Review and analysis of EU wholesale energy markets

Historical and current data analysis of EU wholesale electricity, gas and CO_2 markets

Final report

Client: European Commission DG TREN

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Rotterdam, 09 December 2008

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Executive Summary

This study provides a quantitative analysis of historic and current trading contracts, volumes and prices (electricity, gas and CO_2) for relevant EU regional gas and power markets, including an evaluation of the relative importance of energy exchanges and OTC trading. The underlying goal of the study is to provide an overall picture of these markets by focusing on historical and current data analysis. To do so, ECORYS retrieved data from the various European energy exchanges and had to rely on the cooperation of energy brokers – in this case 'Heren' data was the main input for Over-the-Counter (OTC) trading data. OTC contracts in both gas and power markets constitute the overwhelming bulk of traded volumes, given that they are more flexible in terms of products offered and usually cheaper. The OTC information available is limited due to the confidential nature of these transactions. As such, the analysis of the OTC energy markets is an estimate of the true market dynamics and is in addition focused on Western region markets.

We did not delve into analyzing bilateral contract data given that we were not able to have access to bilateral data from market players due to the highly confidential nature of the former. Furthermore, we did not receive bilateral data from DG Competition, which had initially been agreed to be released to this consortium.

Power Markets

For exchanges over the 2002-2007 period, we found a clear increase in traded volumes, market participants and importantly price correlations among various exchanges. We also noted that there is a negative relation between an increase in market participants (liquidity) and volatility. It should be noted that on spot power trading, price volatility remains notably high. In fact, derivative contracts by volume were found to be higher in volume, less volatile but more concentrated on one exchange (EEX).

Given the substantial share of OTC contracts in power trading (with the exception of the Nordpool area), exchanges provide signals and benchmarking for OTC contract modalities. For example, the convergence of prices seen in the German power market between exchanges and OTC trading is near absolute. The OTC market has grown substantially in Europe - estimated to be worth approximately €285 billion in 2007 with volumes of trade doubling since 2006. Spearheading this trend is the focus of trade in the forward physical markets with very low financial volumes being traded - approximately 1% of total volumes make up purely financial trades (e.g. swaps and options).

In general, an increase in physical connection capacities and market coupling initiatives (e.g. Trilateral Market Coupling initiative) has increased liquidity and price signals in the European power market. Such thrusts at both the national and regional levels must continue to move forward.

Gas

The natural gas market is dominated by the UK in terms of volumes of trading, the majority of which is over the counter. In terms of production volume, the UK along with Norway and the Netherlands are the key players in the market. As Europe's most liberalised gas market, the UK's National Balancing Point (NBP) hub leads European wholesale gas liquidity, but significant future potential exists in the Dutch TTF market which has grown at a faster rate than the UK NBP. In addition, some emerging gas hubs are beginning to develop outside of the UK's NBP market.

Gas trading on exchanges is substantially less developed than for power, in terms of volumes, participants, and the number of exchanges and products offered. The UK NPB has cornered all virtual trading contracts, with exchanges accounting for less than 10% of total physical and virtual trading. In general, because of a lack of data for exchanges (not going back more than 2 years) and a negligible level of volumes and trades, running price correlation calculations and assessing sound volatility indications proved harder than for power markets.

CO_2

Traded volumes of EU emission allowances (EUAs) take place in derivative markets. The immaturity of the carbon market, the reactivity of prices (given the number of covered installations and the impact single trades have on the market), political decisions (to cover the aviation sector for instance, or the apparent lenience of national allocation plans), supply and demand side factors, contribute to current volatility of prices in all ranges of products as well as a higher developed futures market.

1 Introduction to the European energy markets

The EU's energy policy lies in pursuing a sustainable, competitive and secure energy supply. Creating a single integrated market for energy is one of the building blocks of the EU's broad energy policy, given that market integration can increase security of supply and in the long run lower energy prices. Market liberalisation in the power, gas and carbon markets constitute the driving thrust towards a more transparent, fluid and integrated European energy market.

The European Council initiated the liberalisation of the electricity and gas market with the implementation of directives 96/92/EG and 98/30/EG. They were followed by the new Directives 2003/54/EC and 2003/55/EC. The aim of the liberalisation of energy markets is to offer end-users choice between suppliers so that they can profit from lower prices for energy and a better quality of service. In addition, these directives guide the creation of internal markets for electricity and gas by setting up a framework for harmonisation.

A keystone of the current energy policy is to ensure that consumers fully profit from the benefits of liberalisation of energy markets. Where it is thought that competition in energy supplies, as in normal services sectors, leads to lower prices, and a higher quality of service, innovation in energy supplies and more flexibility in services ensues. Energy policy, however, also recognises that liberalisation might not immediately lead to the desired effects and that the sector specific demand and supply relationships may lead to undersupply and poor quality of services.

Although a great deal has been achieved in the years 2005 and 2006 by the Commission in terms of stimulating a single European market for energy services, there remain obstacles to achieving the final end point of a competitive EU-wide market where European customers can adjust their consumption behaviour based on changes in the market and enjoy fair consumer choice. The reasons for this are numerous and are connected to:

- the physical nature of the energy products (i.e. infrastructure requirements, transmission networks, national- as opposed to trans-national generation);
- the asymmetrical availability of this physical information;
- the lack of transparency of trading activities;
- market concentration and vertical integration.

The Commission has set out legislative proposals (19th September 2007) addressing the transparency requirements of the physical components that underlie energy markets, but is now planning to address the trading aspect of this equation and in particular whether transparency requirements (on trading activities) are necessary to ensure the proper development.

1.1 Objective of the Study

The objective of the study is to provide the Commission with a clear overview of the current state of affairs of the European energy markets, specifically the power, gas and CO_2 sectors in the exchanges and Over-the-Counter (OTC) markets. Providing a clear picture of the trading aspects of the wholesale gas, power and CO_2 market will shed light on the current impediments to promoting more liquid and transparent markets. In particular, a review of prices trends, volatility, volumes and coupling will indicate how mature various markets are. Liquidity will be assessed by examining the number of participants in the various trading platforms.

1.2 Outline

Section 2 examines the wholesale market for power in exchanges and OTC contracts. After a review of the state of the EU electricity market (geographic structure of the electricity market, number of exchanges, interconnections, products, regulatory initiatives), in depth assessments and evaluations of the two platforms for electricity trading (OTC and exchanges) will be carried out.

With regards to exchanges, the main geographic area of focus is the Central West and Northern regions, given that they are the most mature, liquid and interconnected. Those exchanges not examined in this study do not present sufficient volumes or longevity to be significant in the final analysis. Prices and volumes, time trends, price volatility, price correlations, volumes vs. consumption, products offered, actors and liquidity will be examined in each market and compared meaningfully to other trading platforms.

OTC data is not readily published or easy to obtain by other means as the data is by its nature confidential. Brokers who facilitate exchanges between two parties in the OTC market do not relinquish their transactions and it is therefore much harder to analyse the OTC market at the same level of detail as compared to exchange-derived trading data. Nevertheless, the OTC power trades are analysed in section 2 as far as it has proven possible to do so – based on the data of the cooperating parties approached by the consortium. The OTC power market is analysed for its size and growth in consecutive years since 2003/4 to the present day, whilst key players, the headline trends and the key products in OTC trading are analyzed. For all commodities, i.e. power, gas and CO_2 emission credits, the OTC trading characteristics will be analysed separately in each chapter by providing an overview of the European markets firstly, then by taking a closer look at the mature and/or longer-standing markets for these commodities.

Section 3 examines the EU gas market in the same structure as section 2. A review of the current state of the gas market will shed light on the role of the two platforms through which it is exchanged. It will emerge that the role of exchanges in the gas market is less important than for electricity, with OTC contracts making up the bulk of energy exchange. Bearing in mind the lack of availability of OTC data it is still possible to

measure liquidity, maturity of the market, the general role of OTC, as well as have a picture of the different actors in the market.

Section 4 delves into the CO_2 allowance market. Due to the recent nature of the CO_2 market in the EU (2005) and its inextricable nexus with political decisions (namely National Allocation Plans), price volatility behaviours and products offered on the market will attest to the need for further regulatory constraints to anchor confidence in the mechanisms set out by the EU Emissions Trading Scheme.

1.3 Definition of Terms

Definitions of key terms in the energy market are important to provide clarity on the role of each component, and understand its relation to the broader market. The following terms are defined in relation to the study, so as to provide the most clarity and relevance.

1.3.1 Market Terms

Power

Electricity in the EU is typically bought and sold in megawatt hours (MWh). When evoking electricity trading at a macro level, gigawatt hours (GWh) are used for matters of simplicity[1]. Electricity is transmitted through a grid that allows a generator to transport power from one point to another, provided the network on which the power is being transmitted has a) the physical capacity to transport the electricity (i.e. a physical interconnection between generation and delivery point) and b) has the capacity to transport power at a given point in time (i.e. the grid is not congested). Electricity is by its nature difficult to store and has to be available on demand. Consequently, unlike other products, it is not possible, under normal operating conditions, to keep it in stock or ration it.

Gas

Natural gas in the EU, which can also take the form of liquefied natural gas (LNG), is mainly imported from Norway, Algeria and Russia. It is a highly strategic commodity and is the centre of attention in Europe with regards to the need to increase the EU's independence of energy imports. Gas is physically transported to the EU via pipelines. The latter usually converge to a gas hub. As opposed to electricity, natural gas can be stored, making the logistic of gas production and distribution slightly easier than for power.

Gas Hubs

A gas hub is the point of entry into a natural gas transmission network. Hubs draw supply from a variety of sources and enable operators to market gas to end-users. Gas hubs can also be a virtual trading point, much like an exchange, where gas products are financially traded but not physically delivered.

[1] 1GWh = 1000 MWh.

EU Emission Trading Scheme (EU ETS)

The CO_2 market in the EU emerged in 2005 after the Emissions Trading Scheme (ETS) was set up in the European Union. By setting a cap on carbon dioxide emissions by country, the right to pollute has become something to be bought and sold on markets, with several exchanges in the European Union having set up some important market places for exchanges. Prices of CO_2 allowances in the first phase of the ETS (2005-2007) ended at a record low price of €0,1 per tonne in 2007, given that it became evident that national emissions allowances granted by individual EU countries were not constraining enough (CO_2 caps were too high). The second phase (2008-2012) has set emissions cap lower than for the first phase.

Exchanges

An exchange (in power, gas or CO_2 for instance) is a marketplace in which securities, commodities, derivatives and other financial instruments are traded. The core function of an exchange is to ensure fair and orderly trading, as well as efficient dissemination of price information for any securities trading on that exchange. Exchanges give companies, governments and other groups a platform to sell securities to the investing public. An exchange may be a physical location where traders meet to conduct business or an electronic platform. The main goal of exchange-based markets lies in the facilitating trading of standardized products as well as promoting market information, participation and liquidity. Exchanges also provide other benefits, such as a neutral marketplace, a neutral price reference, easy access, low transaction costs, a safe counterpart, anonymity and clearing and settlement service. Furthermore, exchanges provide a benchmark reference for both for over-the-counter and bilateral trading.

Day-ahead market

Exchanges usually provide a day-ahead market (also called spot market), where the bids are submitted and the market is cleared on the day before actual delivery. Every day open for trading is divided into periods (e.g. 24 blocks of 1 hour each). Each bidder makes a price bid for every generation unit for the whole day. On the whole, hourly contracts (for the 24 hours of the calendar day) or block contracts (i.e. a number of successive hours) are traded in the day-ahead market. Whereas hourly trading allows the market participants to balance their portfolio of physical contracts, block trading allows them to bring complete power plant capacities into the auction process.

Intra-day market

Due to the long time span between the settling of contracts on the day-ahead market and physical delivery, exchanges sometimes offer an intra-day market. Intraday trading allows for purchase and sale of a product within a given trading day. This market closes a few hours before delivery and enables the participants to improve their balance of physical contracts in the short term.

Futures

A futures contract is a contractual agreement, generally made on the trading floor of a futures exchange, to buy or sell a particular commodity or financial instrument at a pre-determined price in the future. Futures contracts detail the quality and quantity of the underlying asset; they are standardized to facilitate trading on a futures exchange. Futures

fall under the category of derivative products which are securities whose price is dependent upon or derived from one or more underlying assets.

Forward

A forward contract is similar to a future contract in the sense that it is an agreement that locks in the price of a product to be delivered at a future date. However, forward contracts, as opposed to future contracts, are not standardized products; their structure is determined by to parties involved in the transaction. Secondly, a forward contract does not trade on an exchange (i.e. it can be traded OTC or bilaterally). With regards to the power and gas market in the EU forward contracts are mostly used between large energy suppliers and end users.

Over-the-Counter (OTC)

OTC contracts are not listed on exchanges (although OTC deals can be cleared on exchanges) and involve two counterparties, the buyer and the seller. Usually, OTC contracts are not anonymous as opposed to exchanges. Market participants trade over the telephone, facsimile or electronic network instead of a physical trading floor. There is no central exchange or meeting place for this market. In the OTC market, trading occurs via a network of middlemen such as brokers, who carry inventories of securities to facilitate the buy and sell orders of investors, rather than providing the order matchmaking service. OTC are riskier than exchanges, given that there is a default risk. In the EU energy markets, OTC contracts can be seen as financial instruments. Indeed they can be re-sold after purchase and treated as a product like one traded on an exchange. However, it is not standardized nor is it anonymous.

1.3.2 Actors

As well as a physical market place for energy, a financial marketplace for energy has developed in Europe to meet the requirements for risk management amongst producers, suppliers and consumers. Derivative contracts are traded to mitigate variable prices, or for changing future prices between different areas or forms of energy. Contracts are traded to secure minimum or maximum prices or to secure the option to choose future prices for different forms of energy or areas (options). An energy company can use information from the energy financial market as the basis for estimating the market value of a given position, activity or segment, and its exposure to risk. Market information can also be used by a business as a way to gain a higher level of resource profitability in production and distribution. Simultaneously an energy company can operate actively in the energy market to implement its own risk management strategy or to take an independent position in the market. Thus, the role of energy markets has evolved in recent years, which entails the involvement of various stakeholders. The role of different organisations on the European energy markets is therefore explained in this section with an explanation of their positions and risk profiles. A series of tables are given thereafter that list the major actors in selected markets.

Traders

The formation of an energy market starts with a spot market – the short-term organised market where delivery of energy is scheduled for the same day or the next day.

Independently of spot markets, participants can also start long-term bilateral operations in order to evade or reduce market price risk. Today, every utility is exposed to risk due to market price fluctuations (market price risk), but other risks include:

- Liquidity risk, which could be divided in volume and margin risk;
- Credit risks in OTC markets;
- Regulatory risk and;
- Operational risk.

Basic trading activity can be seen as just the sale and purchase of energy. However, trading activity requires a large amount of information, a deep knowledge of utility markets and information systems support. A trading department's front office manages daily operations in markets. It requires information such as historical, spot and forward curve prices from every available market; interconnection capacities for cross-border trades; and specific information about market schedules, etc. The back office is responsible for settlement, contract and invoice monitoring. This department also has many information needs related to framework contracts for legal subjects and settlement dates; official market prices; and contract and invoice statement monitoring. The back office is related to the company financial system, so the importance of information exchange is great. The middle office is responsible for risk management (hedging strategies, scenario analysis, etc.), pricing and risk measures. The difficulty of contract analysis, pricing and risk measuring does not reside only in a utility's counterparts, different underlying asset behaviour, interest rates or foreign exchange, but also in the way the utility is generated, transported and distributed. Factors such as environmental considerations or capacity grid constraints also come into play. Furthermore, one can distinguish between financial and physical settlement: financially settled contracts are similar to the financial derivatives in financial markets, whereas physically settled contracts need information processing because of the underlying seasonal behaviour of electricity.

We have described a variety of energy players operating in the market. The tables in the annex to this study show the major pan-European energy traders currently active in the Europe.

Transmission System Operator

Transmission System Operators (TSOs) are responsible for the bulk transmission of electric power on the main high voltage electric networks and gas via pipelines. TSOs provide grid access to the electricity market players (i.e. generating companies, traders, suppliers, distributors and directly connected customers) according to non-discriminatory and transparent rules. In order to ensure the security of supply, they also guarantee the safe operation and maintenance of the system. In many countries, TSOs are in charge of the development of the grid infrastructure too. TSOs in the European Union internal electricity market are entities operating independently from the other electricity market players.

European Group of Regulators for Electricity and Gas (ERGEG)

ERGEG is a body of independent national energy regulatory authorities, which was set up by the European Commission as an Advisory Group to the Commission on energy issues. ERGEG was set up "to give regulatory co-operation and co-ordination a more formal

status, in order to facilitate the completion of the internal energy market." ERGEG provides a transparent platform for co-operation between national energy regulatory authorities, and between these authorities and the Commission. Respondents to the Moffatt Associate study identified ERGEG as an important political player in furthering the integration of the European energy market, and by the same token increasing liquidity and transparency.

Regulators

A regulator may be best compared to a "watchdog", independent from industry and political influence. Since it does not make economic sense to create an alternative gas or electricity network, the regulator will need to ensure effective and non-discriminatory access to the transmission and distribution networks for electricity and gas. The regulator controls tariffs in order to prevent unduly high tariffs. Regulators often also have other tasks which relate to the efficient functioning of the market and ensuring competition, as well as the protection of consumer interests.

Producers

Producing companies (often a public utility) generate electricity and gas for sale to a variety of consumers. Producers can include investor-owned, publicly owned, cooperative, and nationalized entities; may be engaged in all or only some aspects of the industry and are regulated by local and national authorities. Producer's ability to sell electricity on the wholesale spot market increases the generator's flexibility in scheduling production. Demand for electricity fluctuates and before the establishment of spot markets the vertically-integrated utility had to maintain costly capacity as a reserve. By contrast, competitive generators can now reduce their idle capacity and simply schedule efficient production. They need not wait for customers because they can sell power on the spot market at any time. Efficient scheduling reduces production costs.

Banks and financial institutions

Volatility in the wholesale energy markets offers huge opportunities and equally huge risks. The entrance of new players including hedge funds, investment banks and speculative traders creates new dynamics that mean companies have to operate in a high risk environment. Intraday price movements and long term trends that are in many cases disconnected from market fundamentals create the need for quality business intelligence and analysis.

2 European Wholesale Power Markets

2.1 Introduction

2.1.1 European Power Market

The liberalization of the electricity markets in the European Union was launched at the end of the 1990s, under the auspices of the Florence Forum, a platform for discussion of the multiple challenges different actors face in pushing the new policy forward. The participants in the Forum are national regulatory authorities, Member States, the European Commission, transmission system operators, electricity traders, consumers, network users, and power exchanges. Current issues being discussed concerns the cross border trade of electricity, in particular pricing of cross border electricity exchanges and the management of scarce interconnection capacity (between France and Spain for instance). The need to foster competition in the electricity markets is highlighted by policies geared toward unbundling vertically integrated incumbents.

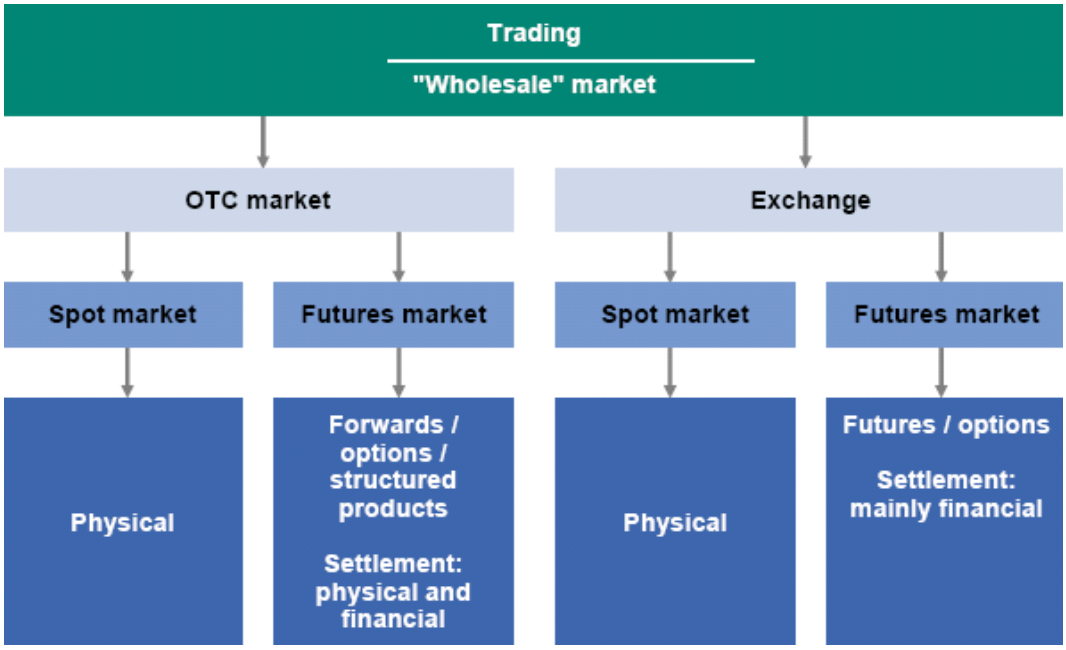
Today, the biggest challenges at hand are the need to improve the physical interconnectivity between markets, and to continue fostering competition through unbundling and non-discriminatory access of market players to national grids. A recent report for the European Commission states that "since the beginning of the liberalisation of the electricity markets in the EU, the occurrence of congestion in the transmission networks has been seen as an obstacle for the realisation of the envisaged Internal Electricity Market (IEM)."[2] Thus, improving connectivity between grids and fighting market concentration are the two most pressing issues faced by policy makers in the EU.

Finally, the issue of transparency is crucial for market players, regulators and policymakers to monitor and assess the functioning of the electricity market. As such, clear information on issues such as prices, market participants, liquidity and volumes is important for markets to operate transparently and efficiently.

The European electricity market is not equally divided among exchanges, OTC and bilateral contracts in terms of volumes. For instance, exchange can represent only a small fraction of total market volume (i.e. APX UK) and in another case represent over half of total market volume (Nordpool). Consequently, each exchange in Europe has a different importance in the electricity market. Overall however, OTC comes out as the main channel for power trading. In figure 2.1 an overview of the functioning of the power market is given showing the division of the OTC and exchange market in wholesale power.

[2] "Towards a common coordinated regional congestion management method in Europe". Consentec, Octover 2007, p1.

Figure 2.1 schematic overview of the functioning of wholesale power markets



2.1.2 Geography

The European power market is a conglomerate of regional markets, which are more or less physically connected. There are seven broad regional energy markets (REM), some of which overlap. All regions form part of an initiative called the Electricity Regional Initiative which was launched by ERGEG in 2006, the aim of which is to move the EU closer to an integrated electricity market. Below is the breakdown of all EU electricity regions as defined by ERGEG.

Baltic Region (Estonia, Latvia, Lithuania)

The Latvian Energy Regulator (PUC) monitors this region. Like the rest of its counterparts in the EU, the Baltic region aims at integrating its three markets into one. The Baltic region represents 21.215 GWh of final electricity consumption, 0,71% of the EU 25 final electricity consumption. The Baltic region is situated between the Central-East and the Northern European regional markets, which thus makes it a potential bridge between the Central east and Northern region. Co-operation between network operators, grid access, balancing rules and transparency are the four key priorities of the Baltic electricity REM

Central East Region (Austria, Czech Republic, Germany, Hungary, Poland Slovakia, Slovenia)

The Austrian Energy Regulator (E-Control) monitors this region. This REM stands out in that both new and old member states are part of the REM. As such, the move towards market integration is also a channel for closer relationship between old and new members. Congestion management, transparency, market entry barriers and regulatory competences are the four key priorities of the Central-East

Central South Region (Austria, France, Germany, Greece, Italy, Slovenia)

The Italian Energy Regulator (AEEG) monitors this region. The Central-South electricity REM represents 1.342.243 GWh of electricity consumption, 51% of the EU 27 electricity market. Harmonization of congestion management methods, inter TSO coordination (harmonisation of operational and security standards), transparency, integration of intra-day and balancing markets and assessment of regulatory competences are the key priorities of the Central-South electricity REM.

Central West Region (Belgium, France, Netherlands, Germany, Luxemburg)

The Belgian Energy Regulator (CREG) monitors this market. The Central-West electricity REM represents 1.1 million GWh of electricity consumption, 42% of the EU 25 electricity market. Some of the biggest market operators in Europe form part of the REM. Harmonization and improvement of long-term explicit auction rules, implementation of a day-ahead flow-based market coupling, implementation of cross-border intraday trade, maximisation of the amount and the utilization of cross-border capacities, and transparency are the key priorities of the Central-West electricity REM.

Northern Region

The Northern region includes countries presently comprising the Nordic electricity market and two other major EU member states. The good practice in terms of regional market arrangements presented by the Nordic participants is expected greatly improve regional and, eventually, European integration. Investment for interconnections, transparency and information availability and accessibility to market actors, joint intra-day and balancing markets and are the key priorities of the Northern electricity REM.

South West Region (France, Spain, Portugal)

The Spanish Energy Regulator (CNE) monitors this region. Annual electricity consumption in the South-West REM stands at roughly 780 TWh, around 30% of the EU 27 electricity market. A regional integration initiative launched in 1998 predated ERGEG's initiative. Indeed the Spanish and Portuguese markets have been growing closer since the end of the 1990s; interconnection capacity between the two countries has double since the launch of the 1998 integration initiative. An action plan for 2007-2009 has been agreed on for the South West Region.

