtaining information, identifying possible trading partners and negotiating the contract itself, are markedly lower in the case of standardised products, all the more so if they can be traded on an exchange. On the other hand, OTC transactions have the advantage that the contract provisions and the supply conditions are fixed, minimising price and quantity risks. Consequently, large power utilities now have departments whose task is to weigh up and to optimise the alternatives – in-house production, or procurement either over the counter or via an exchange – within the framework of the company's portfolio management.

In principle, the characteristics of an exchange (anonymity, concentration of information, price transparency, and neutrality vis-à-vis group interests) generate the expectation that, provided there are sufficient participants and trading volume ('liquidity' as it is called in stock-market jargon), competition will be largely undistorted, unmanipulated and thus 'objective'. The price determined on the exchange is published and also serves as a reference price for transactions not conducted on the exchange. This is in contrast to the prices negotiated in traditional short-run contracts between energy supply companies in order to balance out supply and demand, which need not be made public.

Various forms of auction and price-determination mechanisms are conceivable on the exchange. The elec-

[1] The quantity-weighted Dow Jones/VIK electricity price index has been published monthly since March 1998. The data are based on the quantities of electricity consumed by special-contract clients in 1997. Since March 2000 the electricity price index has been calculated on the basis of the quantities consumed in 1998.

tricity exchanges in Leipzig and Frankfurt are both starting with a spot market for hourly contracts, for electricity to be delivered the next day. After an initial period of a few months, trading is to be supplemented by various power derivatives.

Just as on commodity exchanges, short-run trading (the spot market) and the medium to long-term derivatives market complement one another. Supplies of electricity for the next day are traded on the spot market. Seasonal and temperature-related fluctuations in demand, and variables influencing the conditions under which electricity is generated, such as the cost of fuel and the availability of generating capacity, mean that spot prices may prove volatile. The risks arising out of such volatility for market actors can be mitigated with the help of derivatives or futures contracts (hedging).

Normally it is not physical supplies of electricity that are traded on the futures market, but rather financial products, the aim being to insure against short-run price risks. The volume traded on the derivatives market is many times the physical volume traded. Futures and options are the titles traded. The contracts relate to a standardised amount of electricity at specified supply conditions; all that remains to be determined is the price. Prices for futures transactions can be based on an exchange spot market or on conventional bilateral OTC transactions, provided these are aggregated in the form of a price index.

Price indices – complementary to or in competition with exchanges?

In recent years various companies in Europe have established electricity price indices. In contrast to the prices formed on exchanges, price indices need not necessarily describe the outcome of competition. They are no more than the arithmetic aggregation of electricity prices as reported by – at best, representative – market actors as the result of their bilateral agreements. The voluntary nature of such reporting and the lack of verifiability reduces the reliability of price indices as a source of information; the market concentration characteristic of exchanges is also lacking. The verification problem does not arise in effectively functioning electricity exchanges, where it is solely the market behaviour of suppliers and demanders that determines price.

At present, among the most important price indices in central Europe are:

- The Swiss Electricity Price Index (SWEP), the first of its kind, which since 1998 has registered the daily peak-demand price at the border crossing point of Laufenburg[2] on the German-Swiss border, and
- The Central European Power Index (CEPI), developed by Preussen/Elektra and other electricity generation companies, which has been published since 1999. It covers four prices in the Preussen/Elektra supply area: the prices for daily and for seven-day contracts for normal and for peak-demand electricity. Preussen/Elektra was selected because the company has a large number of international connection points (more than 13) and uses them for cross-border trade.[3]

Over time the various indices and power-exchange prices move within a comparatively narrow band; at the same time they are only slightly higher than the system prices recorded for the Nord Pool (cf. figure 2). This suggests that the price indices generally reflect marginal cost. This view receives further support from the marked fall in prices in new bilateral supply contracts for virtually all segments of the market (level of demand and size) since the electricity market in Germany was liberalised.

In market economic terms, the prices determined on exchanges are superior to those given by price indices. Especially during the transition period, both the price indices and the electricity exchanges have almost certainly served to intensify competition on the central European electricity market. The current boom in electricity price indices will probably prove to be a passing trend, however; in future electricity exchanges will gain predominance on the electricity market throughout Europe.

Amsterdam Power Exchange: Institutional restrictions

The problems that can result from institutional restrictions on exchange trading are exemplified by the Amsterdam Power Exchange (APX), the first electricity exchange in central Europe. The overall volume traded on the Amsterdam exchange has consistently been inadequate. As a result it suffers from at times severe fluctuations in spot prices; in early 2000 sudden price movements exceeded 500%.

The APX opened trading in May 1999 with a spot market for electricity supplied on the following calendar day. Purchase and sales offers are made on a given day for specific hours of the next day. The APX announces,

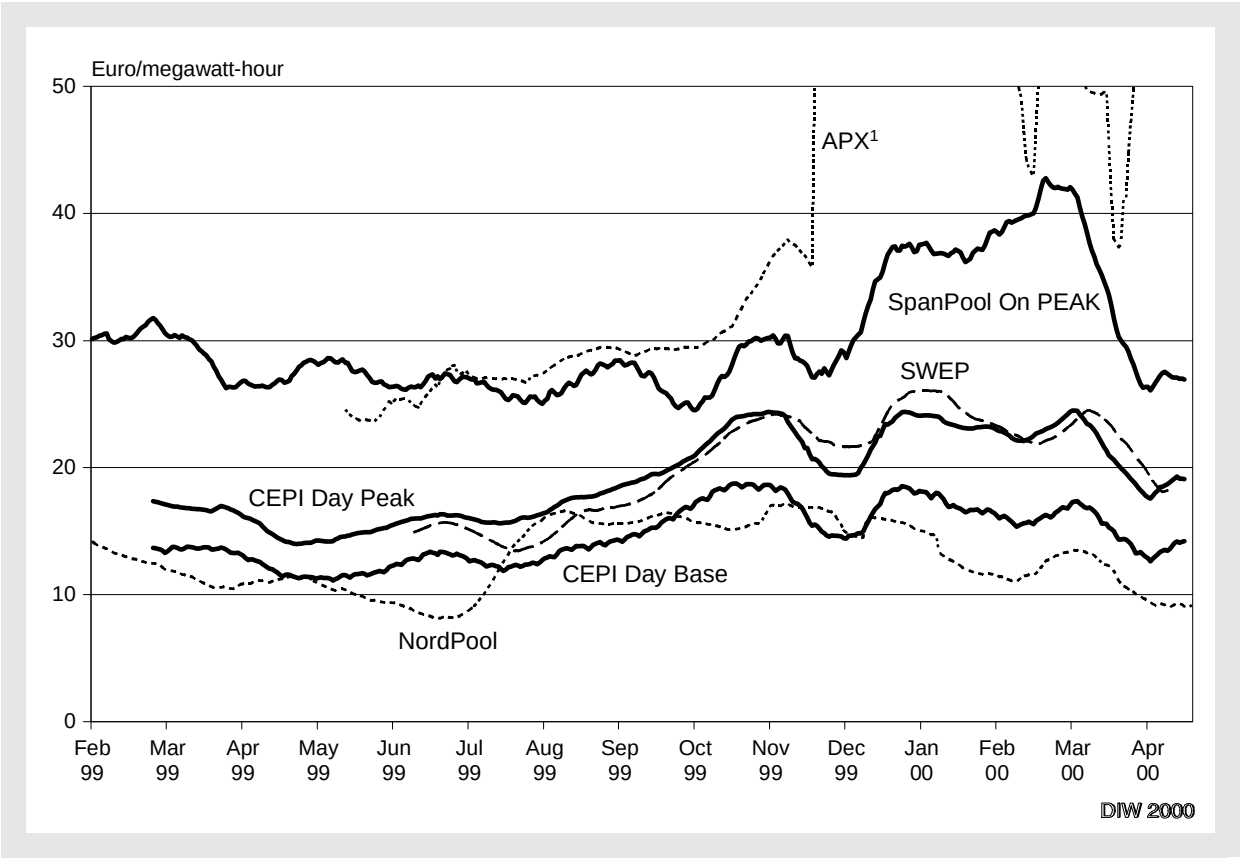
[2] Laufenburg was selected because it is here that the volume of cross-border sales of electricity is greatest.