France, UK, Ireland

The British Energy Regulator (Ofgem) monitors this region. Annual electricity consumption stands at roughly 780 TWh, around 30% of the EU 27 electricity market. Interconnectors and compliance with the Congestion Management Guidelines, intra-day trading, reciprocal access to balancing markets and wholesale market transparency are the key priorities of the electricity REM.

2.1.3 List of Actors in the power market

The tables on the following pages show the major energy players and stakeholders in the different wholesale markets in Europe

Austria	Belgium	France
Power Industry Regulator	**Power Industry Regulators**	**Power Industry Regulator**
E-control	CREG - national commission for electricity and gas regulation	CRE
Power Exchange	Brugel / IBGE-BIM - Brussels regulators	**Power Exchange**
EXAA - Energy Exchange Austria	CWAPE - Walloon regulator	Powernext
System Operations	VREG - Flemish regulator	**System Operator**
Austrian trading market services alliance	**Power Exchange**	RTE
CISMO	Belpex	**Utilities**
Austrian Power Grid (Verbund)	**System Operator**	CNR - Compagnie Nationale du Rhône (Electrabel)
APCS transaction clearing and settlement	Elia	EDF - Electricité de France
Tiwag Netz (Tyrol)	**Utilities**	EdS - Electricité de Strasbourg
VKW Netz (Vorarlberg)	AIEG	Electrabel Suez
A&B (transaction clearing and balancing energy for western	ALE	Gaz Electricité de Grenoble
Austria)	EDF Belgium	SMEG - Société Monégasque de l'Electricité et du Gaz (Elyo /
Utilities	Electrabel (Suez)	EDF)
BEWAG	Eneco Belgium	Usine d'Electricité de Metz
Energie AG	Essent Belgium	**Industrial and Independent Power / Others**
EnergieAllianz (alliance of regional utilities)	Infrax	Air Liquide
e&t (EnergieAllianz trading arm)	Intercommunales Liégeoises	Cofathec (GDF)
EVN	Luminus	Dalkia (Veolia Environnement / EDF)
KELAG	Nuon Belgium	Direct Energie
Salzburg AG	PBE	EDF Energie Nouvelles
Energie Steiermark	SPE	Elyo (Suez)
TIWAG	WVEM	Endesa France
Verbund		Gaselys (GDF / Société Générale)
VKW / Illwerke		Gaz de France
Wien Energie (Wiener Stadtwerke)		Poweo

Austria Germany	Belgium Netherlands	France Norway
Power Industry Regulation	**Power Industry Regulator**	**Power Industry Regulator**
Federal Network Agency (energy regulator)	DTe	NVE - Norwegian Water Resources and Energy Directorate
BaFin - Financial Services Regulator		
BKA - Competition Authority	**Energy and Emissions Exchanges**	**Power Exchange**
BMWi - Ministry of Economics and Technology	APX	Nord Pool Group
	Climex (New Values)	Nord Pool Spot
Power Exchange	Endex - European Energy Derivatives Exchange	
EEX - European Energy Exchange		**System Operations**
	System Operations	Statnett
System Operations	TenneT	NorNed Auction
EnBW Transportnetze	NordNed Auction	
E.ON Netz	TSO Auction	**Major Players**
European Market Coupling Company	Major Utility Players	Agder Energi
RWE Network	Electrabel Nederland	Akershus Energi
Vattenfall Europe Transmission	E.ON Benelux	BKK
	Essent	E-CO Energi
"Verbund" Big 4 Utilities	Nuon	EGL Nordic
EnBW (partly owned by EDF)		Elkem
E.ON Energie	**Other Utilities**	Fjordkraft (BKK / Skagerak Energi)
RWE Group	Delta	Hafslund
Vattenfall Europe	ENECO Energie	Hydro
	EPZ	Interkraft
Regional Utilities	NRE	Lyse Energi
E.ON Avacon	ONS (ENECO Energie)	Naturkraft
E.ON Westfalen Weser	Rendo (Electrabel)	Nord-Trondelag Elektrisitetsverk (NTE)
Energiedienst	RWE Nederland	Ostfold Energi

Austria	Belgium	France
ENSO	Trianel	Skagerak Energi
EnviaM	Westland Energie Services (Essent)	Statkraft
Evonik	**New Entrants**	StatoilHydro
EWE	AES Elsta	Trondheim Energiverk
Harz Energie (Thuega)	Anode	Vattenfall Norway
N-Ergie	Caplare Energy	
Pfalzwerke	De Vrije Energie Producent	
SüdWestStrom	Echte Energie	
Suewag Energie	Energie Data Maatschappij	
Syneco Trading (Thuega)	Energie-keuze.nl	
Thuega (E.ON)	Greenchoice	
Trianel	IMC	
Ueberlandwerk Grossgerau	InterGen	
Ueberlandwerk Leinetal	Oxxio (Centrica)	
Vereinigte Saar-Elektrizitats (VSE) (RWE)	Scholt Energy Control	
	Statkraft Markets	
	STX Energy Services	
	Vattenfall Nederland	

Spain	UK	Europe
Power Industry Regulator	**Power Industry Regulators**	**Regulatory affairs**
CNE	OFGEM (Great Britain)	BASREC - Baltic Sea Region Energy Co-operation
	NIAUR (Northern Ireland)	CEER - Council of European Energy Regulators
Power Exchange		Energy Charter Secretariat
OMEL	**Energy and Emissions Exchanges**	EEF - European Energy Forum
	APX Power UK	ERGEG - European Regulators Group
System Operator	ECX - European Climate Exchange	IEA - International Energy Agency
REE	ICE Futures	
	Single Electricity Market Operator (Northern Ireland)	**Industry Groups**
Utilities		AEBIOM - European Biomass Association
Endesa	**OTC Market Brokers**	APEX - Association of Power Exchanges
EnelViesgo	GFI	CAN - Climate Action Network Europe
HC Energia (EDP)	ICAP	CIGRE - International Council on Large Electric Systems
Iberdrola	Spectron Group	Cogen Europe
Union Fenosa	Tullett Prebon	EFET – European Federation of Energy Traders
		EPIA - Photovoltaic Industry Association
Capacity Auction Site	**System Operations**	EPPSA - Power Plant Suppliers' Association
Endesa / Iberdrola VPP	National Grid (Great Britain)	EREC - Renewable Energy Council
	Elexon / Balancing Mechanism Reports	EREF - Renewable Energies Federation
Independents	SONI (Northern Ireland)	ESHA - Small Hydro Association
Acciona		ESTIF - Solar Thermal Industry Federation
Bizkaia Energia	**Vertically Integrated Major Players**	ETSO - Transmission System Operator Association
Centrica	Centrica	EURACOAL - Association for Coal and Lignite
EDF Iberica	EDF Energy	EUREC - Association of Renewable Energy Research Centres
	EDF Trading	Euroheat & Power
	E.ON UK	Eurelectric - Union of the Electricity Industry
	RWE npower	EuroPex - Association of European Power Exchanges

Spain	UK	Europe
	Scottish & Southern Energy	EWEA - Wind Energy Association
	ScottishPower	FEDARENE - Federation of Regional Energy and Environment Agencies
	Generation Companies	Foratom - Atomic Forum
	British Energy	Geode - Energy Distribution Company association
	Carron Energy	IETA – International Emissions Trading Association
	Drax Power	IFIEC Europe - industrial consumers association
	First Hydro (International Power / Mitsui & Co.)	MEDELEC - Liaison Committee of Electric Companies of the Mediterranean Basin
	InterGen	
	International Power	UCTE - Union for Co-operation in Electricity Transmission
	Magnox Electric (BNFL)	WADE - World Alliance for Decentralized Energy
	Premier Power (BG Group)	
	px	
	Spalding Energy (InterGen)	
	Warwick Energy	
	Pure Distribution Companies	
	CE Electric (MidAmerican Energy)	
	Central Networks (E.ON)	
	United Utilities	
	Western Power Distribution (PPL)	

2.2 Power Exchanges

The EU-27 consumed 2.7 million GWh of electricity in 2007[3]. Running parallel to this, the EU traded 6.3 million GWh in 2007 in all OTC contracts (spot, futures), a 100% increase from 2006[4]. Conversely, total exchange trading in spot markets for 2007 stood at over 820,000 GWh and 1.1 million GWh in futures trading (with EEX constituting the overwhelming majority of this volume)[5].

As can be therefore inferred, power trading in the EU is more than threefold annual consumption (over 8 million GWh traded for a 2.7 million GWh level of consumption in 2007). Our study found that spot power exchanges show high volatility over the 2002-2007 period, although with increasing participants (liquidity), volatility tends to decrease over time. We also found that derivative markets, although less developed than exchanges (judging by the number of exchanges with a mature derivative market), traded higher volumes in 2007, and more importantly were notably less volatile than spot trading. In addition, year ahead contracts are the most traded product in the derivative market by volumes. As such we examined only this product given that it is the most traded. It should be noted that derivative trading in the EU is concentrated on one exchange (EEX). Finally, our study found a clear correlation effect among exchange prices over the 2002 – 2007 period.

Table 2.1 Volumes traded in GWh for the main electricity spot exchanges in 2007[6]

Exchange	Volume 2007
EEX	117.321
IPEX	329.949
NordPool	290.000
Powernext	44.211
APX NL	20.713
APX UK	10.950
EXAA	2.265
Towarowa	2.462
Belpex	7.587
OMEL	266
Total	**825.728**

[3] IEA http://www.iea.org/Textbase/stats/electricitydata.asp?COUNTRY_CODE=37&Submit=Submit.
[4] Financial Service Authority, UK "Analysis of activity in the energy markets 2007".
[5] ECORYS.
[6] Data source: respective exchanges.

Table 2.2 Volumes Traded Futures in GWh for the main future exchanges

Exchanges	2007
Powernext	39.175
EEX Phelix Futures	942.352
Endex NL	96.535
Total	**1.078.062**

2.2.1 Introduction

The sectoral inquiry into the European electricity markets launched by the European Commission and published in 2007 highlighted that market concentration in the electricity market remains very high in certain areas, especially in national wholesale/generation markets. Furthermore, large energy consumers do not believe that prices on the spot and forward wholesale markets are the result of fair competition. The low number of participants in some power exchanges attests to this notion. Nevertheless, some power exchanges play an important role in the EU.

In recent years, market coupling efforts initiated by the European Commission, national market operators and power exchanges have brought a certain degree of interconnectedness among some key power exchanges, namely Powernext, APX and Belpex (France, the Netherlands and Belgium) and within the NordPool region (Norway, Sweden, Finland and Denmark). Below is an overview of the role and importance of the main exchanges in the European Union, including Norway.

This section examines prices and volumes, time trends, price volatility, price correlations, volumes vs. consumption, products offered, actors and liquidity in the main European exchanges over the 2002-2007 period. We examined the nine main power exchanges in the EU (IPEX, APXNL, APX UK, EEX, OMEL, NordPool, Belpex, Powernext, Endex). Those exchanges that are left out (Borzen, Exaa, OMIP etc.) do not have sufficient market activity or longevity for meaningful analysis. Although intra-day and future products are offered on some exchanges, they are not systematically analyzed for two main reasons:

- Intraday or future markets opened too recently (less than two years) for any meaningful analysis to be undertaken for all these products over the 2002-2007 period given the limited time horizon and low volumes;
- As such only year ahead contracts are examined given that they are the dominant product traded in the derivatives market.

In the future markets, only Endex and EEX Phelix futures are analyzed, given that these exchanges (especially EEX) have cornered the majority of power derivative trading in the EU today (see table 2.3).

For clarity's sake, base volumes expressed throughout this report **include** peak volumes given that peak hours are always included in base hours. For instance, the spot market traded 825.000 GWh in 2007. The 75.000 GWh registered in peak trading are included in total figures (see table 2.3).

2.2.2 Main European Power Exchanges

NordPool

Nordpool is the largest physical and financial power exchange in Europe. The exchange organizes the physical trade of electricity, the day-ahead market *Elspot* in the Nordic countries and KONTEK in Germany (the TSO area of Vattenfall Europe Transmission GmbH). In 2007, there were 319 participants on the Nordpool exchange. Traded physical volumes through Nord Pool Spot in 2007 amounted to 290 TWh (60% of the total consumption of electricity in Nordic countries), while financial trading stood at 1.060 TWh. Of notable importance, NordPool does not currently provide derivatives products in the power market. Furthermore, the importance of the NordPool exchange, in terms of volumes traded, is substantially higher than its continental counterparties. Elspot alone represents over 30% of the EU spot trading volume. Peak trading is defined by Nordpool as the period between 8:00 and 20:00.

EEX

EEX is a leading European power exchange and is one of the most important power exchange platforms in terms of volumes exchanged in continental Europe for both spot and future products. Indeed, over the 2002-2007 period, spot volumes traded have almost quadrupled from 31.456 GWh in 2002, to 117.322 GWh in 2007. EEX is based in Frankfurt and offers the most common power products, namely spot (day ahead and intraday) and derivatives with up to six year maturities (Phelix Futures). Futures trading in EEX was launched in June 2005 and in 2007 amounted to 942.352 GWh. Although not formally included in the Trilateral Market Coupling Initiative launched by APX, Powernext and Belpex, EEX has exhibited a strong degree of price correlation with APX, Powernext and Belpex over the 2002-2007 period (see table 2.6). There are 147 participants on the EEX exchange. Peak hours are defined as the period from 08:00 to 20:00 every day.

Italian Power Exchange (IPEX)

IPEX is the Italian power exchange and was launched in 2004 as part of an effort at liberalizing the national market and introduce competitive price settling in the physical spot market for power. Volumes traded went from 231.000 GWh in 2004, to 329.000 GWh in 2007, while participants in IPEX increased from 73 to 127 over the 2002 – 2007 period. IPEX is the only exchange to publish liquidity figures in the EU. It lists liquidity as rising from 29,1% in 2002 to 67,1% in 2007. Such figures are presumably based on the increase in market participants over the 2002-2007 period.

Powernext

Powernext is the French power exchange and offers spot and future trading. There is too little data for analysis in the intraday trading market to meaningfully derive any relevant information (see table 2.3).

Powernext Futures are the derivative products offered by Powernext. They offer up to 3 years of maturities. Powernext in partnership with RTE, the French Transmission System Operator (TSO), has been an instrumental player in pushing for a tighter level of market coupling in the power markets since 2003. Volumes traded on the Powernext exchange

have significantly increased since the platforms launch, going from less than 2.623 GWh in 2002, 44.212 GWh in 2007. Peak is defined as the period between 8:00 and 20:00

APX

APX is a provider of power and gas exchanges for the wholesale market, providing markets for short term (spot) trading only in the Netherlands, the United Kingdom and Belgium. APX NL's traded volumes increased from 14.112 GWh in 2002 to 20.714 GWh in 2007. Peak hours are defined by APX as the period between 08:00 and 23:00 daily.

In cooperation with the European Commission, APX launched a Trilateral Market Coupling initiative in 2004 to bring the French, Belgian and Dutch power exchanges closer together. Coupling power exchanges implies managing their respective supply and purchase curves jointly, by matching the highest purchase bids and lowest sale bids, regardless of where they have been made (eg. matching a purchase bid in Belgium with a sales bid in France), but taking into account the available interconnection capacities on the borders. In other words, the counterparty of a transaction on a power exchange may originate from a foreign exchange without the participants being bound to explicitly acquire the corresponding transmission capacity.

The initiative has improved border power flows among markets, EuroPex (The Association of European Power Exchanges) stating that "border flows are now always in the right direction, with netting of imports and exports. With 100% utilization of the remaining capacity in order to reduce the price difference as much as possible, even often to zero. And as a result, prices have come together, converged, yielding a common integrated market with often one single price". We corroborate this view in our price correlation calculations in table 2.7. When no congestion occurs between coupled markets, the markets merge into a single zone with one price and shared liquidity. This leads to convergence of market prices whenever there is no real constraint.

Belpex

Belpex is the Belgian power exchange, which was launched on November 22nd 2006. An important feature of the BELPEX Day Ahead Market (DAM) is its coupling with the two neighboring Power Exchanges, APX in the Netherlands and Powernext in France. Our price correlation analysis shows a 90% level of price coupling with its exchange counterparts, the highest level of coupling among all exchanges. Belpex does not currently offer derivative products, given that the average time framework for launching futures markets in other power exchanges ranges between 3 and 5 years. Belpex traded 7.588 GWh in 2007.

Endex

The Amsterdam-based European Energy Derivatives Exchange (Endex), is the Dutch energy exchange for wholesale market participants. Endex offers trading and clearing services for power futures only. Endex members include producers, distribution companies, financial institutions, industrial end-users, hedge funds, asset managers and brokers. Endex was founded in 2002 by major players in the European energy market and financial sector. ENDEX's main shareholders include are Delta, Electrabel, Endesa, ENECO, E.ON, Essent, Euronext, Fluxys, Fortis, Gasunie, Nuon, RWE and TenneT.

Major energy users, such as Corus and DSM, also hold ENDEX shares (see section 1.3.3).

Omel

Omel is Spain's operator for the power market. It is thus responsible for the technical management of the electricity system, i.e guaranteeing supply continuity and security. OMEL offers daily trading only (future trading is operated by the Portuguese exchange MIBEL) with its 2002-2007 volumes going from 253 GWh to 267 GWh. An important feature of the Spanish power exchange is the weak physical interconnection capacities of the Iberian peninsula with the rest of continental Europe. As such, regulatory effort to promote market coupling, will have limited effects until physical interconnections are enhanced.

EXAA

EXAA is the Austria power exchange and was launched in October 2002, and has grown from 10 market participants to over 40 today. Volumes grew from 624 GWh in 2002 to over 2.200 GWh in 2007. EXAA only offers spot power products on a daily basis.

Towarowa Gielda Energii

Towarowa Gielda Energii is the Polish power exchange and was launched in 2000. Towarowa offers day ahead trading, and up until June 2006, offered future trading. However, this product was discontinued after 2006 due to liquidity problems. In addition, green certificate trading is offered on the Polish exchange. Traded volumes on the power spot market went from 985 GWh in 2002 to 2462 GWh in 2007.

Table 2.3 gives a breakdown of all available products in all major EU power exchanges in 2007. The "□" symbol indicates that a specific products is not offered by the respective exchange.

Table 2.3 Volumes (GWh) traded in EU exchanges for all available products in 2007

	Spot		Intraday Weekend		Intraday		Month Futures		Quarter Futures		1 Year		2 Years		3 Years		4 Years		5 Years		6 Years	
	Base	Peak	Base	Peak	Base	Peak	Base	Peak	Base	Peak	Base	Peak	Base	Peak	Base	Peak	Base	Peak	Base	Peak	Base	Peak
IPEX	329.949	□	□	□	□	□	□	□	□	□	□	□	□	□	□	□	□	□	□	□	□	□
Nord Pool	290.000	□	□	□	□	□	□	□	□	□	□	□	□	□	□	□	□	□	□	□	□	□
EEX	117.000	60.881	105	□	320	184	79.159	13.986	221.440	23.774	573.059	33.172	113.371	14.729	29.775	2.966	2.917	124	1.458	31	332	0
Powernext	44.211	□	□	□	1,6	□	9,005	□	6.471	□	21.766	□	8.129	□	2.800	□	□	□	□	□	□	□
EXAA	2.265	□	□	□	□	□	□	□	□	□	□	□	□	□	□	□	□	□	□	□	□	□
APX NL	20.713	13.662	□	□	□	□	□	□	□	□	□	□	□	□	□	□	□	□	□	□	□	□
APX UK	10.950	□	□	□	□	□	□	□	□	□	□	□	□	□	□	□	□	□	□	□	□	□
OMEL	267	□	□	□	□	□	□	□	□	□	□	□	□	□	□	□	□	□	□	□	□	□
OMIP	□	□	□	□	□	□	□	□	□	□	1.459	□	□	□	□	□	□	□	□	□	□	□
Endex	□	□	□	□	□	□	5.567	204	16.133	582	49.542	2.644	17.205	840	6.395	163	990	20	703	20	□	□
Belpex	7.587	3.978	□	□	□	□	□	□	□	□	□	□	□	□	□	□	□	□	□	□	□	□
Towarowa	2.462	□	□	□	□	□	□	□	□	□	□	□	□	□	□	□	□	□	□	□	□	□
Total	825.728	78.521	105	□	320	184	84.735	14.190	244.044	24.356	645.826	35.816	138.705	15.569	38.970	3.129	3.907	144	2.161	51	332	0

2.2.3 Power Spot Market

This section examines price and volume trends over the 2002-2007 period (where data is available and/or relevant). The following questions are answered for the power spot market:

- What are the prices and volumes in day ahead, intra-day, monthly and yearly figures?
- What are the time trends in volumes and prices?
- How coupled are the various power exchanges?
- How does price volatility behave over the 2002-2007 period?
- How liquid are these markets?

Power Volumes in the EU

Table 2.4 shows the yearly volume in GWh traded on respective exchanges over the 2002 – 2007 period. IPEX, EEX, APX, Powernext and Nordpool are the most important power exchanges for spot trading in the EU. EEX, Powernext and APX are all within the Central West electricity region (France, Belgium, Germany and the Netherlands), while NordPool covers the Northern Electricity Region (Sweden, Norway, Denmark and Norway). Eastern European exchanges are less developed due to strongly bundled state incumbents who control domestic markets and prevent competitive pricing where exchanges can emerge and as such hinder significant liquidity in competitive markets for power firstly in spot trading and secondly in derivative trading.

Table 2.4 Power Spot Market Yearly Volumes in GWh

	2002	2003	2004	2005	2006	2007
EEX	31.456	49.136	59.449	85.335	87.602	117.322
IPEX	-	-	231.571	323.184	329.790	329.949
Powernext	2.623	7.478	14.128	19.670	29.600	44.212
APX NL	14.112	12	13.366	16.053	19.236	20.714
APX UK	-	-	-	-	-	10.950
NordPool	124.000	119.000	179.000	215.000	260.000	290.000
Omel	253	271	277	306	162	267
EXAA	624	1.324	1.763	1.541	1.666	2.265
Belpex	-	-	-	-	531	7.588

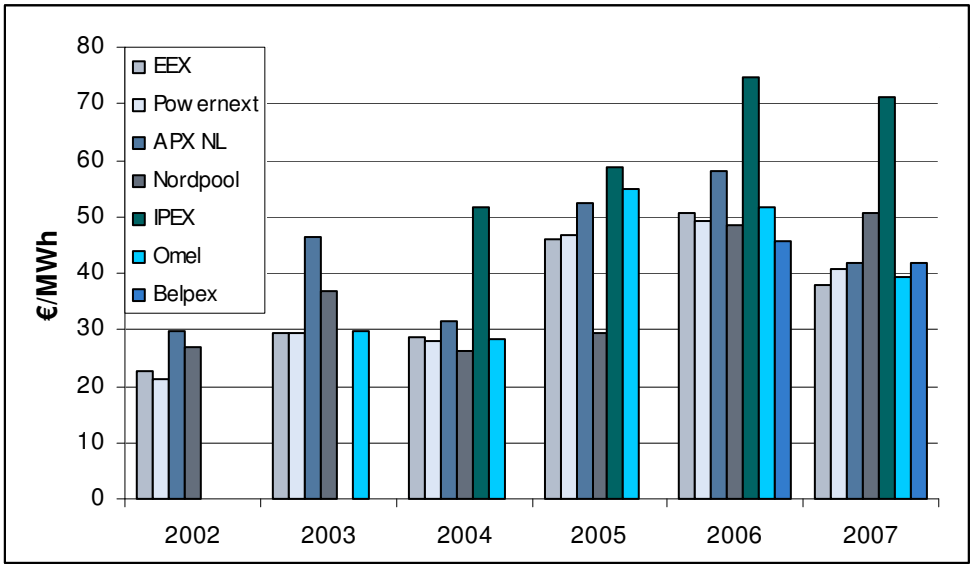
Liquidity

We relied on market participant numbers to draw a picture of liquidity levels in various exchanges. However, mentions of "liquidity levels" are not only subject to one's interpretation, but also subject to change. In other words, exchanges are not either always liquid or illiquid. There is a strong dynamic in these markets and large markets players "registered" on a given exchange may occasionally not trade on a given day and vice versa. The Moffatt report provides a more elaborated picture of liquidity in the EU energy markets.

Price Trends and Market Coupling

Table 2.5 and Figure 2.2 give a breakdown of average yearly spot prices in the main European exchanges over the 2002-2007 period. Prices on the exchanges have increased significantly, in some case doubling (e.g. Powernext, NordPool).

Figure 2.2 Average Yearly Spot Power Prices in €/MWh



In figure 2.2, it should be noted that EEX registers lower power prices in the spot market for 2002, 2005 and 2007, while APX NL and IPEX register the highest spot power prices over 2002-2004 and 2005-2007 period respectively.

Table 2.5 Yearly Average Spot Price for Power in €/MWH*

	2002	2003	2004	2005	2006	2007
EEX	22,63	29,49	28,52	45,98	50,79	37,99
Powernext	21,12	29,22	28,14	46,64	49,25	40,82
APX NL	29,91	46,47	31,58	52,39	58,10	41,92
APX UK (in £/MWh)	15,23	18,23	21,29	35,60	37,75	27,94
Nordpool	26,91	36,69	26,32	29,33	48,59	50,53
IPEX	N/A	N/A	51,60	58,59	74,75	70,99
Omel	38.21	29,74	28,46	54,78	51,53	39,34
Belpex	N/A	N/A	N/A	N/A	45,70	41,77
Average[7]	**25,12**	**34,31**	**32,43**	**47,94**	**52,06**	**43,91**

*unless otherwise indicated.