[3] By analogy with the CEPI, Bayernwerk has developed the Energy Index South (EIS) as an index for the electricity trade zone centred on southern Germany.

Figure 2

Electricity Price Indices in Europe

Moving 30-day average



1 Fluctuations during 2000 far exceeding the scale.
Sources: Dow Jones; Amsterdam Power Exchange; DIW calculations.

on the basis of the offers made, 24 clearing prices, and also publishes a daily electricity price index. The product range is to be supplemented by trading in futures and options. In May 2000 the APX extended trading to parts of the German network, following the conclusion of an agreement in March with the German electricity utility VEW on the utilisation of the latter's electricity network.

APX spot trading commenced with 18 participants, all of which must be able to physically supply or acquire electricity. Although the number of participants has since risen to 27, the figure remains inadequate. Turnover volume – at an average of 6 million kWh per day, or less than 3% of annual electricity consumption in the Netherlands – is also too small.

The most important constraint on trading on the exchange lies in network bottlenecks. Tennet, the network operator, decides each day what quantity of electricity can be traded at what point in time. This severely constrains the volume traded, particularly of electricity supplied across national borders. Until the end of 1999, the volume of electricity imports traded on the exchange was limited to 250 megawatt of the total of 3 500 megawatt of cross-border transmission capacity; the recent increase to 900 megawatt has not removed the bottleneck. In effect this means that the Dutch market is cut off from that of its neighbouring countries, removing the scope for arbitrage.

The limited volume of trade on the exchange, and in particular the lack of market opportunities for Dutch electricity abroad, are due to an institutional characteristic that was established in order to protect so-called 'stranded investments'. Ultimately, electricity trading is regulated by a central institution, the so-called Protocol: electricity producers are allowed to sell only to this institution, while distributors may only purchase electricity from it, the APX, or via existing, long-term import contracts with foreign electricity suppliers. As a result the price of electricity in the Netherlands is higher than the prevailing level in central Europe.

Moreover, the costs of participating in the APX are comparatively high: there is an annual charge of euro 25 000 (Nord Pool and LPX: euro 12 500) and the transaction charges are euro 0.2/MWh, compared with euro 0.04/MWh on the Scandinavian and the nascent German exchanges. As a result potential participants have had an incentive to wait for the German exchanges to begin trading.

Imperfect competition on largely isolated markets: the case of Great Britain

High prices also exist on the electricity market in Great Britain, although prices there are determined by auction. The pool active in England and Wales is considered to be one of the earliest examples of a competitive market. Yet studies have shown that the System Marginal Price (SMP), published by the pool as an index, is significantly above system marginal cost. At the same time the pool prices are just below the market entry costs for new suppliers.[4]

Analysts explain this phenomenon in terms of supply-side concentration on a largely isolated national electricity market. The capacities of the international electricity links are limited to 2 000 megawatt, or less than 5% of the maximum system demand in Great Britain. The influence exerted on prices by the European continent is correspondingly marginal. Not least for this reason, the two leading power producers, PowerGen and National Power, have been able to establish a duopoly and influence the electricity pool through strategic behaviour.

In contrast to most exchanges, the electricity Pool in England and Wales is based on a unilateral auction model. The pool is a wholesale market in which almost all producers, traders and regional distributors must take part. Although large-scale consumers have also been permitted to bid since 1995, effectively the pool is a forum for a unilateral supply-side call auction: next day's prices are ranked (merit order) on the basis of the sales offers of virtually all the power companies for each 30-minute interval of the coming day in terms of rising cost until expected demand is met. The price charged by the last (marginal), and thus most expensive, power station for each 30-minute interval is the system marginal price and is paid to all the power stations supplying electricity.

The procedure's complexity and lack of transparency prevents prices being determined in accordance with market principles, however. Alongside the market power wielded by the two largest producers, PowerGen and National Power, the enforced participation of virtually all producers prevents competition developing. This explains why the system marginal price remains at a high level, in spite of a general fall in fuel, running and capital costs. The system is currently under review.

Similar developments can be observed on the Spanish electricity market. As is the case with the British market, there are scarcely any links with other European regions and there is a high degree of concentration among producers. As a result, pool prices in Spain are higher than those in central Europe.

Successful exchange model in Scandinavia: Nord Pool

Nord Pool, the first international electricity exchange, is a positive example, compared with the British and Spanish model, in terms of promoting competition. Nord Pool commenced operations back in 1993 in Norway; since then it has been progressively extended. In 1996 Norway and Sweden set up a joint electricity exchange; they were joined one year later by Finland, and most recently also by Denmark. Today Nord Pool is the direct trading partner for the more than 260 participants now registered. Around 20% to 25% of the total market volume is traded on the exchange. The exchange also assumes financial liability for the risk incurred by a supplier when a purchaser fails to pay. The exchange is open to producers, suppliers and large-scale consumers, and also to brokers and electricity traders. Alongside Scandinavian actors, British and German participants are also registered, including Preussen/Elektra and the Hamburgische Electricitäts-Werke (HEW). Both short-term contracts (spot trading elspot) and futures contracts (elfutures) are traded on the Nord Pool. On the spot market electricity quantities for supply next day are traded. Futures contacts can be concluded for any period between one week and three years. In future trading in options is also to be permitted. The experiences gained in trading on the Nord Pool are to form the basis for the electricity exchange in Leipzig, in which Nord Pool currently owns a 25% stake.

The unstoppable momentum of competition in central Europe

Experiences to date with electricity trading on exchanges suggest that competitive pressure on the

[4] Cf., for example, Catherine Wolfram (1999), 'Measuring duopoly power in the British electricity spot market', *American Economic Review*, vol. 89, no. 4, September, pp. 805–826.

highly integrated central European electricity markets, with their large number of suppliers and demanders, will be large enough to bring about a lasting reduction in prices to the level of system marginal cost. The establishment of international electricity exchanges is likely to add further impetus to this development. Given the existing excess supply, a situation that is expected to continue for some time to come, and adequate network capacity, the scope for arbitrage there will soon be removed.

At the same time, trading electricity on exchanges opens up new institutional opportunities to achieve other energy-policy goals. For instance, certificates for 'green' electricity and electricity from combined heat/power plants could be traded on such exchanges.

A crucial element in the successful liberalisation of the German electricity market remains the question of network access. Most countries are characterised by a more or less complete organisational and corporate separation between network operation and electricity generation and distribution. The problems that arise from the imposition of restrictive conditions on network access can be observed in the Netherlands. In Germany the leading energy supply companies have adopted a simplification of the conditions for network access,[5] one that moves away from the case-by-case transmission of electricity and is compatible with the establishment of electricity exchanges. However, the history of the association agreement itself indicates the lack of interest on the part of vertically integrated companies in broad-based network access.

Although the competing initiatives to establish a German electricity exchange have led to their establishment sooner than had been expected, the parallel operation of numerous exchanges, traded products and price indices reduces market volume and thus possibly the effectiveness of each individual trading place.

As the experience of other countries has shown, it is the prevailing institutional conditions and market structures that are decisive for effective competition. The most important of these are simplified rules for network use. The problems resulting from institutional barriers, as in Great Britain and Spain and in the case of the electricity exchange in the Netherlands, can, on the other hand, be expected to be merely temporary in nature, as in the longer run they will be unable to withstand the pressure of comparative European markets.

Barbara Praetorius

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[5] In a revision to the Association's Agreement on Criteria to Determine Transmission Tariffs, signed on 13 December 1999.