Figure 2.3 shows price behaviours in the major European power exchanges during the second quarter of 2002. OMEL is the most uncoupled exchange among the major European power markets. APX UK (shown here in £/MWH) shows coupled price trends with APX NL although APX Group (APX NL and UK) are not tightly coupled with either Powernext or EEX.

Figure 2.3 Average Daily Spot Power Price 2nd Quarter 2002

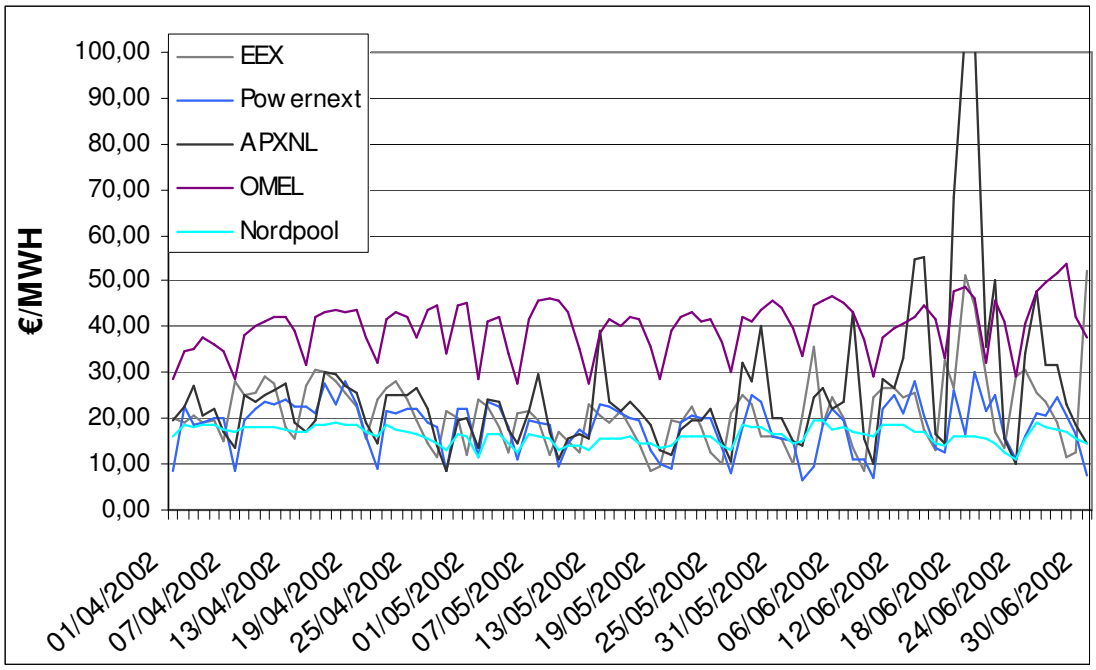
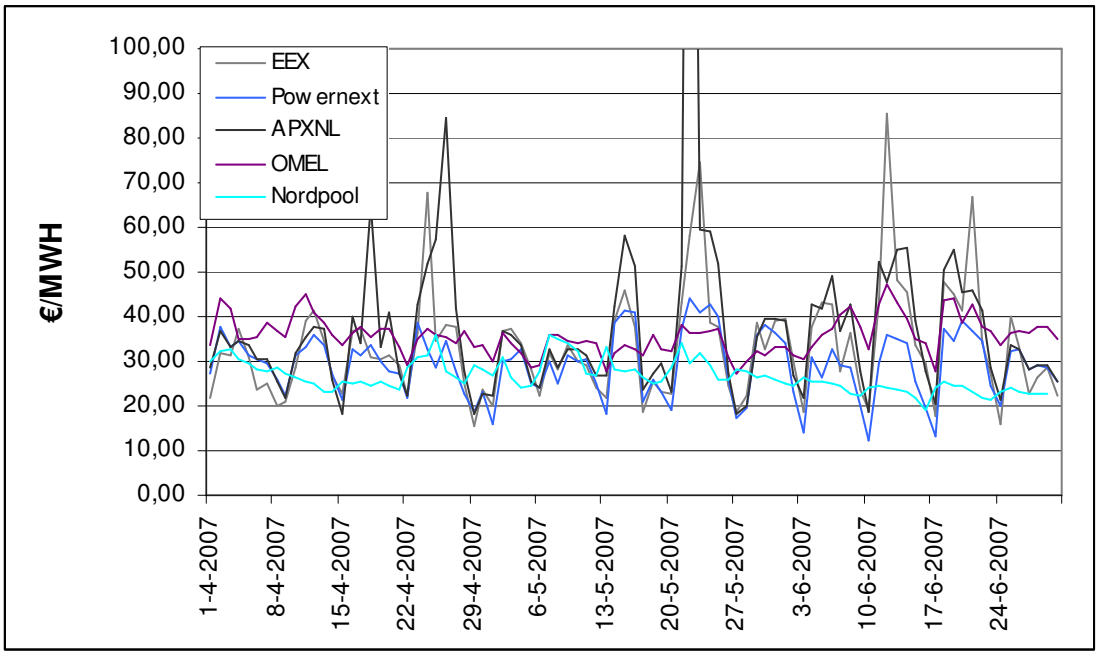


Figure 2.4 shows 2007 price trends in the major power exchanges in the first quarter of 2007. The figure shows that APX, Belpex and Powernext are more tightly coupled than in

[7] Excluding APX UK. Sources: respective exchanges listed in the table.

2002, thus highlighting that the market coupling initiative launched by APX, Powernext and Belpex in 2004 (the so-called Trilateral Market Coupling initiative) has shown progress among the other factors that contribute to coupling effects in the power markets. In addition, OMEL prices have broadly fallen in line the rest of the EU exchanges.

Figure 2.4 Average Daily Spot Price 1st Quarter 2007



Price Correlations

Table 2.6 gives a detailed breakdown of the price correlations among all major exchanges in 2002 and 2007. Our correlation analysis shows that there was only a 28% correlation of prices among the main EU power exchanges in 2002. Conversely, price correlations among the exchanges in 2007 (APXUK included) stood at 67%, a twofold increase over the 2002-2007 period. Of significant importance is the fast pace at which Norpool system prices have caught up with Western region exchanges over the examined period, starting out at less than a 10% correlation (except for APX UK) and increasing to over 60%, and in the case of the Nordpool/Powernext price correlation, standing at 72% in 2007. Similarly, OMEL prices have also exhibited a clear price convergence trends over 2002-2007.

Table 2.6 Price Correlations Among Major Power Exchanges

Exchange Correlation	2002	2007
Nordpool and EEX	0,04	0,64
Nordpool and Powernext	0,04	0,72
Nordpool and APX NL	0,09	0,61
Nordpool and APX UK	0,37	0,64
Nordpool and Belpex	×	0,64
EEX and Powernext	0,51	0,80
EEX and APX NL	0,34	0,78
EEX and APX UK	0,24	0,75
EEX and Omel	0,30	0,49
Powernext and APXNL	0,41	0,76
Powernext and APXUK	0,44	0,73
Powernext and Omel	0,58	0,53
APXNL and APXUK	0,20	0,62
APXNL and Omel	0,12	0,49
APXUK and Omel	0,21	0,48
OMEL and Belpex	×	0,47
EEX and Belpex	×	0,76
Powernext and Belpex	×	0,91
APXNL and Belpex	×	0,91
APXUK and Belpex	×	0,65
Average	**0,28**	**0,67**

Price Volatility

There are various ways of calculating volatilities for financial markets trading in derivatives.

At first, the standard price volatility model was used to analyze the data series. The consultants started by computing average daily spot prices (the average price over a trading day, i.e twenty four periods) for a given exchange (i.e EEX). Secondly, the daily return of each day (percentage of price fluctuations from one day to the next) was calculated, using the daily spot price as a base. Thirdly, the standard deviation of the daily return was calculated, using a two-months period as a time series. Two months is the standard time period for volatility modelling when looking at yearly price series, given that the shorter the period used, the higher reactivity results will show. Conversely, using longer time series will show much lower reactivity. Finally, once the standard deviation was computed, the volatility series was annualized by multiplying standard deviation results (i.e. daily volatility) by the square root of 260. This methodology is the standard realized volatility calculation model used in most financial analysis modelling.

However, another methodology for calculating annualized volatility involves several logarithmic calculations, which are able to control the figures and make them consistent both with regards to different exchanges and products, and comparable to world markets. This method is known as the Mean Reverting Process and it is especially used for pricing energy derivatives. Hence, the consultants have adopted this method to obtain the least biased results possible. This process incorporates the tendency of energy prices to

gravitate towards a "normal" equilibrium price level that is usually governed by the cost of production and level of demand. Thus, it is assumed that prices are not independent, or at least not totally, from the previous price levels. The probability of returning to a "normal" price level is therefore higher with the mean reverting process method.

According to the literature on electricity and energy markets, annualized volatility can easily range between 100% and 200%. The consultants undertook multiple calculation steps for obtaining the table below. First of all, the log of daily prices was taken, daily returns were calculated (the quotient of the two subsequent log prices), and the average of log(daily prices) M added. Secondly, the mean reverting speed K was estimated by regressing the series on "daily returns" using the data on "M – log(daily prices)".

The residual series of our interest is: (log(S(t+1) - log(S(t))) - K*(log(M) - log(S(t))

with: S(t+1) = spot price of day t+1
S(t) = Spot price of day t
M = average log(daily price)
K = mean reverting speed

Hence, as a last step, there is a need to estimate the volatility of this series. Then the two month standard deviation was computed and standardized by multiplying it with the square root of 260 (like in the previously mentioned methodology).

Finally, we averaged the calculated volatilities for the time period under consideration. The results can be seen below.

Please note that all of the following volatility calculations were made by means of the Mean Reverting Process methodology.

Table 2.7 Price Volatility by Year in Main EU Power Exchanges

	2002	2003	2004	2005	2006	2007
Nordpool	37.31%	35.83%	28.8%	32.08%	29.1%	N/A
EEX	166.52%	185.23%	111.89%	95.32%	127.33%	140.58%
Powernext	175.95%	166.9%	119.82%	99.24%	128%	128.29%
APX NL	193.17%	204.28%	116.1%	107.85%	110.88%	122.51%
APX UK	78.15%	93.68%	62.93%	66.01%	77.91%	100.84%
OMEL	97.27%	104.27%	84.14%	68.38%	57.71%	41.92%
Belpex	N/A	N/A	N/A	N/A	N/A	144.85%
Average	**124.73%**	**131.7%**	**82.49%**	**78.15%**	**88.79%**	**113.17%**

As shown above, EU spot power exchanges are volatile. However, it should be noted that it is standard observation on world energy markets for price volatility to range between 50% and 200%[8]. It is thus not surprising that for physical delivery, derivative markets for year ahead contracts are widely used as a risk hedging mechanisms for most market

[8] Consultation with Fortis energy trading desk.

players. Table 2.7 shows that 2003 saw a generally volatile market, with all exchanges experiencing their highest price volatility in the analyzed time period except for the Nordpool area and Powernext. It is also interesting to note that Nordpool, which has the lowest price volatility of all exchanges, is also the most mature market in all of Europe. Such an observation conforms the view that over time, with increasing participants and connectivity, price volatility in power trading tends to decrease. The current high volatility observations in the power markets may be due not only to underlying volatile primarily energy markets (coal, oil and gas) but also to the nascent nature of the liberalized power market in Europe.

2.2.4 Power Futures Market

This section delves into the futures markets in the main European exchanges. These are the Endex Futures exchange in the Netherlands, and the EEX power future market in Germany. As has been done for the spot market, the following questions are answered:

- What are the prices and volumes in day ahead, intra-day, monthly and yearly figures?
- What are the time trends in volumes and prices?
- How coupled are the various power exchanges?
- How does price volatility behave over the 2002-2007 period?
- How liquid are these markets?

Given that the futures market is only significant in terms of volumes in only two exchanges, we look here only at the two most important exchanges by volume, which are EEX Phelix Futures and Endex Futures. Furthermore, as table 2.3 (page 30) shows, year ahead contracts are the s most significantly traded contract in the power market. As such, we examine this product most closely.

Volumes

Table 2.8 Volumes Traded Futures in GWh for the main future exchanges[9]

	2003	2004	2005	2006	2007
Powernext	×	×	×	×	604
EEX Phelix Futures	341.976	337.675	494.469	638.729	942.352
Endex BE	×	×	890	4.890	4.474
Endex NL	×	2.041	51.698	32.128	96.553

ENDEX NL

Endex offers derivatives in two main exchanges, ENDEX NL (The Netherlands) and ENDEX BE (Belgium). However, there is a notable discrepancy in traded volumes between the two exchanges, with ENDEX NL cornering the overwhelming majority of derivatives trading: 51.000 GWh were traded in 2005, 32.000 GWh in 2006 and a jump to 96.500 in 2007. ENDEX BE was launched in October 2004, with total yearly volumes

[9] EEX Source from EEX website. Endex sources from internal Endex staff.

peaking in 2006, with close to 5.000 GWh and then dropping in 2007, to 4.474 GWh in 2007. We only examined ENDEX NL here.

Phelix Futures

Phelix futures are the oldest derivative product offered by EEX and in the EU. Phelix futures make up almost 1 million GWh exchanged on the exchange in 2007 (see table 2.3 for a detailed breakdown of products). They were launched at the end of 2002, and exhibit notably higher activity than the French and German power futures. Because Phelix futures were launched at the end of 2002, only the 2003-2007 period is examined here.

Market activity for EEX German and French futures exhibits too low activity to warrant any analysis. Indeed since 2005, over 80% of recorded daily traded volumes is 0 in both French and German EEX futures, with *total* volumes traded on a yearly basis not exceeding 1000 GWh.

Powernext Futures

Powernext futures were launched in April 2007. Similarly to other power exchanges in the EU, the Powernext derivatives market is not yet fully developed or mature. Total volumes traded on the exchange from April 2007 to December 2007 stood at 604 GWh, a negligible level of activity.

Price Trends

Given that year ahead contracts are the most commonly used product in the derivatives market, we examine year ahead contracts between the two most significant exchange (by volume), which are Endex and EEX Phelix futures. Of notable significance, market coupling between Endex and EEX in the derivatives market is notably weak, with strong price differentials in each.

Table 2.9 Average Yearly Base Price in €/MWh for Year Ahead Contracts

	2003	2004	2005	2006	2007
Endex Year Ahead (Base)	33,98	39,36	49,21	65,84	60,18
Phelix Year Ahead (Base)	27,98	33,49	41,48	55,01	55,83

From tables 2.9 and 2.10 it becomes clear that there is no significant market coupling effect between the two main future exchanges in Europe. This is especially surprising because a clear price correlation between EEX spot market and APX NL is observed over the same period – thus implying that better pricing signals and physical capacity facilitated market coupling in the day-ahead market (spot markets). The significant volumes that EEX exhibits compared to Endex (see table 2.3) could explain price differences.

Table 2.10 Average Yearly Peak Price in €/MWh for Year Ahead Contracts

	2003	2004	2005	2006	2007
Endex Year Ahead (Peak)	51,47	54,68	67,80	94,00	81,58
Phelix year Ahead (Peak)	43,56	49,12	56,20	81,02	79,32

Price Correlations

We do not calculate price correlations here, given that each exchange lists trades on different days. In other words, there is no coherent overlap of data to compare EEX and Endex. On any given day, one exchange may have registered trades when another hasn't. Conversely, there may be multiple trades on one day but for different products, making a coherent time frame correlation comparison impossible.

Volatility

Tables 2.11 and 2.12 show two clear trends in the evolution of prices and volatility over the 2003-2007 period. These are that prices and volatility have both increased together and constantly over the 2003-2006 period, with a dip in both figures during the 2007 trading year (for 2008 and 2009 contracts).

Table 2.11 Endex NL and Phelix Futures Base Volatility 2003 – 2007 Year Ahead Contracts

	2003	2004	2005	2006	2007
Endex NL	2,68%	2,8%	3,95%	4,12%	3,11%
Phelix	20,05%	24,5%	15,01%	9,41%	6,55%

Table 2.12 Endex and Phelix Futures Peak Volatility 2003 – 2007 Year Ahead Contracts

	2003	2004	2005	2006	2007
Endex NL	2,76%	2,68%	4,02%	3,98%	3,29%
Phelix	19,31%	30,36%	17,88%	7,13%	5,46%

A comparison of volatility trends between future and spot markets shows that derivative markets over the 2003-2007 period exhibit significantly lower volatility. This is explained by the fact that future markets in the EU play their role in providing risk hedging for energy buyers and seller and providing a balancing tool for financial and physical portfolios.

Intraday

The intraday market is still in its infancy. Although Endex does not publish volumes for intraday trading, information provided by the Endex Futures services to ECORYS, indicated that volumes in intraday have been "low" compared to standard future trading. It is interesting to note that price volatility in the intraday market has been lower than for standard year ahead trading.

Table 2.13 Endex NL Intraday Base Price and Volatility 2003 -2007 Year Ahead Contracts

	2003	2004	2005	2006	2007
Average Price in €/MWh	34,04	39,35	49,33	65,82	60,17
Volatility	2,69%	3,13%	3,95%	4,29%	3,47%

Table 2.14 Endex NL Intraday Peak Price and Volatility 2003 -2007

	2003	2004	2005	2006	2007
Average Price in €/MWh	51,57	54,67	67,97	94,00	81,59
Volatility	2,63%	2,9%	4,01%	4,24%	3,68%

2.3 OTC trading in the power market

2.3.1 Introduction

Over-the-Counter trading is the trading of power directly between parties and not through an exchange. Usually this is facilitated by large brokerage firms. OTC trading thus entails using a decentralized market not listed on an exchange where market participants' trade over the telephone, instead of a physical trading floor and where there is no central exchange or meeting place for this market - sometimes referred to as the "OTC market". While exchange-based trading is electronically recorded, OTC deals between for example brokers and their customers are not published, which is why the market's size can only be assumed. As trading on OTC markets is usually performed via telephone and facsimile etc., it leads to a limited price transparency, limited liquidity, an ex ante restricted number of potential market partners and often substantial transaction costs. The function of an OTC market should be to facilitate the various parties involved in transactions so that TSOs can provide low cost and transparent balancing services; so that producers/suppliers can utilise the market to lay off risks (hedging) and so that traders can provide liquidity by actively taking price risks and that brokers can compete with exchanges as an efficient intermediary.

In general, for trading power in Europe, the OTC market is predominantly used. For example, in 2007 the trade volume for power increased on the EEX to 1273 TwH, which corresponds to an increase of 12% compared to the previous year, yet it is estimated that the volume of OTC during the same periods is double that of EEX, approximately 2500 TwH[10]. The main brokers and traders in the OTC market in each country are given in table 2.15 below.

From this table it is easy to see that the same brokers are prevalent throughout the European region, indicating the global scale of these players. The traders are made up of

[10] Source: Fortis Gas, Power and Coal Trading 2008.

the incumbent electricity suppliers such as EDF and the large investment banks and financial institutions such as Merrill Lynch who have become increasingly active in the market in recent times. The list of traders is to be seen in Annex 1 in this report.

Table 2.15 Major market parties in European OTC power trading

	Belgium	France	Netherland	Germany	UK	Spain	Nordpool
Traders	Merrill Lynch EDF Electrabel	EDF Merril Lynch Gaselys Barclays Capital	Essent Nuon Merrill lynch	RWE EDF EON EnBw	EDF RWE SSE EON	Iberdrola SEMPRA EGL	Nordpool Elsam EON
Brokers	SPECTRON ICAP GFI	SPECTRON ICAP GFI Prebon Tullett	SPECTRON ICAP Prebon	SPECTRON ICAP GFI TFS	Prebon Tullett SPECTRON GFI	CIMD A.V. ICAP	Nordpool SPECTRON

This rest of this section is divided into three main categories: an overview of the European OTC power market as a whole, of the UK power market and of the German power market. The fact that these markets trade high volumes will provide a good basis for an analysis for the rest of the study. For each of the UK and German cases, a discussion of the liquidity of energy securities in the OTC markets will be presented. Each market is discussed in detail on a variety of products, followed by a comparison. The analysis is conducted in the same way for each market. In addition, the evolution of this indicator is observed and potential conclusions about the liquidity (market development) are formulated.

2.3.2 European OTC power market

As can be seen in table 2.16, the power market has increased in size by a large extent in Europe as a whole from 2006 to 2007 and continues a trend of growth since 2004. An important component of this trend is the focus of trade in the forward physical markets with very low financial volumes being traded - approximately 1% of total volumes make up purely financial trades (e.g. swaps and options). In the analysis of the OTC markets to follow this will be taken into account and the focus will remain on the physical markets. The market was estimated to be worth approximately €285 billion in 2007 with volumes of trade increasing from 2006 twofold.

Table 2.16 Estimated total Euro-zone Power Market Size and Value 2004-2007

Euro Power	Estimated size of market (GWH)	Estimated value of market
2007	6,336,909 (+103%)	€285 billion[11]
2006	3,126,841 (+24%)	€215 billion[12]
2005	2,524,470 (-12%)	€113 billion[13]
2004	2,878,796	€45 billion

Source: Based on Financial Services Authority U.K. (FSA) figures

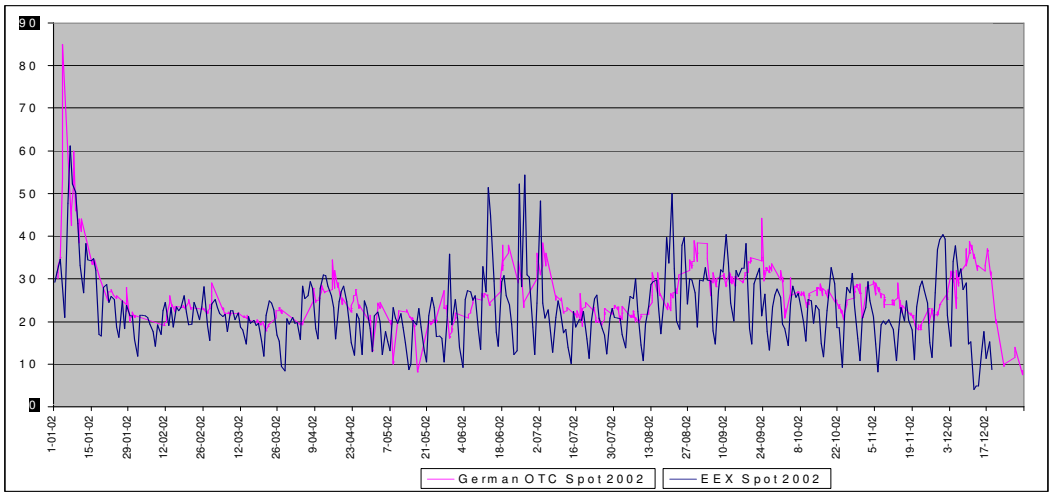
Average spot prices for some of the Euro-zone countries are given in the table below (Table 2.17) for the years since 2002. The data is based on Heren data and shows the day ahead prices in €/MWh.

Table 2.17 Average Spot Prices per annum of European Power Markets (€/MWh)

	2002	2003	2004	2005	2006	2007
German Spot	26,30	35,38	31,49	46,20	54,52	42,32
French Spot	23,87	33,43	31,10	47,97	48,73	40,80
Dutch Spot	43,31	58,67	38,06	94,39	no data	85,59

Average spot prices show German and French markets exhibiting parallel trends, while the Dutch market shows consistently higher power prices. The high cost of Dutch power has been well documented and has been shown to be connected with factors such as the physical barriers to importing cheaper power to the Netherlands from Germany as well as the lack of sufficient domestic power capacity.

Figure 2.5 OTC versus exchange-based trading prices for German spot power in 2002

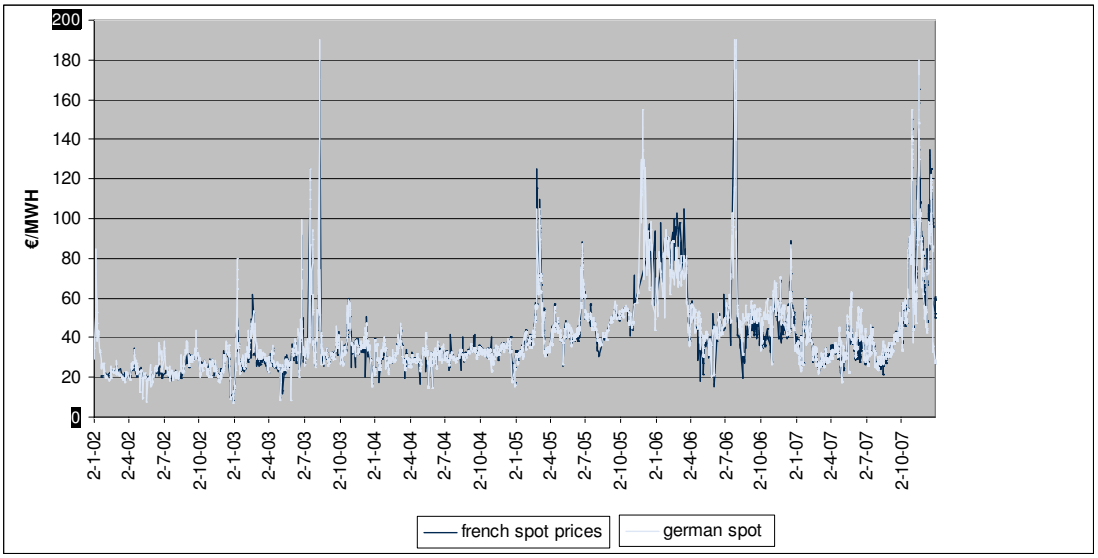


[11] Based on €45 per MWH.
[12] Based on €69 per MWH.
[13] Based on €45 per MWH.

A comparison of long-term OTC prices to the exchange price for 2002, German power (Figure 2.5) shows that there is general convergence of prices over the entire period, which although is taken for granted, it is presented graphically here to fully allow the reader to see the parallel trend in price movements.

In Figure 2.6 below, the historical spot prices are shown for French and German OTC wholesale power using a day-ahead product. In the long run, the markets share the same price trends and thus show in reference at least to these two market prices a high degree of correlation. This finding is in keeping with the perceived consolidation of the two markets as they increasingly integrate.

Figure 2.6 Daily spot prices for power in France and Germany 2002-2007



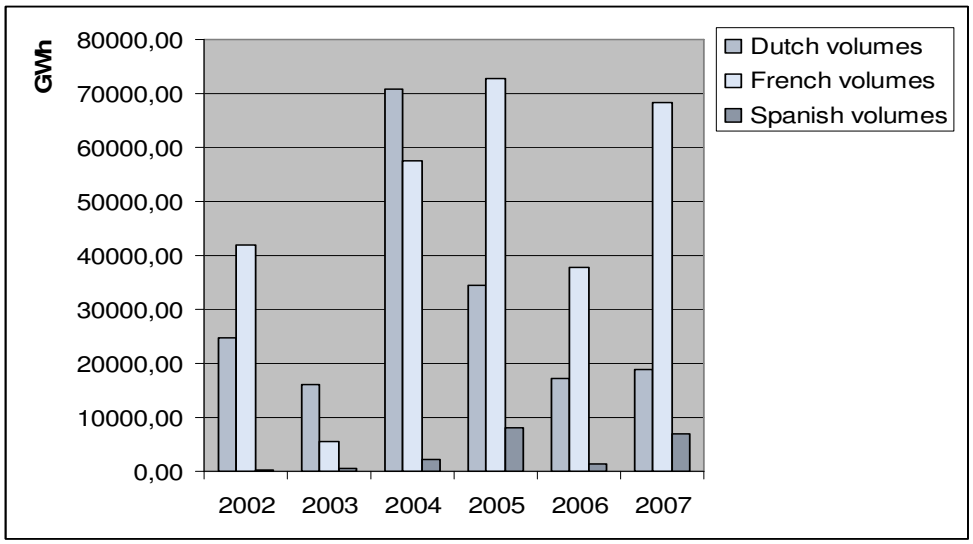
The tables below give the prices and volumes for the year-ahead forward product for power markets in Europe. In similar fashion to the exchange-based trades, the Dutch prices are the highest over the longest period.

Table 2.18 Forward prices for power in European markets from 2002-2007 in €/MWh

Year-ahead product	2002	2003	2004	2005	2006	2007
German forward	23,84	28,98	33,65	40,54	54,77	57,16
French forward	23,57	26,44	32,92	41,07	54,64	54,36
Spanish forward	23,25	32,79	30,96	46,02	52,57	52,81
Dutch forward	31,72	35,62	39,39	46,34	66,64	60,28

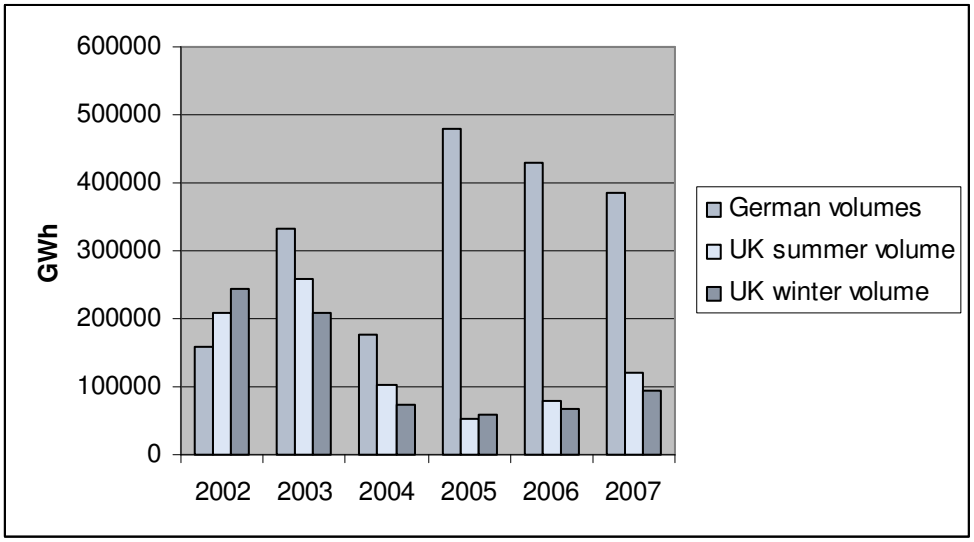
The volumes of year-ahead forwards are depicted in the figure below. It is clear that the Spanish market is in its infancy in 2002, but has shown considerable growth in the last couple of years, although it is still dwarfed by its Northern neighbours.

Figure 2.7 Volumes of year-ahead power in European markets per annum



In the following figure the volumes of power being traded for a year ahead are depicted for the German and UK markets.

Figure 2.8 Volumes of year-ahead power in German and UK markets per annum



It is plain to see that a divergence of the volumes being traded occurs in 2005 as German year-ahead trades increase dramatically, while there is simultaneously a further contraction of the UK forward market – in line with the trend for the market as a whole in the UK, which as will be outlined below saw a decrease in the value of the power market by 38% in 2005 vis-à-vis 2004. A likely explanation of the increase in forward volumes is down to the simultaneous increase in the oil price, which the electricity producers indexed themselves to, which in turn implied a greater willingness by the large electricity consumers to buy forward.

Correlations

Correlation analysis of the OTC data received, has shown there is little evidence to suggest a correlation of volumes and prices in the markets analyzed. The range of correlation coefficients were negative and ranged from -0.01 to -0.3 for the various countries analyzed.

Bid-ask spreads

The relative spreads for the UK, Germany and France when compared among products is presented in table 2.19. Comparison of absolute values has little use since the significance of a spread directly depends on the price of a product. Hence, the spreads are expressed as percentages of the respective price for each type of product and each market (the values for peaks are presented in brackets).

As can be seen, German and French relative spreads are negatively correlated with the duration of the product. In the UK, this pattern is interrupted by the small relative spreads observed for the April forward. However, this is only true for the baseload spread. This observation suggests the market for annual forward contracts being the most - and the spot market being the least - liquid. This, though, is not in line with the observation of the annual transaction frequencies.

Another discrepancy is observed when a comparison between baseload and peak spreads is made. The United Kingdom data is in line with the theory – the spreads during peak times are relatively larger given the liquidity constrains. Nonetheless, France displays the exact opposite for all products but the annual securities. The most significant spreads are observed for the UK spot market.

It should be noted a separate liquidity analysis is presented for the UK and Germany in the corresponding country-relevant OTC power sections.

Table 2.19 Base-load and peak-load spreads

	UK	Germany	France
Spot	1.84 (2)	1.05	1.38 (1.24)
Month (April)	0.66 (1.22)	0.75	1.12 (1.11)
Month (2007)	0.83 (1.14)	0.63	0.78 (0.69)
Year	0.73 (0.6)	0.31	0.49 (0.68)

2.3.3 UK OTC power market overview

The OTC market is mature in the UK with many products on offer and being traded: for example, power can be bought day-ahead, week ahead, month ahead, quarter ahead, winter ahead, summer ahead, summer and winter-two-year-ahead, year ahead, two-year ahead etc. The following tables give an indication of the size of the wholesale market for power in the UK. UK power has witnessed strong growth in 2007 in comparison with 2006, with the volume of trading increasing by 52%.

Table 2.20 Estimated total UK Power Market Size and Value 2004-2007

UK Power	Estimated size of market (GWH)	Estimated value of market
2007	984,811 (+52%)	£31 billion[14]
2006	646,634 (-6%)	£30 billion[15]
2005	809,637 (-38%)	£25 billion[16]
2004	1,311,289	£35 billion

Source: Based on Financial Services Authority U.K. (FSA) figures

According to a questionnaire sent to various stakeholders in the wholesale energy market, the perception of the UK power market is one of a liquid market[17]. Table 2.21 shows the average spot prices and associated volumes traded for power in the UK from 2002-2007, while table 2.22 depicts the forward market for year ahead power.

Table 2.21 Average spot prices and total volumes per year 2002-2007 (€/MWh)

UK spot market	2002	2003	2004	2005	2006	2007
Average spot price	17,73	19,97	23,08	40,31	42,54	48,72
Total volume (GWh)	13140	21784	12808	17028	17288	38262

Table 2.22 Volumes of year-ahead power (Summer and Winter) traded in the UK OTC market 2002-2007

UK year ahead market	2002	2003	2004	2005	2006	2007
Average price (Summer)	15,26	16,52	25,62	38,13	40,30	39,08
Total volume (GWh)	208654	258297	103587	51773	78567	119163
Average price (Winter)	18,42	22,57	33,51	50,73	53,56	44,36
Total volume (GWh)	244171	209844	73185	59247	67403	94361
Total volume (GWh)	**452825**	**468097**	**176531**	**110999**	**146079**	**213109**

Tables 2.21 and 2.22 show the overarching trend for increasing volumes and prices in the spot and forward markets in the UK since 2002. They also show the substantial volume differences for the amount of power traded that exist between the spot and forward markets. For example, in 2007 the year-ahead volumes being traded in the UK was of a magnitude of 213,000 GWh, whereas the day-ahead market (spot) was 38,000 GWh. It is also worth to note the difference in price between the summer and winter products available OTC in the UK. It is clear that there is a significant difference between summer and winter prices as might be expected.

Figure 2.9 depicts the prices and volumes for prompt power traded over the counter in the UK in 2007. Towards the end of the year the price is increasingly volatile and the volumes traded at this point are less than at the beginning of the year: the total volume of spot traded in January 2007 was 5,179,296 MWh whereas in December 2007 this figure was a mere 1,219,416 MWh.

[14] Average ICE spot month settlement of £31.65/MWH.
[15] Average ICE spot month settlement of £47.89/MWH.
[16] Average ICE spot month settlement of £30.89/MWH.
[17] Ecorys data 2008.

Figure 2.9 Price and volume of OTC traded spot power in the UK in 2007

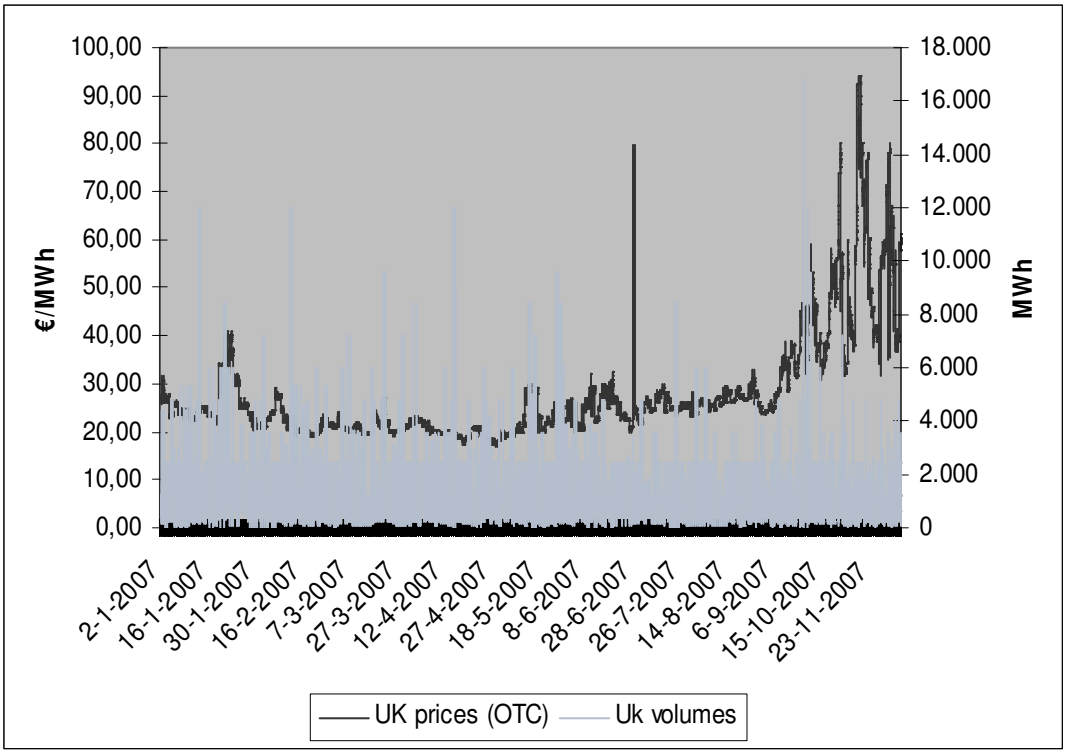
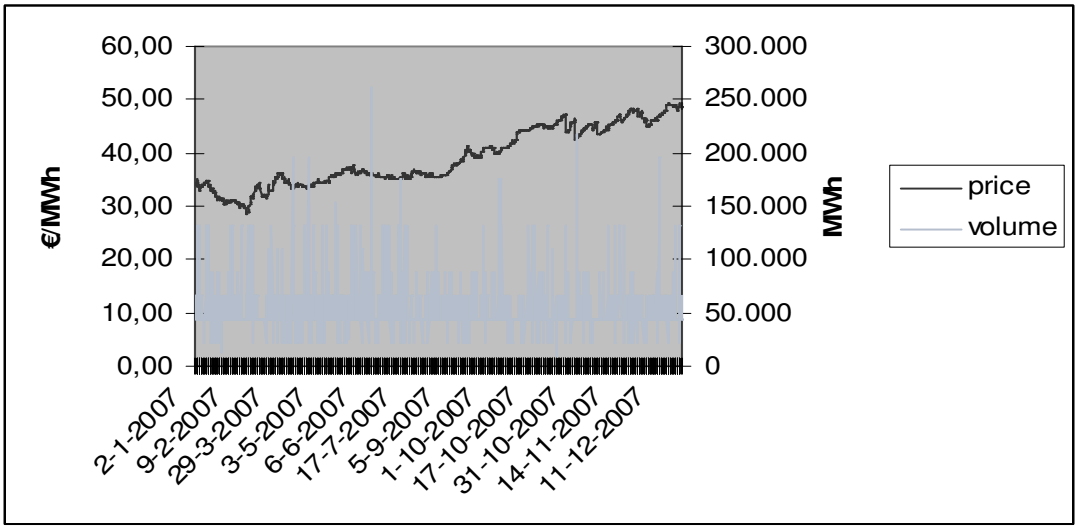


Figure 2.10 shows the volume and price of the year-ahead power market in the UK for summer. The price volatility is less than that for the prompt market as are the volumes being traded both in line with expectations.

Figure 2.10 Price and volume of OTC traded forward (year-ahead summer) power in the UK in 2007



UK liquidity

The UK has an active OTC power market as can be seen by the number of transactions depicted in the tables presented below.

Table 2.23 Spot

2002	2003	2004	2005	2006	2007
249	246	252	250	250	251

Table 2.24 Month ahead (April)

2002	2003	2004	2005	2006	2007
20	20	20	22	23	21

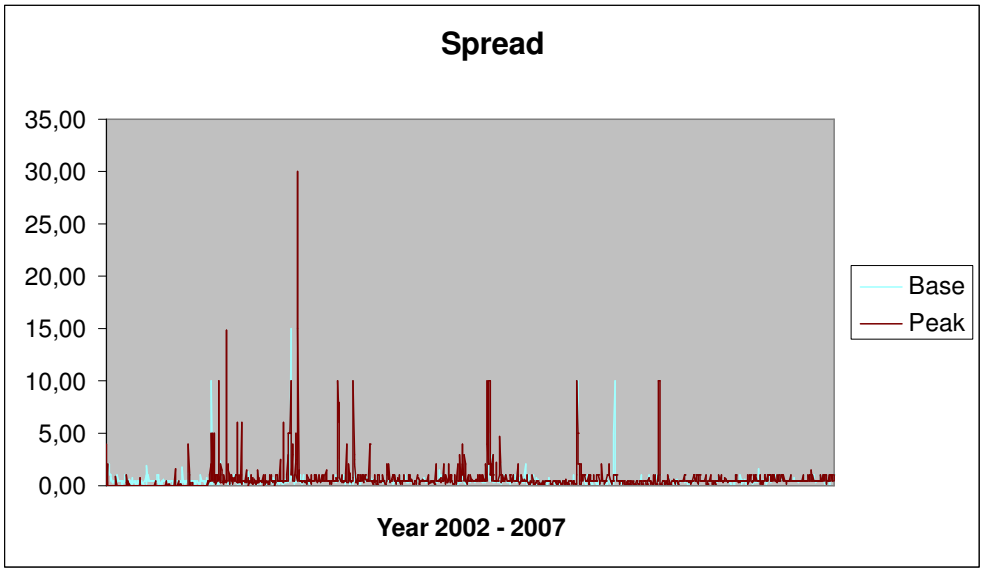
Table 2.25 Year ahead

2002	2003	2004	2005	2006	2007
120	125	127	125	125	62

The number of transactions is relatively constant over time indicating a relatively stable amount of players in the market. Notably, day-ahead contracts are most frequently traded.

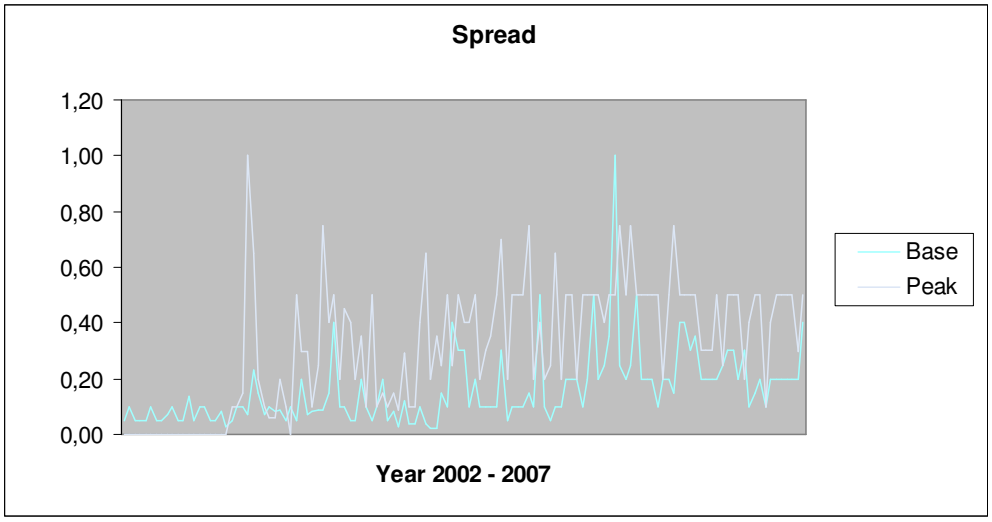
The figures below present the calculated bid-ask spreads for the spot prices, the monthly forward prices and the yearly forward prices respectively. Each graph displays the bid-ask spread for baseload and peak. Linear trend approximations are added in case of significance.

Figure 2.11 Spread on the spot prices in €/MWh for UK power 2002-2007



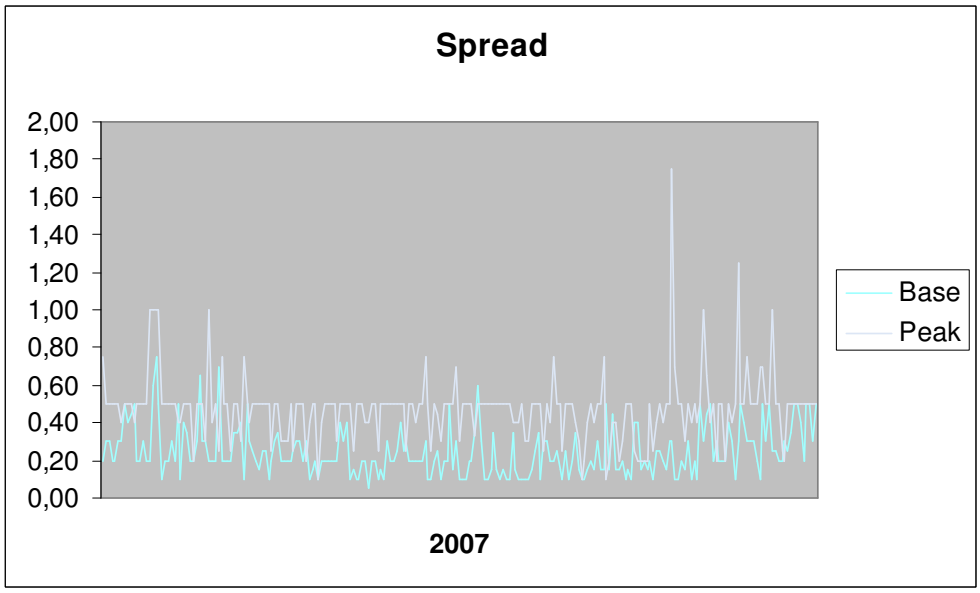
Assuming that the bid-ask spread is a good indicator of liquidity, the spot market does not display significant changes in these terms. This is in line with the finding of the constant quantities of transactions. However, it is worth noting that the amount of large spreads has gone down in size and frequency.

Figure 2.12 Spread monthly forward (April) 2002-2007



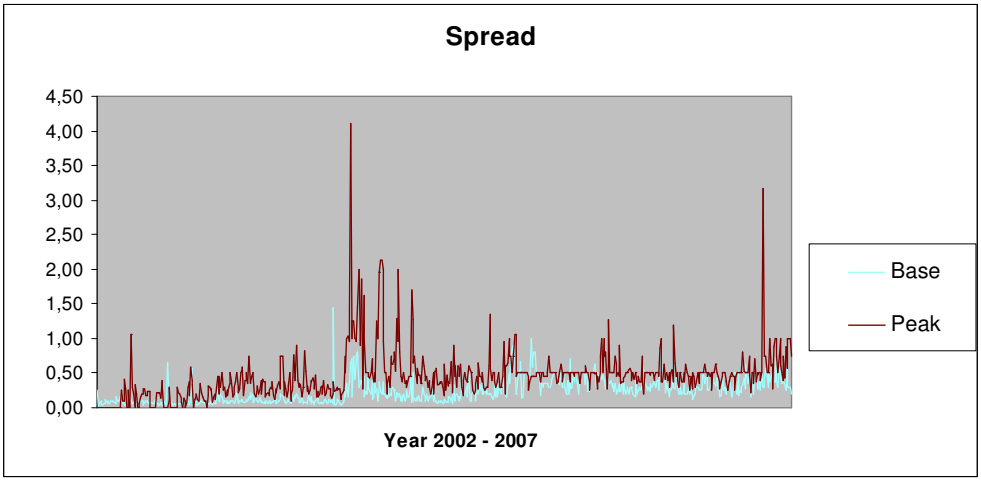
The above graph presents the bid-ask spread for an April forward contract for the period 2002 – 2007. The total number of spreads has gone up as has the average level of the spread. This trend suggests a possible decrease in liquidity. The permanent nature of the new pattern opens the possibility of a structural break. Nonetheless, the scaling is relatively low. Furthermore, the total amount of transactions has gone up, instead of down, contradicting the assumption of reduced liquidity.

Figure 2.13 Spread monthly forward (2007)



The above depiction shows the bid-ask spread for the monthly forward contracts throughout the year 2007. Interestingly, a relatively stable pattern is observed. The spread becomes more volatile towards the end of the year during peak sales times.

Figure 2.14 Spread yearly forward in €/MWh



The pattern in figure 2.14 indicates an increase in the spread and thus, potentially, a decrease of liquidity in the market of annual forward securities. The increase in the observed average follows the shocks in October 2004 and might indicate certain nervousness in the market. Nonetheless, the total number of transactions has not gone down, on the contrary in the years 2005 and 2006.

2.3.4 German OTC power market overview

In Germany, while the mutual exchange of electric energy has been a business activity between vertically integrated utilities for a long time, wholesale electricity trading is also now reasonably well established. Electricity has become a commodity traded at power exchanges and on over-the-counter markets; although in Germany, the wholesale electricity market is dominated by the latter form of trading. Germany's wholesale power market for example, expanded in total by 14 percent in 2007 – one possible reason being the increase in transparency of generators well documented in the literature. If one looks at the German spot power market for example (table 2.26) there has been an increase in the volume of trading of German power in 2007 by 190% compared to 2006. Total trading on the German EEX, and in the over-the-counter (OTC) power market outside the exchange in 2007 grew to 3,200,000 GWh compared to a joint volume of exchange trading and OTC of approximately 2,400,000 GWh in 2006. Furthermore, Germany's power consumption is roughly 500,000 GWh, which means wholesale trade turns over approximately five to six times' consumption, which is generally seen as a sign of an increasingly mature market. This is further manifested by the possibility the EEX merge with Powernext of France as the two energy markets converge, which could possibly reduce costs and entail higher liquidity.

Table 2.26 Average prices and total volumes of OTC spot power trades in Germany

German spot market	2002	2003	2004	2005	2006	2007
Average spot price	26,30	35,38	31,49	46,20	54,52	42,32
Total volume (GWh)	1629	1693	2767	2500	1775	5150

In figure 2.15 the prices and volumes of week-ahead products are given for the German OTC power market since 2002. The volumes traded for this product are significantly reduced in 2004 and 2005 with very few transactions, but volumes increase again in 2006. The price volatility is seen to increase over time with 2003 proving a particularly volatile year for this product. In figure 2.16 the same product (week-ahead) for peak power is shown in terms of price and volume. The volumes being traded in peak also drop at the same time as for base-load power, but recover in 2006.

Figure 2.15 Price and volume of OTC traded forward (week-ahead) base power in Germany in 2002-2006

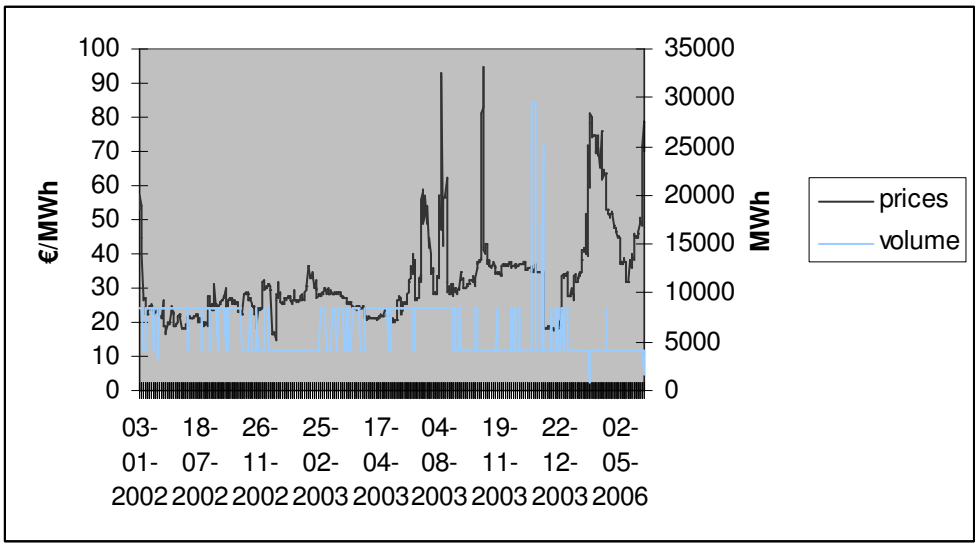
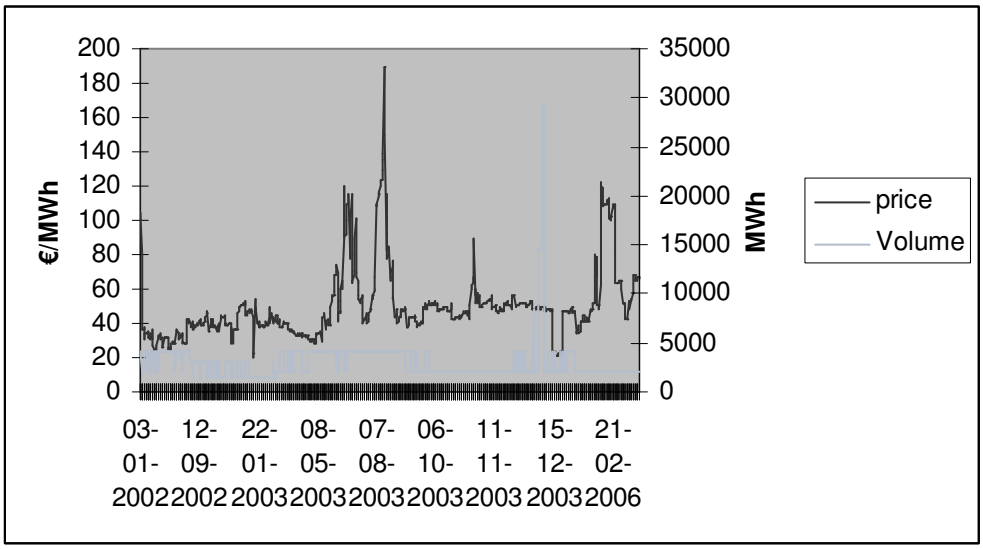


Figure 2.16 Price and volume of OTC traded forward (week-ahead) peak power in Germany in 2002-2006



German market liquidity

Overall, Germany has a relatively well developed and stable market. The number of transactions is not volatile and the annual forward contracts are of equal importance as

the spot transactions. The information presented below is based on the baseload transactions only due to the lack of data availability for peaks.

Table 2.27 Spot

2002	2003	2004	2005	2006	2007
253	253	254	252	252	253

Table 2.28 Month (April)

2002	2003	2004	2005	2006	2007
20	21	23	21	23	22

Table 2.29 Year

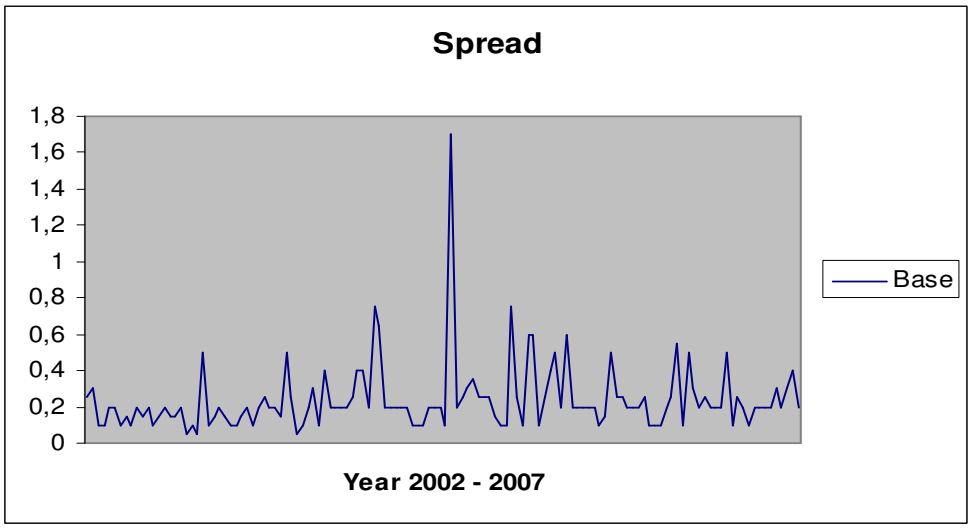
2002	2003	2004	2005	2006	2007
253	253	254	252	252	253

Spot

The price mismatches for day-ahead contracts showed spreads on the spot market maintaining stability following the shocks of August 2003. The average spread decreased slightly throughout this period.

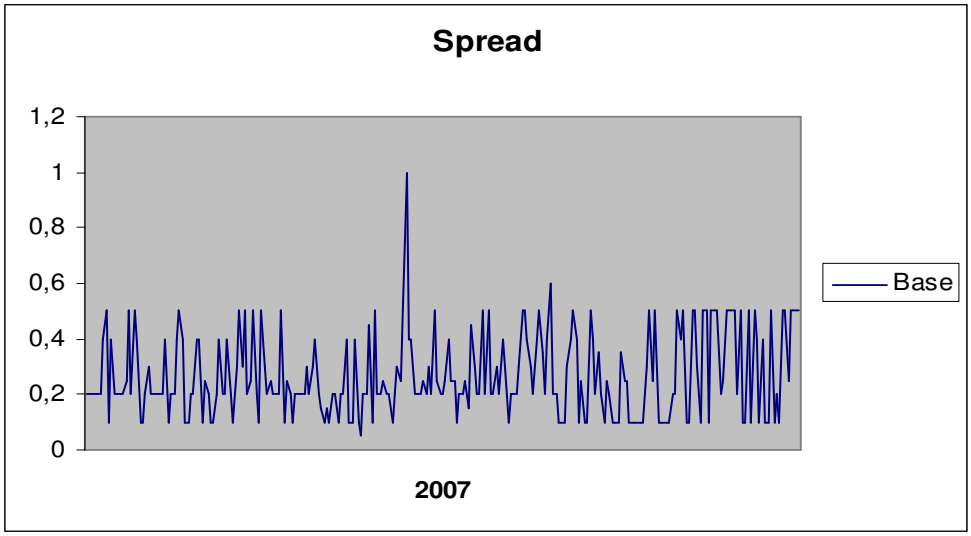
Month

Figure 2.17 Spread monthly forward for base load power in €/MWh (April)



The spread of the April forwards are on average stable. Increased volatility surrounds the spike from early March 2005.

Figure 2.18 Spread monthly forward in €/MWh (2007)

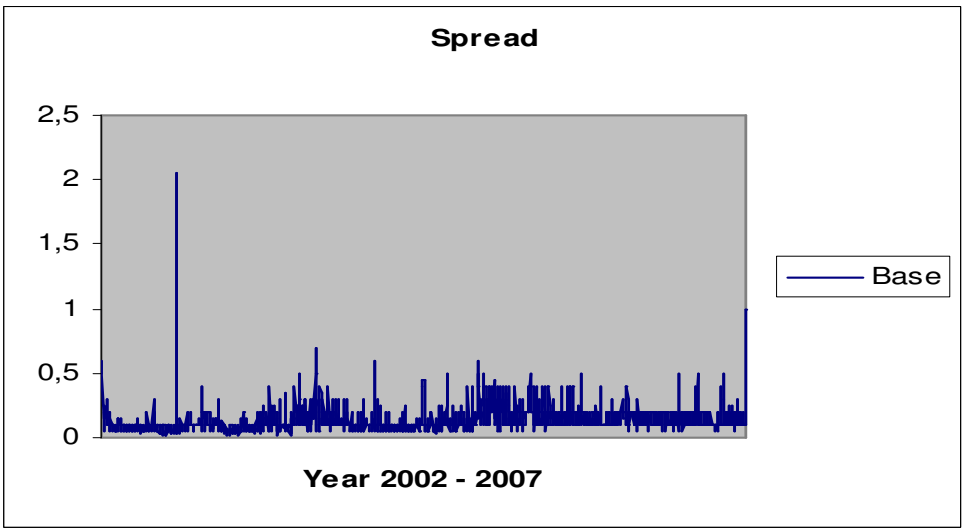


The liquidity, if measured by the bid-ask spread, remained stable for the monthly forwards except for the observed spike on the transaction day of 16th of May 2007 acquiring a June 2007 forward.

Yearly products

Figure 2.19 shows the spread for yearly forwards on the OTC market. The annual spread stabilizes after some volatility halfway through the period.

Figure 2.19 Spread yearly forward



The analysis of German liquidity backed up by the questionnaires sent to various energy traders as part of the research into liquidity upholds the view of Germany being regarded as a big market with high liquidity.

3 European Wholesale Gas Markets

3.1 Introduction

International gas trade is increasing due to rising global gas demand, declining gas reserves in Europe, the USA, and parts of Asia, lower gas transportation costs particularly for liquefied natural gas, requirements to diversify supply and higher gas prices. Furthermore, restrictions on CO_2 emissions, the nuclear phase-out announced by some Member States, high emissions from coal-based generation, and barriers to rapid development of renewable generation, are factors that result in a high level of dependency on natural gas in Europe.

Natural gas accounts for 25% of primary energy use in the European Union. Nearly 60% of consumed natural gas in the EU is imported, with Norway, Algeria and Russia constituting the bulk of natural gas exporters to the EU. The sectoral inquiry launched by the European Commission which was published in 2007, found serious distortions to a competitive gas market in the EU, namely:

- Unbundling and the dismantlement of vertically integrated large incumbents has not fundamentally occurred, there is still a high level of market concentration;
- Illiquid markets and a lack of infrastructure limit the access of new entrants on the market for gas in the EU;
- Cross border sales do not generate significant competitive pressure;
- There is no truly transparent and reliable information on gas markets in the EU;
- Higher transparency is needed.

The EU is therefore far from having an integrated, liquid, open and transparent gas market. Indeed, the four largest companies in the EU account for almost 50 percent of the total production in the EU. Both in the external supply situation as well as the internal supply, a minority of companies control a large part of the market.

This section will provide an overview of the current state of the gas market with a focus on the role of gas hubs, gas exchanges, as well as OTC and bilateral trading. Specifically, the following questions will be addressed for each:

- What are the prices and volume trends for the various platforms on which gas is exchanged?
- What are the time trends in volumes and prices?
- How coupled are the various exchanges?
- How does price volatility behave over the 2002-2007 period?
- How liquid are these markets?

The EU-27 consumed 5.993.000 GWh of natural gas in 2006[18]. Recorded volumes in EU hubs and exchanges stood at 9.011.000 GWh in 2006, including OTC trading. The UK NPB hub (OTC) cornered most volumes for gas trading in 2006, standing at 7.058.000 GWh. Virtual and physical gas hubs constitute the rest of OTC trading, the Belgian Zeebrugge gas hub being a major trading point for OTC gas contracts (500.000 GWh in 2006). Other physical hubs include the CEGH Austrian hub (98.000 GWh in 2006). Virtual trading points are PSV in Italy (78.000 GWh in 2006), PEGs in France (77.700 GWh in 2006) as well as BEB, GTS and GDFDT in Germany (18.000 GWh combined in 2006).

Total traded volume in the EU is more than one third higher than total consumption, while exchange based trading for both spot and future products represents less than 10% of total traded gas volumes in the EU, OTC and bilateral trading making up the rest of total traded gas volumes. Keeping in mind these proportions, our analysis and exchanges is less exhaustive than for power exchanges given that traded volumes on open markets are not wholly significant.

Table 3.1 Volumes Traded Futures in GWh for the main gas spot and futures exchanges

Exchange	Volume 2006
Endex Futures	12.000
APX UK	200
APX Zee	10
Total	12.210

Volumes traded relative to consumption are notably higher in the power markets (2.7 million GWh consumed and 6.3 million GWh traded) than in gas markets (5.9 million GWh consumed and 9 million GWh traded).

3.2 Gas hubs in the EU

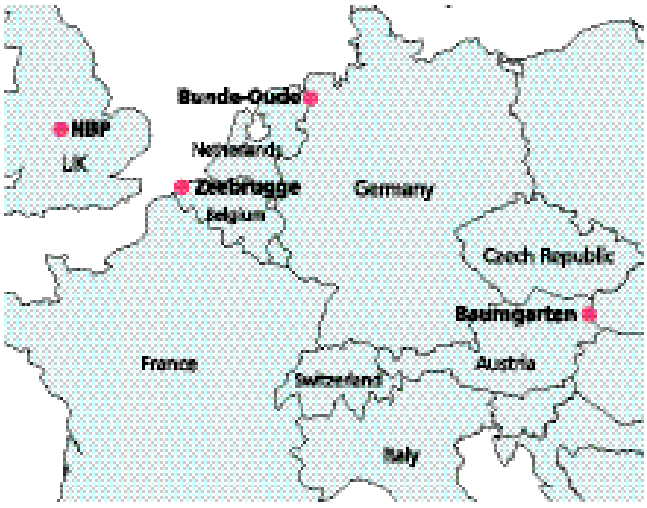
The liberalisation of natural gas prices and increasing flexibility in the gas market means that market centres and hubs are continuously being developed. A hub is a place where connections of gas pipelines meet each other and buyers and sellers can trade in natural gas and in the location of the delivery of this gas at such a hub. The higher levels of trading at gas hubs will in turn lead to the development of gas spot markets and if developed enough, will also lead to the development of financial gas markets. Financial gas trading means that non-gas players, such as banks, institutional investors and pure trading firms, can enter the market and take on gas-specific risks.

Financial gas contracts are used to manage two types of risk in the natural gas market: price and basis risk. Price risk is generated by the volatile spot market prices of natural gas. Basis risk is the risk of change in the price differential between locations, time periods, and qualities of natural gas deliveries, and between natural gas and other commodities. Transparency and liquidity are the fundamentals for success for a natural

[18] National statistics, regulators.

gas trading hub. For this to originate there are a lot of operational and commercial requirements. The major EU gas hubs are depicted in the figure below and show those gas hubs that currently are dealing with the largest volumes of gas in Europe. Specifically, the Zeebrugge, Baumgarten and Bunde-Oude hubs are considered the main players in the EU gas market.

Figure 3.1 Major European Gas Hubs



source: www.eprm.com

Germany

Wholesale gas trading in Germany started in 2002, with the attempt to develop the Bunde-Oude hub on the Dutch/German border. Despite showing potential in the period immediately after its launch, trading activity at Bunde had little impact. Difficulties in obtaining third-party access to pipelines and the complex network ownership situation both hampered liquidity development. In addition, competition from the much easier to use the Title Transfer Facility (TTF) market in the Netherlands further hampered liquidity development at Bunde-Oude.

During 2006 three new German hubs were launched - the BEB hub (currently Germany's leading hub), the E.ON Ruhrgas (the largest gas wholesaler in Germany) hubs launched in October 2006 and the Gaz de France Deutschland (GDFDT) hub, also launched in October 2006. Increasing volumes of gas are being exchanged at E.ON's Ruhrgas hub on which energy exchange EEX bases its contracts: both the gas trade on the spot market (day ahead) and the futures market trade are included in the EEX.

One of Eon's gas hubs is a virtual marketplace - E.ON Gastransport (EGT) operates the hub and has combined three zones for delivery of H-Gas, which is the main commodity piped to Germany from suppliers such as Russia or Norway and which is the dominant gas used with 90% market share. The churn rate at the hub - a market measure expressing the ratio of physical transports versus traded volumes - has risen to 1.6 in February 2008. This shows that E.ON's H-gas market, is still small in relation to the Dutch hub, the Title Transfer Facility (TTF), where the rate is between 4 and 6, and in comparison to Britain's

National Balancing Point (NBP), where it is an estimated 13[19]. Germany's gas market has been developing over the past two years after pipeline grid operators simplified transport rules due to regulatory pressure and the cartel office ended long-term supply contracts.

Belgium

Belgium is home to the Zeebrugge Gas Hub. The Zeebrugge Gas Hub is one of the largest gas hub in Europe. The throughput capacity of the Zeebrugge storage terminal will double to 9 billion cubic meters of LNG by the end of 2009. Zeebrugge is strategically located as it is at the crossroads East/West artery between Scotland and Siberia on one hand, and the North/South artery between Norway and Southern Europe on the other. As well as being a physical storage facility, Zeebrugge is also the home of the largest financial gas exchange market in the EU. In 2007, Zeebrugge Hub physically traded 447.000 GWh. Daily average trading fluctuates between 1.300 and 1.500 GWh.

The Netherlands

The largest gas hub is the TTF or the Title Transfer Facility as it is more commonly known. It is a virtual trading point for natural gas set up by Gasunie in 2003 and allows gas to be traded within the Dutch network. The TTF has a pivotal role in the ambition to create a "Dutch gas roundabout". The TTF may make it possible for the Netherlands to become a North-West European trading centre for gas and gas-related services. The Endex derivatives exchange offers trading for TTF gas.

Austria

Austria's Central European Gas Hub (CEGH) is located in Baumgarten near the intersection of Austria's borders with Hungary and Slovakia and is being turned into a 50%-50% OMV-Gazprom joint venture. The two companies plan to expand CEGH to become Europe's number-one gas-trading hub and also intend to build underground storage sites for Gazprom gas near the CEGH in Austrian territory.

Baumgarten handled an estimated 16 to 18 billion cubic meters of mostly Russian gas in 2007, more than double the 2006 volume of 7.7 billion cubic meters. Gazprom is tempting Austria with the promise to use the CEGH for some 30% of Gazprom's total gas exports to the EU already this year.

U.K.

The National Balancing Point, commonly referred to as the NBP, is a virtual trading location for the sale and purchase of UK natural gas. It is the pricing and delivery point for the IPE (International Petroleum Exchange) natural gas futures contract. It is the most liquid gas trading point in Europe and is a major influence on the price that domestic consumers pay for their gas at home. Gas at the NBP trades in pence per therm.

The following tables give an overview of the various players in the gas market.

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[19] Reuters 2008.

Table 3.2 List of actors

Austria	Belgium	France
Gas Industry Regulator	**Gas Industry Regulators**	**Gas Industry Regulator**
E-control	CREG - national regulator	CRE
	CWAPE - Walloon regulator	
Marketplace	IBGE-BIM - Brussels regulator	**Gas Exchange**
CEGH - Central European Gas Hub (OMV)	VREG - Flemish regulator	Powernext
System Operations	**Gas Exchange**	**System Operations**
A&B (transaction clearing and balancing energy for western Austria)	APX Gas Zeebrugge	GRTgaz
		Gaz de France Distribution Network
AGCS - Gas Clearing and Settlement (eastern Austria)	**System Operations**	Geostock
AGGM (network management for eastern Austria)	Fluxys	Total Infrastructures Gaz France
CISMO - Austrian energy trading market services alliance	Fluxys LNG (Zeebrugge LNG terminal operator)	
	Huberator (Zeebrugge gas trading services)	**Market Players**
Pipeline Operators		Altergaz
BOG - Baumgarten-Oberkappel Gasleitung	**Market Players**	Gaselys
TAG – Trans Austria Gasleitung	Distrigas (Suez)	Gaz de Barr
	Electrabel (Suez)	Gaz de Bordeaux
Market Players	Infrax	Gaz de France (GDF)
Begas	Luminus	Gaz de Strasbourg
EconGas (BEGAS, EVN, Linz AG, OÖ Ferngas, OMV and Wien Energie)	Nuon Belgium	Gaz Electricité de Grenoble
	WVEM	Poweo
Energie Graz		Total
Energie Steiermark		
E.ON Ruhrgas Austria		
EVN		
KELAG		

Austria	Belgium	France
OÖ Ferngas OMV RAG Salzburg AG Terragas (E.ON Ruhrgas/Salzburg) Tigas VEG - Vorarlberger Erdgas Wiengas		

Germany	Netherlands	Norway
Gas Industry Regulation	**Gas Industry Regulators**	**Gas Industry Regulators**
Federal Network Agency (energy regulator)	DTe	Ministry of Petroleum and Energy
BaFin - Financial Services Regulator	State Supervision of Mines	NPD - Norwegian Petroleum Directorate
BKA - Competition Authority		NVE - Norwegian Water Resources and Energy Directorate
BMWi - Ministry of Economics and Technology	**Gas Exchanges**	
	APX Gas NL	**System Operator**
Marketplaces	Endex - European Energy Derivatives Exchange	Gassco
EEX		
HubCo - North West European Hub	**System Operations**	**Market Players**
	GTS - Gastransport Services	Amerada Hess
System Operations - Major Networks	Alkmaar Gas Storage	Bayerngas Norge
BEB Transport	NAM Grijpskerk Storage	BP Norway
E.ON Gastransport		ConocoPhillips Norway
ONTRAS - VNG Gastransport	**Pipeline Operators**	DNO
RWE Transportnetz Gas	BBL - Balgzand-Bacton Pipeline	Eni Norge
Wingas Transport		E.ON Ruhrgas Norge
	Market Players	ExxonMobil Norway
Market Players	***Production and Wholesale Companies***	Gasnor
Bayerngas	4Gas	Marathon Oil
BEB Erdgas und Erdoel	ATP Oil & Gas	Norske Shell
Dong Energy	BP	Petoro
EnBW	Chevron	RWE Dea Norge
E.ON Avacon	Cirrus Energy	StatoilHydro
E.ON Ruhrgas	ConocoPhillips	Total E&P Norge
Erdgas Muenster	DSM Energy	
Erdgas Suedbayern	Dyas	

Germany	Netherlands	Norway
EVG	Energie Beheer Nederland	
EWE	Eni	
ExxonMobil	ExxonMobil Benelux	
Ferngas Nordbayern	GasTerra	
Gas-Union	Gate Terminal LNG project	
Gasanstalt	Gaz de France Production Nederland	
Gaz de France Produktion Exploration Deutschland	LionGas LNG project	
Gazprom Germania	Lundin Petroleum	
GVS - Gasversorgung Sueddeutschland (EnBW / Eni)	NAM (Shell / ExxonMobil)	
IVG Caverns	Northern Petroleum	
NatGas	Oranje-Nassau	
RWE Energy	Shell Nederland	
Saar Ferngas	Star Energy	
VNG - Verbundnetz Gas	TAQA	
Wingas	Total	
Wintershall (BASF	Venture Production	
	Vermilion Energy Trust	
	Wintershall	
	Supply-based Companies	
	Cogas	
	Delta	
	Electrabel Nederland	
	ENECO Energie	
	E.ON Benelux	
	E.ON Ruhrgas	
	Essent	

Germany	Netherlands	Norway
	Intergas Nuon Rendo (Electrabel) RWE Nederland Westland Energie Services (Essent)	

Spain	UK	Europe
Gas Industry Regulator	**Gas Industry Regulators**	**Selected Regulatory and Policy Links**
CNE	OFGEM (Great Britain)	BASREC - Baltic Sea Region Energy Co-operation
	NIAUR (Northern Ireland)	CEER - Council of European Energy Regulators
System Operator		European Commission environmental portal
Enagás	**Gas Exchanges**	Energy Charter Secretariat
	APX Gas UK	EEF – European Energy Foundation
Market Players	ICE Futures	ERGEG - European Regulators Group
Bahia de Bizkaia Gas		IEA - International Energy Agency
BP Espana	**OTC Market Brokers**	
Centrica Energia	ICAP	**Industry Groups**
Cepsa	Spectron Group	Baltic Gas Organization
Endesa	Tullett Prebon	Cedigaz - Natural Gas Association
Gas Natural		Easee Gas - Association for the Streamlining of Energy
Iberdrola	**System Operations**	Exchange
Medgaz (Algeria to Spain pipeline project)	National Grid	Edig@s - Gas Trading Technology Workgroup
Naturgas Energia	Centrica Storage	Eurogas - Union of the Natural Gas Industry
Reganosa LNG		EFET – European Federation of Energy Traders
Repsol YPF	**Pipeline Operators and Services**	Fedarene - Federation of Regional Energy and Environment
Shell Espana	BBL Company (Netherlands-UK)	Agencies
Union Fenosa	Interconnector (Belgium-UK)	GERG - Gas Research Group
	Ormen Lange project (Norway-UK)	GIE - Gas Infrastructure Europe
	Premier Transmission (Scotland-Northern Ireland)	Geode - Energy Distribution Company association
		International Association of Oil & Gas Producers
	LNG Terminal Projects	IGU - International Gas Union
	Dragon LNG	IETA – International Emissions Trading Association
	Grain LNG	IFIEC Europe - industrial consumers association

Spain	UK	Europe
	South Hook LNG	Marcogaz - Technical Association of the Natural Gas Industry
	Industry Players	
	Amerada Hess	
	BG Group	
	BP	
	British Gas (Centrica household supply)	
	Centrica Group	
	Chevron Europe	
	ConocoPhillips	
	EDF Energy	
	Eni	
	E.ON UK	
	ExxonMobil UK	
	Gaz de France UK	
	Gazprom Marketing and Trading	
	Maersk	
	Marathon Oil	
	Noble Energy	
	Perenco	
	Ramco	
	RWE Dea UK	
	RWE npower	
	Scottish & Southern Energy	
	ScottishPower	
	Sempra Energy Europe	
	Shell Trading	

Spain	UK	Europe
	Star Energy Statoil UK Total Wingas	

3.3 Gas exchanges in the EU

3.3.1 Introduction

The gas exchange market in the EU is significantly less mature than power exchanges. Moreover, gas volumes on exchanges are insignificant compared to virtual and physical hubs, which are the focal point for trading. Only since 2006 have any notable, albeit minor (by volumes traded and products offered) gas exchange platforms emerged. Today, gas is exchanged on APXNL, APX ZEE,APX UK, Powernext, EEX and Endex (futures only) platforms. EEX and Powernext launched their gas exchanges in 2007. There is thus little data for analysis at this point.

Alongside hubs, exchanges also accommodate gas trading as outlined in the description of the various European exchanges. A list of gas exchanges is shown in table 3.3.

Table 3.3 Gas exchanges in the EU

Exchanges	Spot	Intraday	Derivatives
APXNL (Netherlands)	✓	✓	✗
APX ZEE (Belgium)	✓	✓	✗
APX UK	✓	✗	✓
EEX (Germany)	✓	✗	✓
Powernext (France)	✓	✓	✗
Endex (Belgium)	✗	✗	✓

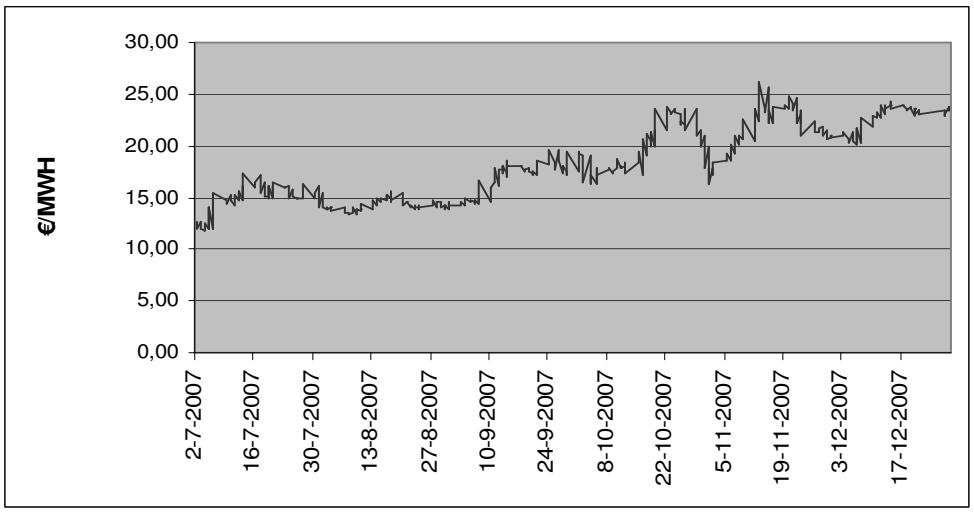
3.3.2 Spot Gas Exchanges

As mentioned above, because of the recent nature of the gas spot market, there is little data available on the underlying trends in the EU. Indeed, available information does not go back more than two years. The current gas exchanges for spot products in the EU, are APXNL, APX ZEE, EEX and Powernext. On the whole, the liberalization of the gas market lags behind that of the power market, which itself cannot boast a glorious state of affairs. Intraday trading on exchanges, although an available product, is virtually not exchanged on the APX platform. For instance, APX NL Gas exchanged no more than 25.000MWh in *total* over the 2006-2007 period. APX Zeebrugge exchanged close to 290.000MWh in intraday trading (9.868.000 therms) over the same period.

EEX

EEX is a leading exchange in the power market for the whole of the EU. In 2007 it launched its gas exchange platform which offered spot and future trading. Data for the gas exchange in only available starting in the second and third quarters of 2007. Thorough analysis is thus not warranted, especially when considering the minimal amount of volume traded on the gas exchange. BEB and EGT gas refer to different types of products in terms of calorific values.

Figure 3.2 EEX Spot Price BEB Gas (07/07 – 12/07)



We can however observe that prices in the spot market have almost doubled for the BEB Spot Market, starting at an average of 12 €/MWh and ending close to 25 €/MWh. From July 2007 to December 2007, 130.320 MWh were traded on the BEB Spot Market.

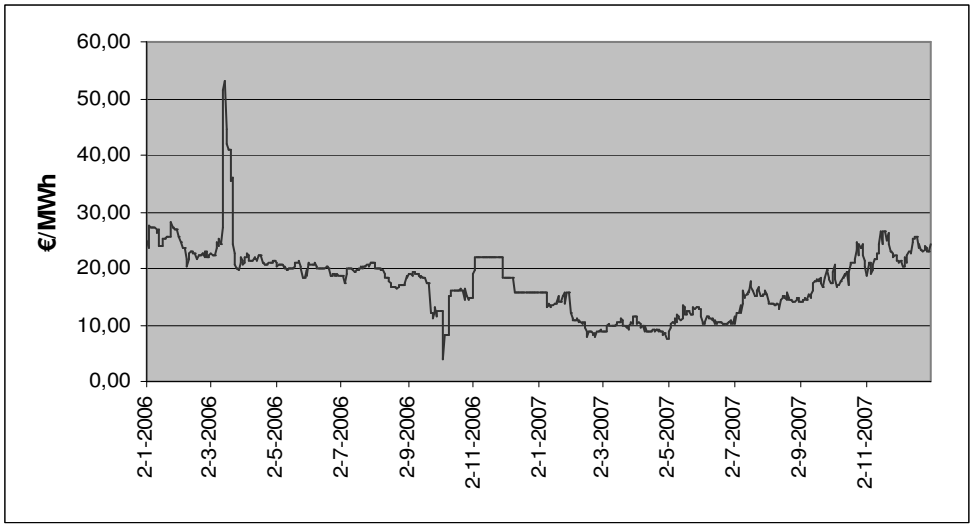
APX

The main feature of the APX exchange is its link to the Zeebrugge Gas Hub. There are two exchanges that offer gas trading on the APX exchange: APXNL (in the Netherlands) and APX Zee (in Belgium). Both exchanges do not offer derivative products, only spot.

APX NL

APX NL offers different types of gas, TTF-Hi and TTF-G+. They refer to different calorific value qualities of gas, tradable on APX Gas NL. TTF terms are traded in units of €/MWh, in line with market practice. However, over the 2006-2008 period no volume was traded for TTF G+ gas.

Figure 3.3 APX NL Spot Prices TTF-Hi Gas 2006-2007

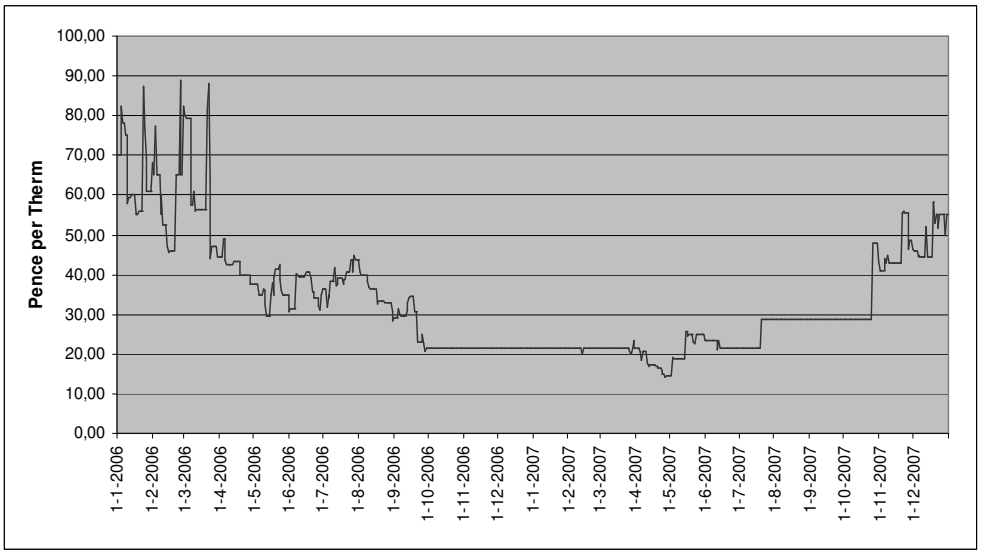


Data for APX NL TTF Prices is available from January 2006. Figure 3.4 shows price variations from 2006 through 2007. Price started at an average of 26 €/MWh and ended around the same price. However, it peaked at over 50 €/MWh with a low of less than 5 €/MWh. 838.000 MWh were traded during the 2006-2007 period.

APX ZEE

The APX ZEE exchange is not significant in that volumes traded on a daily basis are low, while total volume traded since the exchange's inception has been minimal.

Figure 3.4 APX ZEE Spot Prices 2006 - 2007



Data in figure 3.5 ranges from 2006-2007. Although the price evolution seems to suggest significant price fluctuations, volumes traded on the exchange were minimal. Traded volumes on APX Zee were insignificant until November 2006, ranging from zero trades a

day, to little over a few tens of thousands of therms a month. 3.650.000 therms were traded over the 2006-2008 period (a little less than 110.000 MWh). Flat lines in the graph indicate that no volumes of trade are registered or that market participants are too few to sway prices.

APX UK

APX UK is the most mature gas exchange in Europe. It was launched in 2002

APX UK price have steadily increased since 2002, ranging from an average of less than 20p/Therm in 2002, to 30p/therm in 2007. Prices peaked at the end of 2005 and the beginning of 2006. Volumes traded on the APX UK OCM from 2002-2007 spot gas market stood at 23.845.920.000 therms, close to 700.000 GWh (see figure 3.6). ECORYS obtained volume data from the APX data services. However, a breakdown of volumes per product was not made available to us.

Price Trends and Volatility

There are no other significant exchanges to compare the APX UK gas exchange to, given that no other exchange in the EU goes further back than 2005. In addition, the large level of volumes traded on APXUK make any comparison to another exchange with a fraction of its volume irrelevant. We can note however that price volatility in the APX UK OCM market was high over the 2002 period, while volumes traded were also relatively high (see table 3.4). In the UK gas market, price volatility can be partially explained by high capacity utilization in the market, which subsequently may prevent buffer supplies to dampen price reactivity in periods of high demand.

Figure 3.5 APX UK OCM Spot Gas Prices

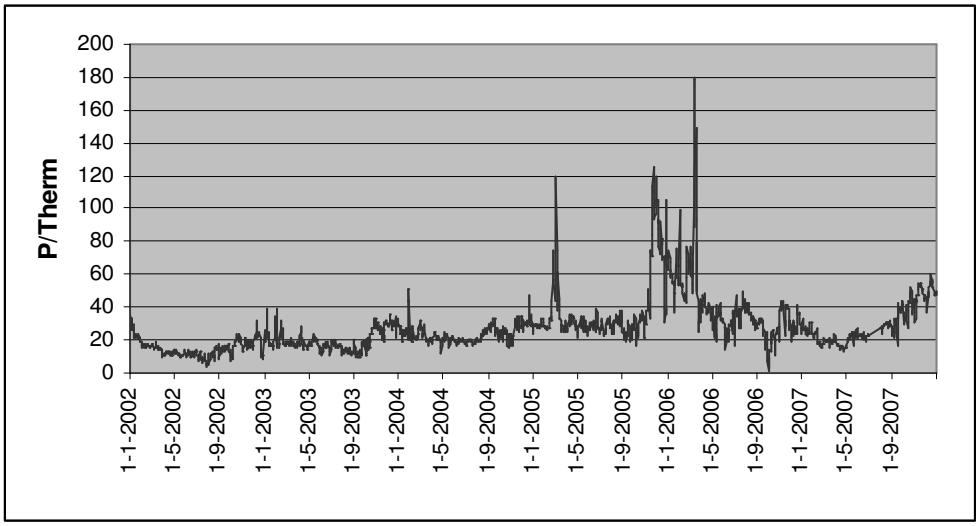


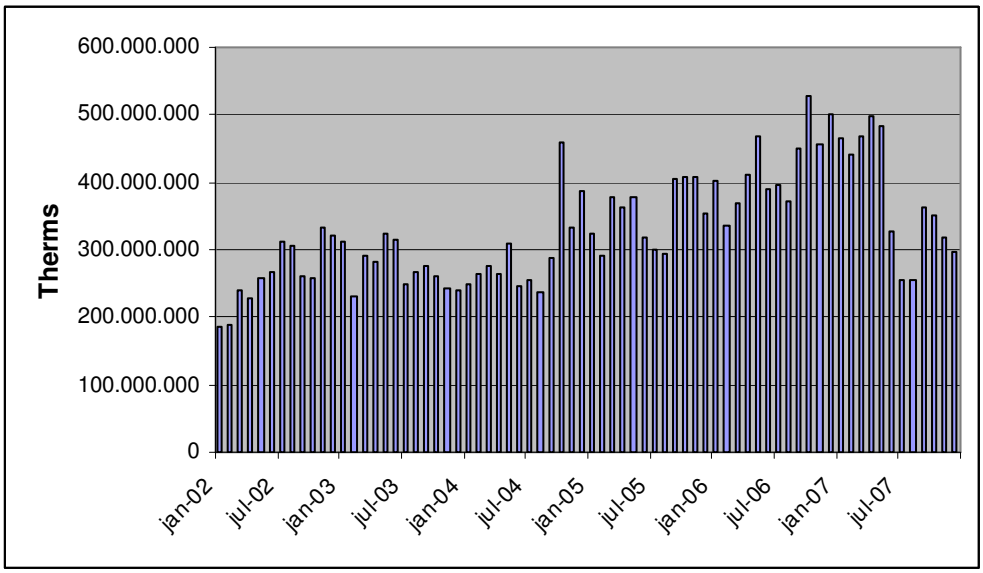
Table 3.4 Price Trends and Volatility APX UK OCM 2002 - 2007

	2002	2003	2004	2005	2006	2007
Average Price in p/therm	15,04	20,78	23,73	37,72	39,26	29,60
Volatility	85,25%	61,97%	47,83%	64,33%	173,13%	53,12%

Volumes

The volumes traded on the APXUK gas exchange have increased from 2002 to 2007. However, a notable decline in traded volume occurred during the second quarter of 2007, with average monthly volumes being almost halved from 450 million therms (13.000 GWh) a month to 250 million (7.300 GWh).

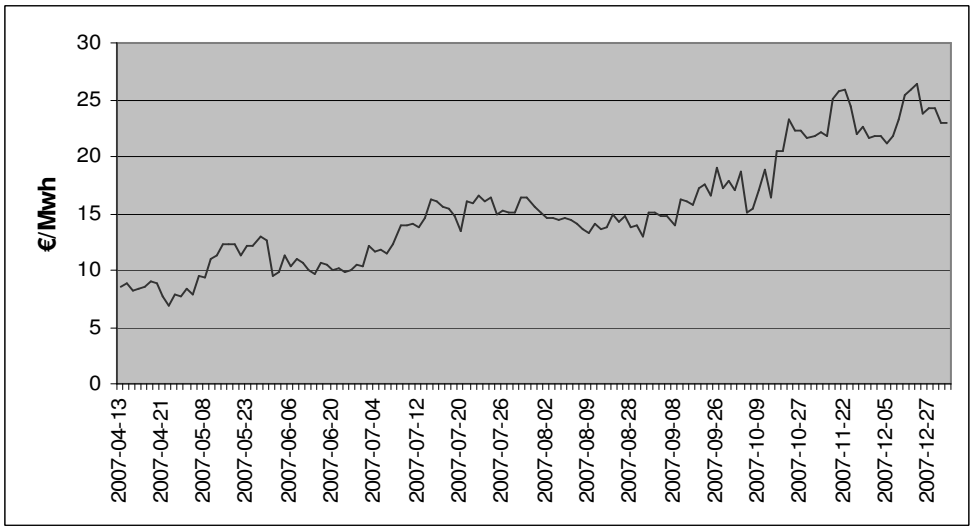
Figure 3.6 Volumes Traded APXUK OCM 2002-2007



Powernext

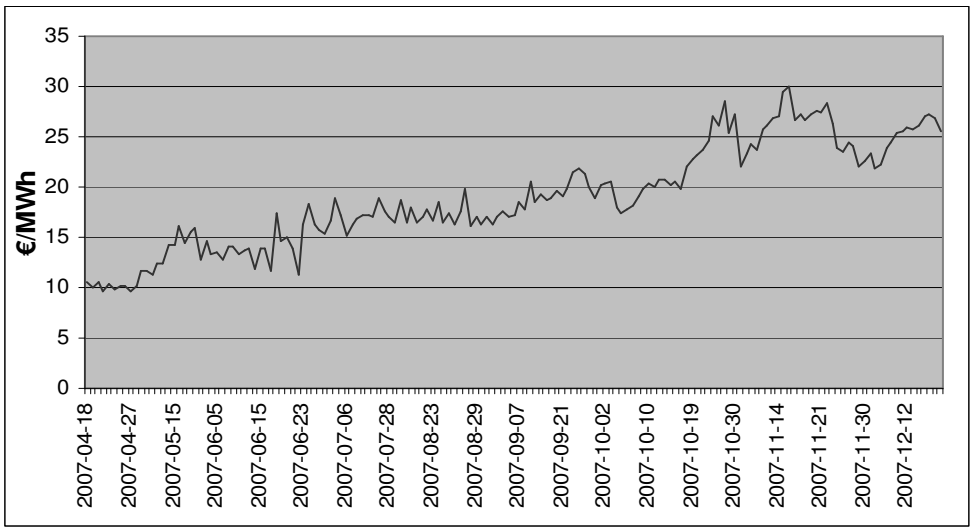
Powernext is also a currently small gas exchange. Since it opened spot trading for gas, in April 2007, 604.000 MWh were traded until the end of that year, a small amount by all standards.

Figure 3.7 Powernext Spot Ask Price April – December 2007



Asking price for spot gas products on the APX exchanged almost tripled over the 3 last quarters of 2007, going from 9 €/MWh to almost 23 €/MWh at the end of December. However, little volume was exchange over that period.

Figure 3.8 Powernext Spot Bid Price April - December 2007

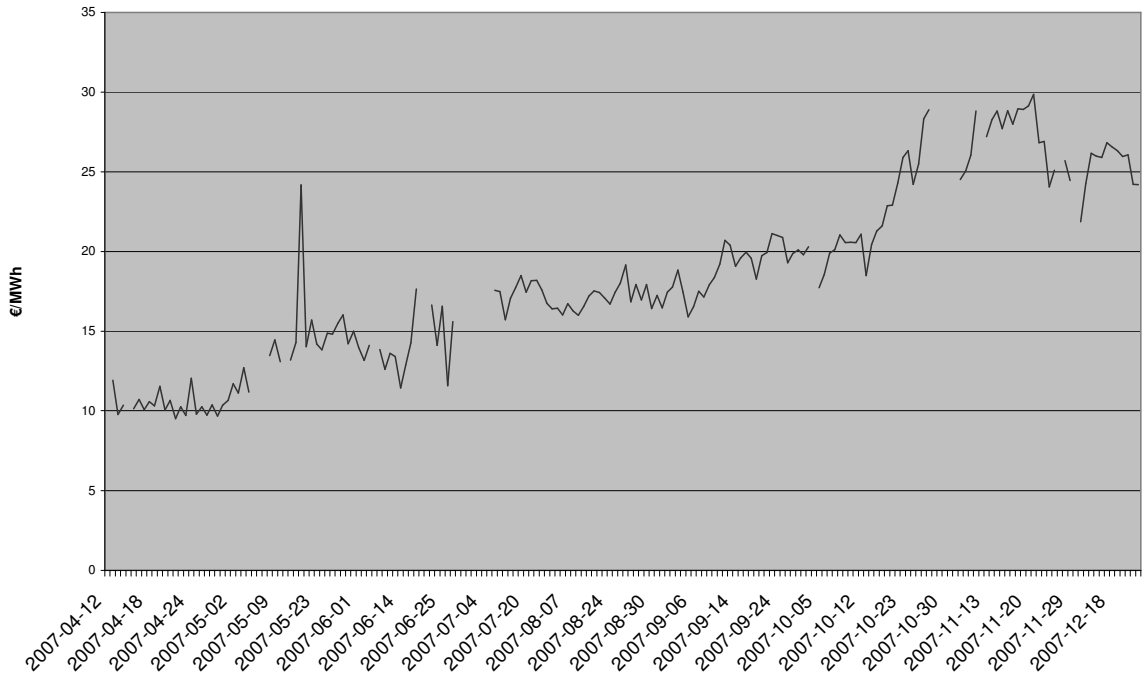


Bid prices on the Powernext exchange for gas shadowed asking prices from April to December 2007, as one would expect.

3.3.3 Intraday Trading

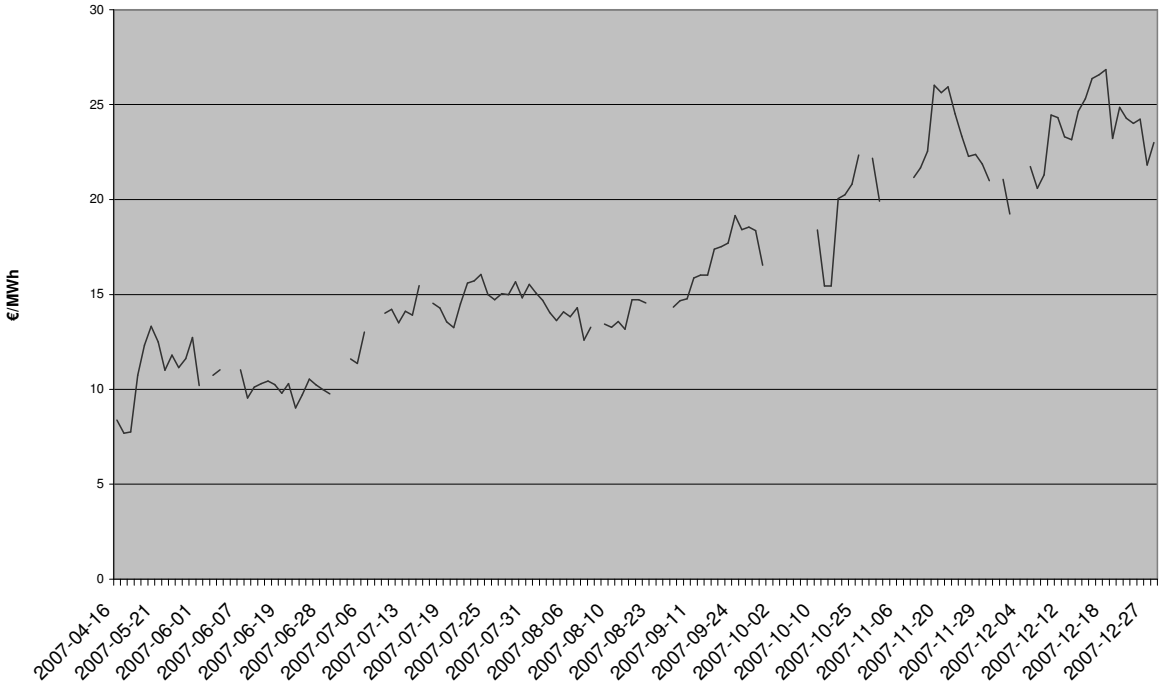
Powernext has a slightly more mature intraday gas trading platform. Gaps in the graph indicate that no volumes were exchanged over the given period.

Figure 3.9 Powernext Intraday Ask Spot Prices April –December 2007



Total daily asking volumes stood at 296.100 MWh while total daily bidding volumes stood at 325.000 MWh. Average daily asking total volumes were of 1948 MWh from April to December 2007, while average daily bidding total volumes were of 1643 MWh.

Figure 3.10 Powernext Intraday Bid Spot Prices April – December 2007



3.3.4 Futures

Gas futures on the European market are only traded on the Endex exchange. Because the spot market is already in a development stage, derivative products lag behind day ahead trading in the gas markets. In addition, over-the-counter and bilateral contracts make up the bulk of gas trading today.

ENDEX

The table below shows the various organisations that are players on the Endex exchange for gas trading. The gas exchanges offer similar services to the hubs - for example, the ENDEX exchange in the Netherlands has the capability to trade Dutch hub TTF long-term gas contracts via the ENDEX Futures Exchange (EFE). The contracts offered on the Endex exchange cover the gas curve from 3 months ahead, 4 quarters ahead, 2 seasons ahead till 3 years ahead. These contracts are cleared by a central counterparty (the clearing house). Trading on ENDEX is completely anonymous as the clearing house ECC becomes the central counterparty.

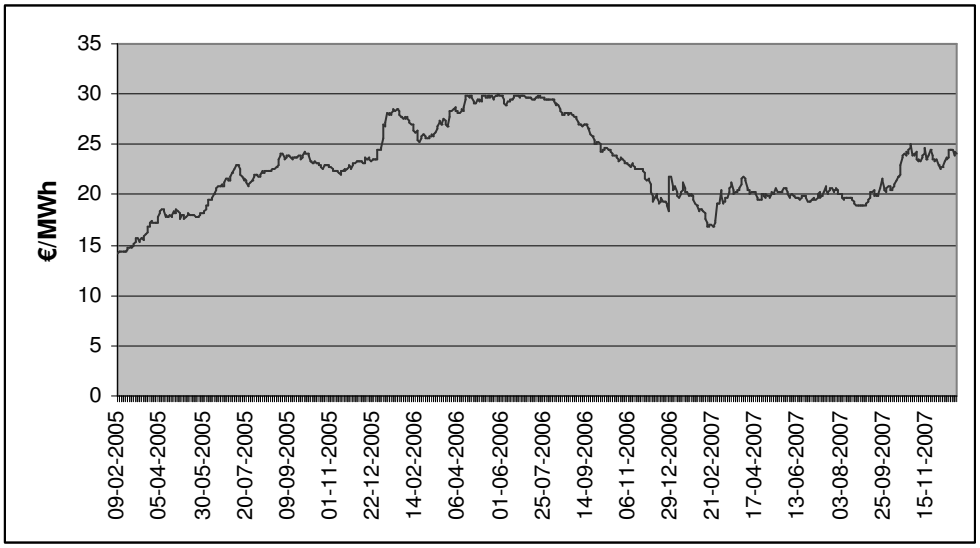
Figure 3.11 Market Players on the Endex Gas Exchange

Price Trends

Table 3.5 Endex TTF Gas Average Price and Volatility Year Ahead Price

	2005	2006	2007
Price in €/MWh	20,62	26,7	20,67
Volatility	5,28%	3,96%	8,17%

Figure 3.12 Endex TTF Gas Year Ahead Prices 2005 - 2007



As can be seen in Table 3.5, prices in the year ahead market have generally increased from 2005 to 2006, with a high price of nearly 30 €/MWh during the second and third quarter of 2006. Volatility, however, has remained tame throughout; although it rose to a higher level in 2007, as the price fluctuation during that period indicate in figure 3.13.

ENDEX TTF Volumes

Data for volumes is only available after March 2006. Both number of trades and megawatts hour increased from 2006 onward, showing the growing interest the market has in derivative products. Judging from the higher volatility prices in the UK spot market, Endex futures can be seen as a hedging option for balancing portfolios for those actors involved in the market.

Table 3.6 Endex Trades and Volumes for TTF Derivatives

	2006	2007
Number of Trades	168	301
Megawatts Traded	4.170	6.940
Megawatts Hour Traded	12.124.960	17.793.940

3.4 OTC trading in the wholesale gas market

3.4.1 Euro-zone OTC gas markets

Gas supplies to Europe remain dominated by long term contracts (15 to 25 years) between incumbents, which are the main importers, and producing companies from exporting countries external to the European Union (Gazprom in Russia, Sonatrach in Algeria and Statoil in Norway) and countries from the EU, e.g. Gas Terra in the Netherlands. These contracts include price indexation clauses on crude oil and oil products. Zeebrugge (Belgium) and the TTF (Netherlands) are the two dominant market places (gas hubs) on the continent; several other ones are emerging, however, their development is hindered by obstacles to cross border gas transit within the EU.

As the UK is by far the biggest gas market in Europe worth an estimated £134 billion in 2007 compared to the aggregate Euro-zone value of £11 billion in the same year, the following analysis is examined from the perspective of both the Euro-zone area as a whole - albeit a brief overview - and from that of the UK. As can be seen by table 3.8, the market value in the Euro-zone area has tripled since 2004. In addition the market has grown in terms of volume between 2006 and 2007 (65% growth) after two years of shrinking trade volumes.

Table 3.7 Estimated total Eurozone gas market size and value 2004-2007

Eurozone Gas	Estimated size of market millions of therms	Estimated value of market
2007	37,871 (+65%)	£11 billion[20]
2006	22,972 (-2%)	£11 billion[21]
2005	23,509 (-23%)	£7 billion[22]
2004		£3.5 billion

Euro-zone products on offer can be seen in table 3.8. TTF is the most mature market in terms of the amount and variety of products that are traded. The TTF facilitates trades on the forward curve up to four years ahead. The other markets have less scope for these long-term types of transactions.

[20] Average IPE spot price applied.
[21] Average IPE spot price applied.
[22] Average IPE spot price applied.

Table 3.8 Products on offer in the Eurozone gas markets

Market place	Within-day	Day ahead	Week-end	BOW	BOM	Month ahead	Two months ahead	Q1, Q2, Q3, Q4	Summer ahead	Year ahead and more
Zeebrugge	√	√	√		√	√	√	√		√
TTF	√	√	√		√	√	√	√	√	√
Peg Nord		√				√				
Germany (EGT & BEB)		√	√	√	√	√	√	√		

In table 3.9 the total volumes and average prices of the Belgian market is given while figure 3.13 shows price and volume movements for the same market for month-ahead products. This is the only Eurozone market where full historical data since 2002 was available and is therefore presented here. In table 3.10 historical volume data since 2006 is given for selected Eurozone markets (as for the years between 2002 and 2006 there is no data available). These figures represent the total volumes being traded in all products and is based on data from Heren. The table illustrates the fact that the NBP is the largest hub in Europe in terms of total volumes being traded and is in addition a relatively liquid market compared to Zeebrugge (see liquidity table 3.11). It should be noted that the figures given here are only approximates of the actual volumes being traded given the fact that Heren data captures approximately 10% of the TTF volumes and 30% of the NBP volumes being traded OTC.

Table 3.9 Belgian spot market 2002-2007: volumes and prices

	2002	2003	2004	2005	2006	2007
Volume (day-ahead) Therms	6,667,232	2,806,928	2,943,566	2,997,967	6,026,070	6,986,736
Price (day-ahead) £/Therm	18	22	25	43	45	32

Table 3.10 European traded gas volumes (GWh) 2006 and 2007[23]

Market	2006	2007
TTF (The Netherlands)	279,724	344,829
Zeebrugge (Belgium)	176,628	264,783
NBP (UK)	523,541	843,104

[23] Heren data 2006, 2007. For Zeebrugge and NBP, units of therms were converted to MWh using 1 therm: 0.029307 MWh and then expressed in the table as GWh

Figure 3.13 Price and volume of Belgian month-ahead gas market 2002-2007

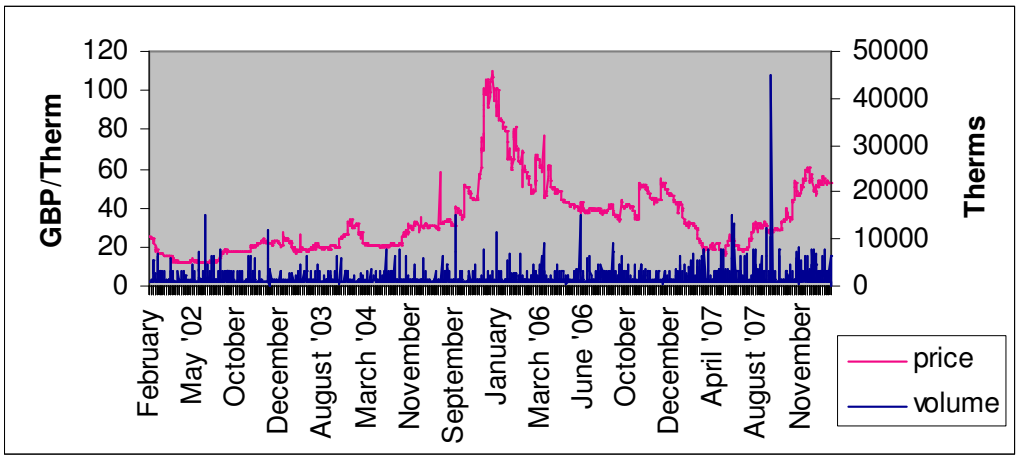
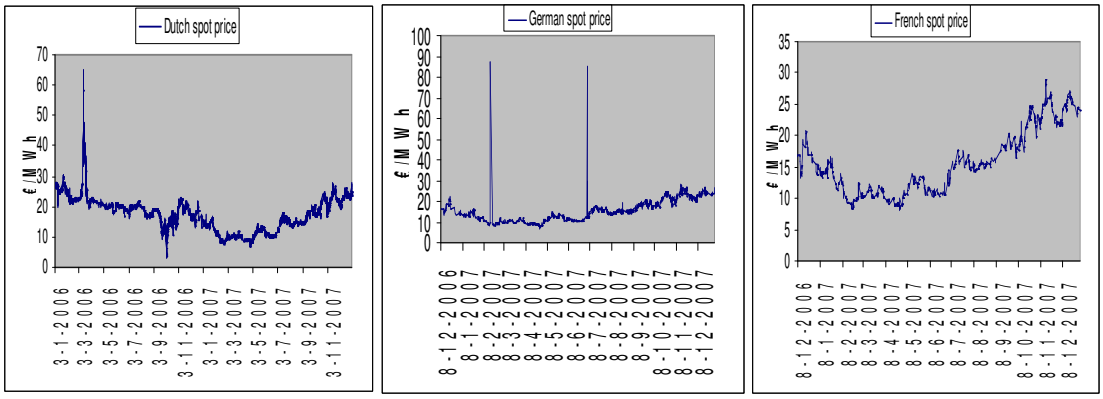


Figure 3.13 shows the increased volatility in the price of natural gas on the wholesale market with a peak in the price in 2006. Volumes traded remained more or less stable during the same period.

In figure 3.14 the price movements for various Eurozone markets are given. German and Dutch gas markets show signs of price co-movement in 2007. The TTF market and EGT hub in northern Germany exhibit a strong price correlation as do the main gas hubs of TTF and NBP in 2007[24].

Figure 3.14 Dutch, German and French historical gas (spot) prices 2006-2007



Eurozone liquidity

The various stages of development of the gas hubs in the EU are partially reflected in the liquidity of these hubs. Table 3.11 shows the rates of liquidity of gas hubs as rated during the summer of 2007.

[24] Heren data 2008

Table 3.11 Rates of liquidity in various European gas hubs

Gas Hub	Liquidity rating (out of 20 during Summer 2007)*
NBP	19
TTF	15
Zeebrugge	12
EGT	9
PEG Nord	7
BEB	4
CEGH	0
PSV	0

*Based on Heren data 2007

It is clear to see that the TTF leads the Eurozone gas hubs in terms of the bid-ask spread, the amount of trades being transacted on a given day and by the number of market players – factors that equate to high liquidity. The NBP in Britain tops the league and in fact is almost "perfectly" liquid with a score of 19 out of 20. The dynamics of the UK market and the NBP will be discussed in greater detail in section 3.4.2. Interesting to note is the difference in score between the TTF in the Netherlands and that of its counterpart in Belgium, Zeebrugge. The latter has a score of 12 compared to the former's 15 points, and is generally considered less liquid due to factors such as varying gas quality, the fact the access capacity is controlled by the incumbent (Distrigas) and that its status is primarily as a transit hub.

3.4.2 UK OTC gas market

Wholesale markets are developing in Europe, but the NBP (Great Britain) is the only market place considered as a mature market by traders. Thanks to its liquidity and to the two gas lines connecting the British market to continental Europe (Interconnector and BBL), the NBP exerts a high degree of influence on the continental hubs. The market size in the UK is shown in table 3.12 and illustrates the maturity of the UK market, which dwarfs the Eurozone markets in estimated value terms.

Table 3.12 Estimated total UK gas market size and value 2004-2007

UK Gas	Estimated size of market millions of therms	Estimated value of market
2007	437,042 (+109%)	£134 billion[25]
2006	209,180 (+20%)	£108 billion[26]
2005	173,680 (+21%)	£54 billion[27]
2004	168,711	£40 billion

Source: Based on Financial Services Authority U.K. (FSA) figures

[25] Average ICE Futures Europe ("ICE") spot month settlement of 30.8 ppth.
[26] Average ICE Futures Europe ("ICE") spot month settlement of 51.82 ppth.
[27] Average ICE Futures Europe ("ICE") spot month settlement of 31.10 ppth.

3.4.3 NBP and the wholesale spot market for gas

The need for a wholesale market for players structurally short of gas to obtain supplies led to the development of the UK National Balancing Point (NBP). The NPB is by all measures the most important virtual trading gas hub in Europe, trumping all other trading hubs and platform. In 2006, out of the EU's 9 million GWh traded volumes, UK NPB traded 7 million GWh. The data we obtained for NBP are from Heren. This data is thus a representative sample of the trends in the gas trading market.

Liquidity and volatility at the NBP

The NBP exhibits high levels of volatility on the spot market – a phenomenon that although is less than in 2002, is still around the 50% mark. UK gas prices are actually considered one of the most volatile commodities in the world, which can put a brake on liquidity as long term contracts are used to cover this phenomenon, which in turn means that markets have less volume to trade and become less responsive to changes in the supply-demand balance. The price trends and the oscillations seen at the NBP are shown in figures 3.15 for 2002 and for 2007 in figure 3.16. In addition, figure 3.17 shows the *volumes* being traded in 2007 at the NBP. The table below (3.13) provides volatility estimates for 2002 and 2007.

Table 3.13 Day ahead market UK: volatility and price

	2002	2007
Volatility	17,46%	8,26%
Price (p/therm)	14,73	30,36

Figure 3.15 2002 day ahead prices in pence per therms

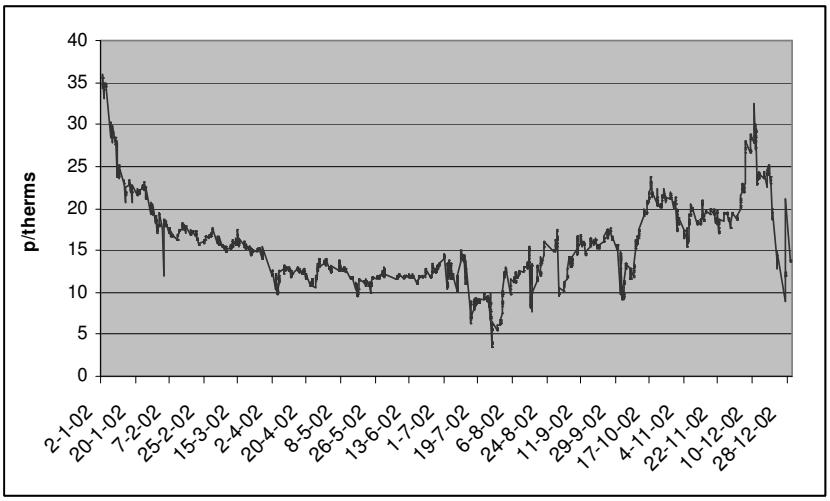


Figure 3.16 2007 day ahead prices in pence per therms

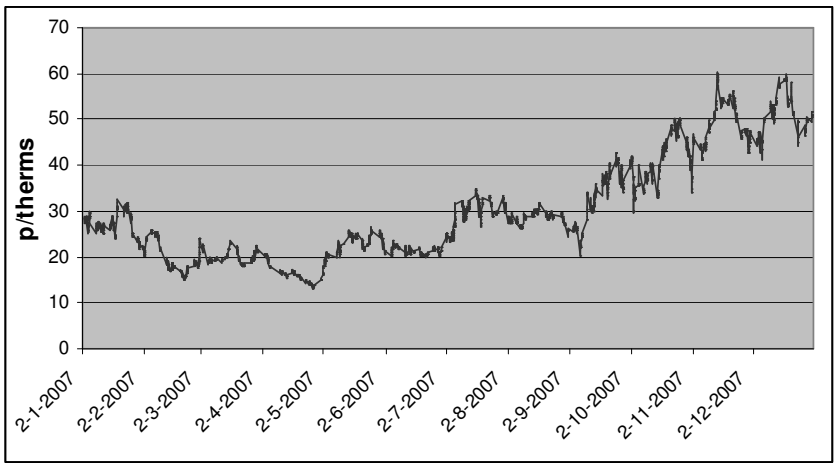
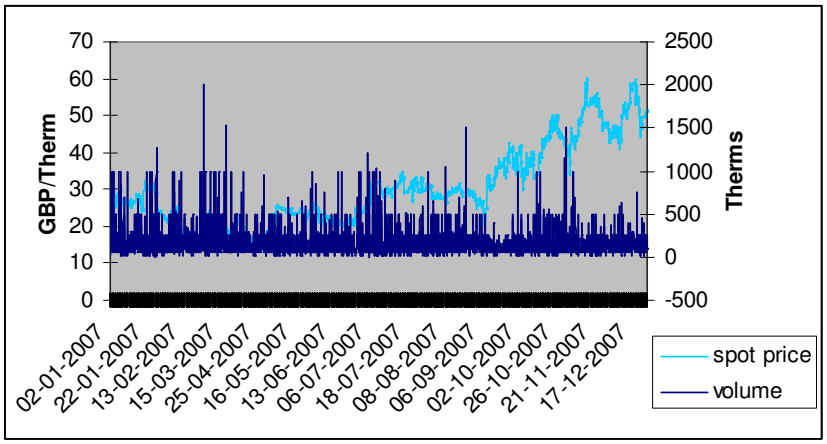


Figure 3.17 Spot price and volumes for the NBP gas hub UK 2007



The day-ahead contract on gas at the NBP remained fairly stable in the first half of 2007 in line with estimated long-term contract prices[28]. However, the market finished in a context of high volatility both on the UK NBP and on the two other main European gas hubs (TTF and Zeebrugge) during the last quarter of 2007. The beginning of 2008 however has seen day ahead prices stabilize between 22 and 25 €/MWh, and the NBP, Zeebrugge and TTF hubs indexes showing high levels of correlation[29][30].

The rating of the liquidity of the NBP is given as 19 out of 20 as shown in table 3.11 according to data from Heren. The break down of the liquidity per product is shown here in table 3.14. It highlights the products that are typically available at the NBP on most trading days. Both the spot and the forward markets are liquid except for - as might be expected - the three year-ahead contract that is also available at the trading hub.

[28] Heren data 2008.
[29] Source: Datamonitor.
[30] Graph data shows uptil end 2007 only.

Table 3.14 Liquidity of various products on the NBP hub

Within-day <€ 0.5/MWh spread	1	Month-ahead <€ 0.3/MWh spread	1
Day-ahead <€ 0.5/MWh spread	1	Next quarter <€ 0.3/MWh spread	1
Month-ahead <€ 0.5/MWh spread	1	Next season <€ 0.3/MWh spread	1
Next quarter <€ 0.5/MWh spread	1	Two seasons ahead <€ 0.3/MWh spread	1
Next season <€ 0.5/MWh spread	1	Two years ahead <€ 0.3/MWh spread	1
Two seasons ahead <€ 0.5/MWh spread	1	Three years ahead <€ 0.3/MWh spread	0
Two years ahead <€ 0.5/MWh spread	1	Exchange-based balancing market	1
Three years ahead <€ 0.5/MWh spread	1	Brokers widely used	1
Within-day <€ 0.3/MWh spread	1	Independent daily price quotes published	1
Day ahead <€ 0.3/MWh spread	1	Active futures exchange	1
Total			19

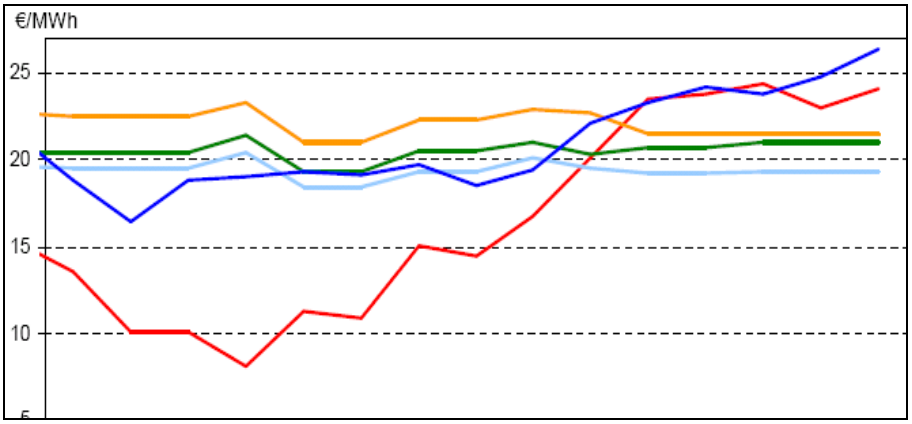
Another measure of liquidity is the ratio of trades to consumption which Heren analyzed for the month of January in 2007. It was calculated that 670 million cubic metres (mcm) of spot gas were traded OTC at the NBP, with nearly 1,700 trades taking place; while during the same month, 10,000mcm of gas was consumed in the UK, equating to a ratio of 0.06:1. In contrast to the two main gas hubs in the eurozone area, 170mcm of gas and 418 trades took place at Zeebrugge and 57mcm of gas and 56 trades took place on the TTF respectively: total spot trade on these hubs combined was therefore only a third that on the UK hub, yet the demand for gas in North West Europe (excluding the UK) was over twice of the demand in the UK. This shows that relative liquidity is still much higher at the NBP compared to the main eurozone hubs in accordance with the results of the questionnaire sent out by ECORYS and in line with the findings of Heren themselves.

Despite the NBP's spot market being so volatile, it is still considered as Europe's most liquid wholesale market, and is principally attributable to the UK's past leadership in terms of facilitating market opening and liberalisation that has taken place there compared to elsewhere in Europe. Other factors that have helped the NBP become a leading liquid European hub have been the UK's role as a gas producer with its North Sea supplies, the variety of gas import infrastructure available in the UK and the presence of a strong financial services sector in London speculating on gas prices.

NBP and the wholesale forward market for gas

The forward curve on the NBP extends up to three years ahead although the liquidity on this product is limited as outlined in the previous section. The largest volumes being traded on the forward curve are up to one-year ahead. Figure 3.18 depicts the forward market (year-ahead) on the NBP in 2007 in comparison to the long-term contract prices for gas from the various exporting countries. Even though during the same period there are strong oil price increases, the stability of long term contracts prices is maintained due to a) the decrease of dollar's exchange rate against the euro; and b) due to the indexation to oil prices, which includes delays of between 3 and 6 months.

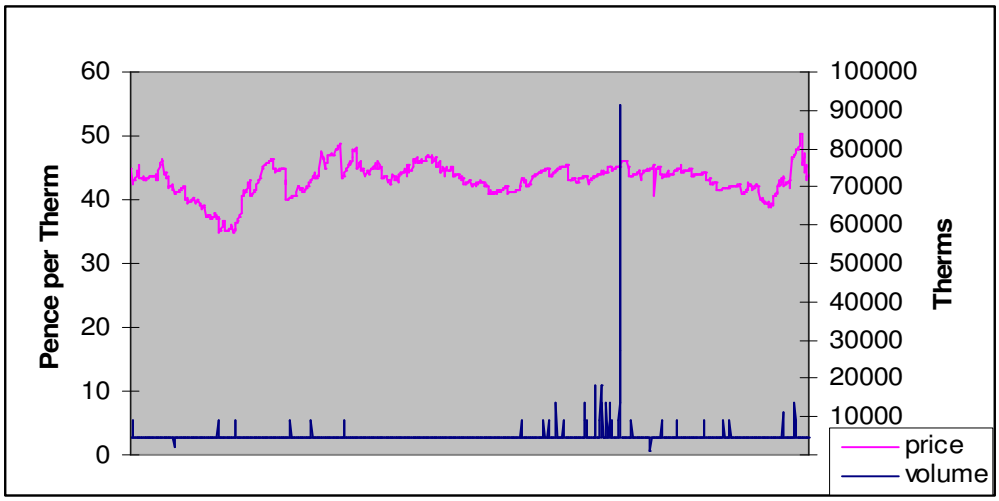
Figure 3.18 Long term contracts prices and NBP day ahead and forward Y+1 (2007)



Day-ahead
Year+1
Algerian gas
Russian gas
Norwegian gas

Figure 3.19 shows the price and volumes of quarter 4 2007 and 1st quarter 2008 product traded at the NBP in 2007 is presented here to illustrate the price and volume movements of this forward product: correlation analysis proved to be insignificant between volumes traded and prices. The mean price fluctuates between 40 and 50 pence per therm.

Figure 3.19 Price and volume of Quarter 4 2007 and 1st Quarter 2008 product at the NBP 2006-2007



Gas hubs and increased competition

Several new hubs are emerging in the European market to rival the three major hubs of NBP, TTF and Zeebrugge. It is envisaged that the development of these new hubs will encourage more trade and more market players, which should hopefully result in a more open, flexible and competitive market. At the same time, as more players start to trade on and between hubs, efficient pricing and price signals could also improve. If this occurs liquidity could increase and the delivery of gas would be determined more by market signals.

While the NBP's position as the leading wholesale gas market in Europe is indisputable, the role of Europe's other reasonably liquid wholesale markets is still in development. The UK has been predicted to increasingly become a spot-orientated gas market as it will have to adapt to rising import dependence while North Sea Gas producers who are natural sellers at the NBP are increasingly unwilling to sell gas forward, given a lack of confidence to make physical delivery in the longer-term. It has been furthermore predicted that Holland will fill the niche left by the struggling forward market at the NBP as it becomes the natural base for European forward gas trading - shippers in the Dutch wholesale market exhibit a much greater propensity to sell gas forward, reflecting the Netherlands's net exporter status and close proximity to key Norwegian import lines.

As European gas and power markets liberalise, the required steps to facilitate wholesale hub development will begin to become clearer. The best example has been set by the UK, which as Europe's most liberalised gas market leads European wholesale gas liquidity.

4 European CO_2 Emissions Allowance Market

4.1 EU Emissions Trading Scheme

The EU Emissions Trading Scheme (ETS) was launched on 1 January 2005, initiating the world's first multi-country emissions trading system. There are two phases in the EU ETS: 2005-2007 (Phase I) and 2008-2012 (Phase II which overlaps with the first commitment stage of the Kyoto agreements). 6.57 billion tonnes of CO_2 were allocated under National Allocation Plans during the first phase of the EU ETS.

Directive 2003/87/EC is the pillar of the EU ETS. The directive gives rights to the holder of one EU Allowance (EUA) to emit one tonne of CO_2. The number of EUAs allocated to each emitter (i.e the number of tonnes of CO_2 to be authorized for emissions) in the scheme is set out in National Allocation Plans prepared by the Member States and approved by the European Commission. However, there is currently an initiative to centralize the allocation of EUAs under one authority. Five sectors are covered by the Directive: Power and Heat Generation, Oil Refineries, Metals, Pulp & Paper, and, Energy Intensive Industry.

Close to 12,000 energy and industrial plants across the EU 27 are covered by the scheme which applies not only to utilities and industrials who are de facto covered by the directive, but also many major financial institutions who play an important role as liquidity providers and intermediates. These include investment banks, hedge funds, trading houses and brokerages.

In 2006, the global carbon markets were worth €22.5 billion. 1.6 billion tonnes of CO_2 were exchanged; the EU ETS accounted for 62 per cent of the volume and over 80 per cent of the value. Although traded volumes have drastically increased since the launch of the EU ETS, the market for EUAs collapsed during the second half of 2007, when it became increasingly apparent that member states had been too lenient in their allocation plans of EUAs. Thus, a tonne of CO_2 went from over €25/tonne to €0.1/tonne in 2007. Such an impressive shift in market perceptions, underlies the very important role that regulatory and political oversight has in sparking a truly competitive and confident CO_2 market.

Today, most trading in CO_2 emissions rights and related products still takes place between traders in the European OTC market (i.e not on exchanges).

Table 4.1 Estimated total CO_2 emissions market size and value

Emissions	Estimated size of market (metric tonnes)	Estimated value of market
2007	779,780,990 (+106%)	€13 billion[31]
2006	378,663,623 (+213%)	€8 billion[32]
2005	120,836,789 (+10,554%)	€2 billion[33]

4.2 CO_2 exchanges

Over 95% of the traded volume of EUAs take place in derivative trades (forwards, futures and options) with the remaining in spot trades. This can be explained by the initial delay of national registries and final allocations in many of the EU Member States which prevented the execution of instant delivery for spot contracts. Another reason may be that in such a new and volatile market, derivative instruments are crucial tools to optimise the value of emissions portfolio. There are several CO_2 exchanges in the EU; the main ones being ECX, Climex, EEX and Eurex. The European power exchange (EEX) and Eurex are planning to launch trading of options on EUAs, the credits under the EU's Emissions Trading Scheme, from April 14 2008. Because ECX is the dominant European exchange platform for EUA trading, we examine only this exchange, given that it is representative of the general CO_2 exchange market, and price differences from one exchange to another are minimal.

European Climate Exchange

The European Climate Exchange (ECX) was launched in 2005 and has since cornered most of exchange-based futures trading. Carbon trading stands out from the gas and power markets, in the sense that derivatives are the most commonly traded products on carbon exchanges, for reasons explained above. As such, ECX only offers derivative products.

At the beginning of 2008, Eurex and ECX also announced they would launch trading of related products: U.N.-approved Certified Emissions Reduction certificates, also known as CERs from March 26. CERs are exchanged when companies in rich nations invest in clean energy projects in developing countries. They also plan on launching CER options next year.

Price and Volume Trends

As mentioned above, EUAs trade mainly in the derivative market. Thus, we examine mainly this market. EUAs trading in the EU started in 2005. As figures 4.1, 4.2 and 4.3 show, volume exchanged over the three year period has increased significantly. Exchanged volumes on ECX increased tenfold, going from a total of 94 million tonnes (of 362 million tonnes traded total) in 2005 to over 980 million in 2007. End of year

[31] Average price €17.73/mt.
[32] Average price €20.83/mt.
[33] Average price €18.39/mt.

settlement prices have been very volatile. Such observations are perfectly consistent with the fact that derivatives and the emergence of sophisticated derivative products in the carbon market (swaps, options etc) have been offered in a futures-dominated market; precisely as a instrument to hedge against important price fluctuations as we see below. However, the immaturity of the carbon market, the reactivity of prices (given the number of covered installations and the impact single trades have on the market), political decisions (to cover the aviation sector for instance, or the apparent lenience of national allocation plans), supply and demand side factors, contribute to the current volatility of prices in all ranges of products.

Table 4.2 End of Year Settlement Prices and Volatility

	2005	2006	2007
Price in €/tonne	21,59	14,44	0,70
Volatility	14,08%	28,02%	N/A[34]

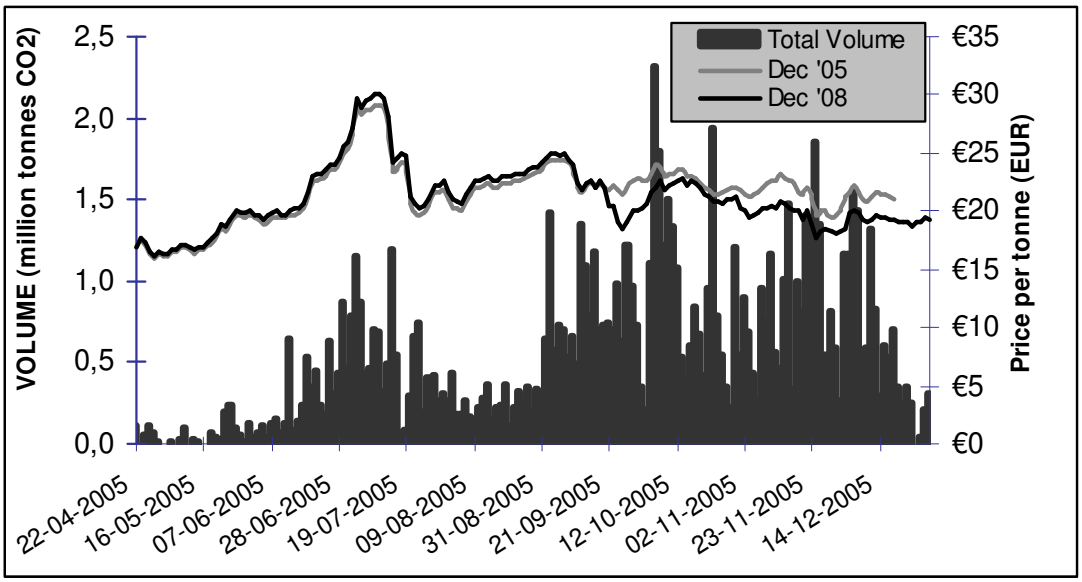
Instead of examining year ahead contracts as has been done in the two previously examined markets (power and gas), we look at three year ahead contracts to contrast price volatility with end of year price behaviours. Volatility in three year contracts significantly decreases over the 2006-2007 period, while prices remain constant over time. Table 4.2 thus exemplifies the fact that a solid derivative market in the EU carbon market is important for confidence and price stability in the long run, given the uncertain variable governing the market today, as the spectacular end of year settlement prices behaviour in 2007 points to.

Table 4.3 Three Year Ahead Prices and Volatility

	2005	2006	2007
Average Price €/tonne	21,16	21,01	20,58
Volatility	15,81%	16,36%	12,35%

[34] The Mean Revertig Process Methodology cannot be applied due to the pricing pattern in the given period

Figure 4.1 ECX Futures Price and Volumes 2005



The first year of EUAs trading saw volume rapidly increase in the ECX market, with prices in the end of year and three year ahead contracts staying tightly coupled until the end of the third quarter of 2005 (fig. 4.1).

Figure 4.2 ECX Futures Price and Volumes 2006

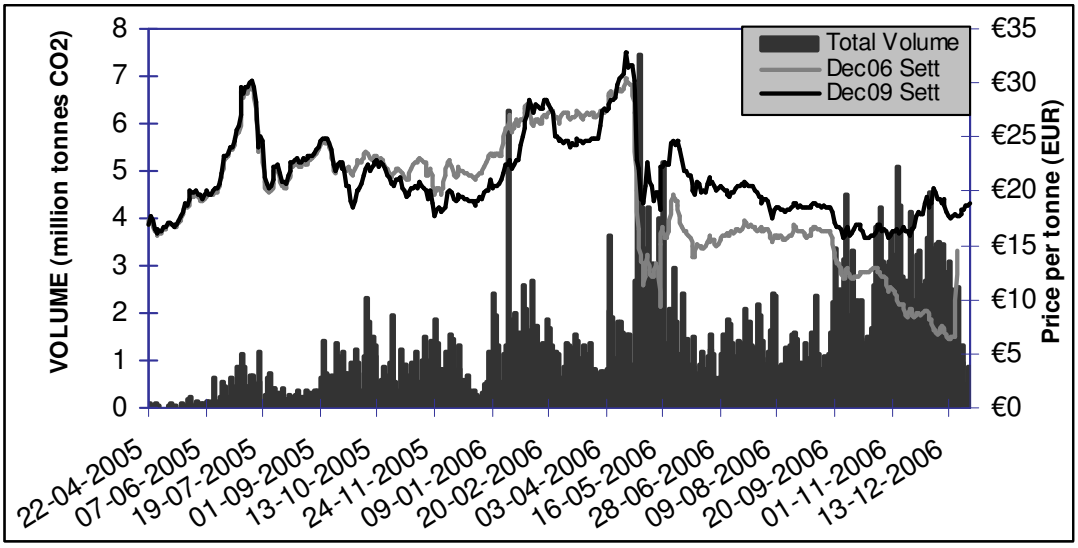
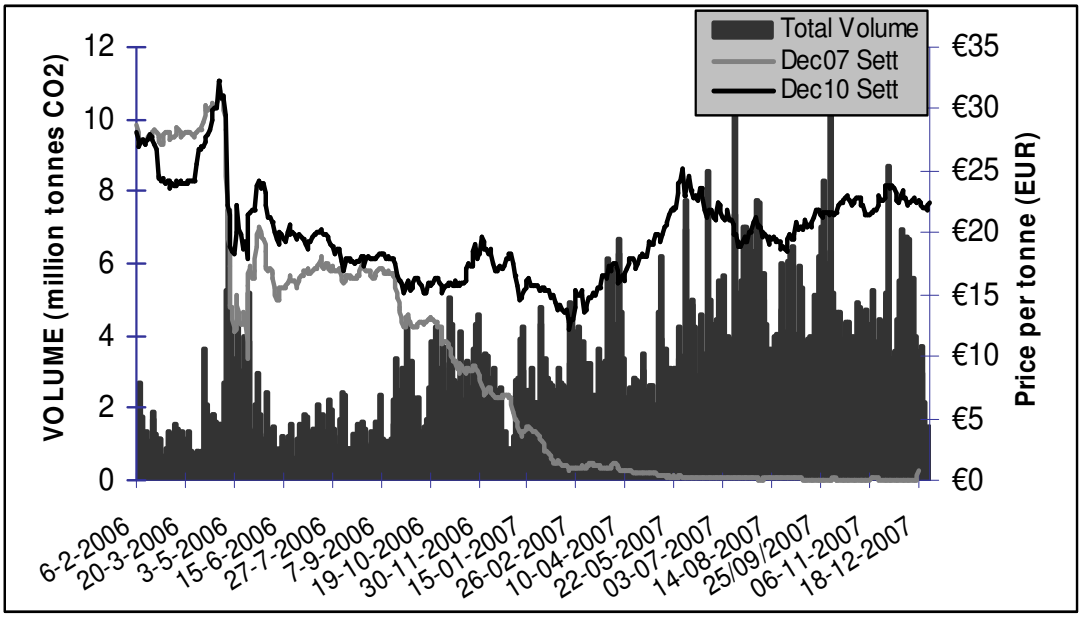


Figure 4.2 shows an increasingly decoupling effect of end of year contracts with three year ahead contracts, showing the growing importance of derivative instruments in the market to hedge short and medium term price risks. Running in parallel, volumes during 2006 continued to increase.

Figure 4.3 ECX Futures Price and Volume 2006- 2007



With the market perception that there was not enough EUA scarcity in 2007, end of year contract prices started to tumble at the beginning of the third quarter of 2006. However, as three year contract prices and volatility show, market confidence in the fundamental solidity of the EU ETS kept medium term derivative prices afloat.

Annex 1 Energy traders

Nordpool	Germany	UK
AS Latvenergo LV	Aare-Tessin AG für Elektrizität	Aare-Tessin AG für Elektrizität
Markedskraft Deutschland GmbH D	actogas GmbH	Accord Energy Limited
Atel CH Vattenfall Trading Services GmbH D	Bayerische Hypo- und Vereinsbank AG	Barclays Bank (Barclays Capital) PLC
Barclays Bank Plc GB	Bayerische Landesbank	BG International Limited
Cargill International SA CH	Bergen Energi Commodity Markets Access	BNP Paribas Commodity Futures Ltd.
CEZ, a.s. CZ	GmbH	BP Gas Marketing Limited
Deutsche Bank AG London UK	BHF-BANK Aktiengesellschaft	Calyon, London Branch
EDF Trading Ltd GB	Braunschweiger Versorgungs-AG & Co. KG	Citigroup Global Markets Ltd.
Eesti Energija AS EE	citiworks AG	EDF Trading Limited
Electrabel SA B	Currenta GmbH & Co. OHG	Fimat International Banque S.A. (UK Branch)
Elektrizitäts-Gesellschaft Laufenb CH	DB Energie GmbH	G.H. Financials Ltd.
Endesa Trading E	Deutsche Bank AG	Gazprom Marketing & Trading Ltd.
EnBW Trading GmbH D	Dresdner Bank AG	GFI Security Ltd.
ENECO Energy Trade B.V. NL	DREWAG Stadtwerke Dresden GmbH	Goldman Sachs International
E.ON Sales & Trading GmbH D	E.ON Ruhrgas AG	HSBC Bank plc
EOS Holding Avenis Trading CH	E.ON Sales & Trading GmbH	J.P. Morgan Securities Ltd.
Essent Energy Trading B.V. NL	EHA Energie-Handels-Gesellschaft mbH &	Lehman Brothers
EXEN s.r.o CZ	Co. KG	Merrill Lynch Commodities (Europe) Limited

Nordpool	Germany	UK
IMC Trading NL	ELECTRA Deutschland GmbH	MF Global Ltd.
J.Aron & Company USA	Electrabel Deutschland AG	Mitsui Energy Risk Management Ltd.
Merrill Lynch Commodities Europe Limited GB	EnBW Trading GmbH	Morgan Stanley & Co. International plc.
Morgan Stanley Capital Group Inc. USA	Energie- und Wasserversorgung Mittleres	Nexen Energy Marketing London Limited
MVV Energie AG D	Ruhrgebiet	Saxon Financials Ltd.
N.V. NUON Energy Trade & Wholesale NL	Energiehandelsgesellschaft West mbH	Sempra Energy Europe Limited
OstElektra GmbH D	Energieunion AG	Shell Energy Trading Limited
Rwe Trading GmbH D	Energy & More Energiebroker GmbH und	Shell Trading International Limited
Scaent Europower Ltd. IE	Co. KG	Spectron Energy Services Limited
Sempra Energy Europe Limited GB	ENSO Strom AG	TFS Derivatives Ltd.
Shell Energy Trading Limited GB	envia Mitteldeutsche Energie AG	Total Gas & Power Limited
Stadtwerke Flensburg D	Eurel GmbH	Tullet Prebon (Securities) Ltd.
Statkraft Markets GmbH D	Evonik New Energies GmbH	UBS AG London Branch
TotalFinaElf Gas and Power Ltd GB	Evonik Steag GmbH	UBS Clearing and Execution Services Ltd.
	EWE AG	
	FSE Portfolio Management GmbH	
	GETEC Energie AG	
	Hüttenwerke Krupp Mannesmann GmbH	
	in.power GmbH	
	Karstadt Warenhaus AG	
	KES Kommunale	
	Energiedienstleistungsgesellschaft S	
	KfW	
	KoM-SOLUTION GmbH	
	Kom-Strom AG	
	Mark-E AG	
	MVV Energie AG	

Nordpool	Germany	UK
	N.N. Neubrandenburger Stadtwerke GmbH Nordea Bank Finland PLC Niederlassung Deutschland OstElektra GmbH ovag Energie AG PCC Energie GmbH Pfalzwerke AG REWAG Regensburger Energie- und Wasserversorgung A RheinEnergie AG RWE Trading GmbH RWE Transportnetz Strom GmbH SE Scherbeck Energy GmbH Stadtwerke Chemnitz AG Stadtwerke Düsseldorf AG Stadtwerke Flensburg GmbH Stadtwerke Gießen AG Stadtwerke Hannover AG Stadtwerke Heidelberg AG Stadtwerke Karlsruhe GmbH Stadtwerke Leipzig GmbH Stadtwerke Wolfenbüttel GmbH Statkraft Markets GmbH Stora Enso Beteiligungen GmbH Südwestdeutsche Stromhandels swb Vertrieb Bremen GmbH	

Nordpool	Germany	UK
	Syneco Trading GmbH ThyssenKrupp AG Tradition Financial Services GmbH Trianel European Energy Trading Vattenfall Trading Services GmbH VNG - Verbundnetz Gas VW Kraftwerk GmbH	

Annex 2 Gas market players

Country	Gas Company / Shippers / Traders	Infrastructure-related Stakeholders / TSOs	Association / Union
Austria	Begas EconGas (BEGAS, EVN, Linz AG, OÖ Ferngas, OMV and Wien Energie) Energie Graz Energie Steiermark E.ON Ruhrgas Austria EVN KELAG OÖ Ferngas OMV RAG Salzburg AG Terragas (E.ON Ruhrgas/Salzburg) Tigas VEG - Vorarlberger Erdgas Wiengas	A&B (transaction clearing and balancing energy for western Austria) AGCS - Gas Clearing and Settlement (eastern Austria) AGGM (network management for eastern Austria) CISMO - Austrian energy trading market services alliance BOG - Baumgarten-Oberkappel Gasleitung TAG – Trans Austria Gasleitung	FGW
Belgium	Distrigas	Distrigas (Suez)	Febeg / Figas

Country	Gas Company / Shippers / Traders	Infrastructure-related Stakeholders / TSOs	Association / Union
	Fluxys Fluxys LNG (Zeebrugge LNG terminal operator) Huberator (Zeebrugge gas trading services)	Electrabel (Suez) Infrax Luminus Nuon Belgium WVEM	
Czech Republic	RWE Transgas Moravské naftové doly (MND)		CPU CPS - Czech Gas Association
Denmark	Dong HNG Maersk Naturgas Fyn Naturgas Midt-Nord	Energinet.dk	HNG
Finland	E.ON Finland Fortum Hyvinkään Lämpövoima Joutsenon Energia Kangasalan Lämpö Keravan Energia Kotkan Energia Lahti Energia Lappeenrannan Energia Mäntsälän Sähkö Neste Oil Orimattilan Lämpö Porvoon Energia Ruokolahden	Gasum	

Country	Gas Company / Shippers / Traders	Infrastructure-related Stakeholders / TSOs	Association / Union
	Tampereen Sähkölaitos Valkeakosken Energia Vantaan Energia Vari Vattenfall Finland		
France	Altergaz EDF E.ON Gas Natural Gaselys Gaz de Barr Gaz de Bordeaux Gaz de Strasbourg Gaz Electricité de Grenoble Poweo Total	GdF/Suez GRTgaz Geostock Total Infrastructures Gaz France	AFG UPRIGAZ
Germany	RWE Gas Thyssen Gas WNG Bayerngas BEB Erdgas und Erdoel Dong Energy EnBW E.ON Avacon E.ON Ruhrgas Erdgas Muenster	E.ON Ruhrgas Verbundnetz AG BEB Transport E.ON Gastransport ONTRAS - VNG Gastransport RWE Transportnetz Gas Wingas Transport	BGW / Verbundsnetz Gas AG

Country	Gas Company / Shippers / Traders	Infrastructure-related Stakeholders / TSOs	Association / Union
	Erdgas Suedbayern EVG EWE ExxonMobil Ferngas Nordbayern Gas-Union Gasanstalt Gaz de France Produktion Exploration Deutschland Gazprom Germania GVS - Gasversorgung Sueddeutschland (EnBW / Eni) IVG Caverns NatGas RWE Energy Saar Ferngas VNG - Verbundnetz Gas Wingas Wintershall (BASF)		
Greece	DEPA EPA Attiki (DEPA / Duke Energy / Shell) EPA Thessaloniki (DEPA / Italgas) EPA Thessaly (DEPA / Italgas) Prometheus Gas (Gazprom / Copelouzos Group)	DEPA	DEPA
Hungary	Panrusgaz (MOL / Gazprom)	FOGAZ - Budapest Gasworks Co. (RWE / E.ON Ruhrgas) E.ON Földgáz Storage	GE

Country	Gas Company / Shippers / Traders	Infrastructure-related Stakeholders / TSOs	Association / Union
Ireland	Bord Gais Flogas Lansdowne Oil & Gas Shell Ireland Statoil Ireland Vayu Phoenix Natural Gas	Republic of Ireland: Bord Gáis Northern Ireland: Phoenix Natural Gas Premier Transmission (Scotland - Northern Ireland)	BGE
Italy	Asmea BG Group Blugas Dalmine Edison Enel Energia Eni Group ENìA Gas Natural Italia Gas Plus Hera Italcogim Italgas (Eni) Plurigas (A2A, Iride and ASM Brescia) Sorgenia (CIR / Verbund) Toscana Energia	Snam Rete Gas (Eni) Stogit (Eni)	
Luxemburg	Erdgas Soteg Sudgaz		

Country	Gas Company / Shippers / Traders	Infrastructure-related Stakeholders / TSOs	Association / Union
Netherlands	GasUnie 4Gas ATP Oil & Gas BP Chevron Cirrus Energy ConocoPhillips DSM Energy Dyas Energie Beheer Nederland Eni ExxonMobil Benelux GasTerra Gate Terminal LNG project Gaz de France Production Nederland LionGas LNG project Lundin Petroleum NAM (Shell / ExxonMobil) Northern Petroleum Oranje-Nassau Petro-Canada Shell Nederland Star Energy TAQA Total Venture Production	Fluxys NAM – Shell GTS - Gastransport Services Alkmaar Gas Storage NAM Grijpskerk Storage BBL - Balgzand-Bacton Pipeline	EnergieNed

Country	Gas Company / Shippers / Traders	Infrastructure-related Stakeholders / TSOs	Association / Union
	Vermilion Energy Trust Wintershall Cogas Delta Electrabel Nederland ENECO Energie E.ON Benelux E.ON Ruhrgas Essent Intergas NRE Nuon Rendo (Electrabel) RWE Nederland Trianel Westland Energie Services (Essent)		
Poland	PGNiG Polenergia	Pomorska	
Portugal	EDP - Energias de Portugal Galp Energia	REN	
Slovakia	Nafta	SPP - Slovenský Plynárenský Priemysel	
Spain	Bahia de Bizkaia Gas BP Espana Centrica Energia Cepsa Endesa	Enagás Other LNG terminals (Bilbao, Sagunto, etc.)	Sedigas

Country	Gas Company / Shippers / Traders	Infrastructure-related Stakeholders / TSOs	Association / Union
	Gas Natural Iberdrola Medgaz (Algeria to Spain pipeline project) Naturgas Energia Reganosa LNG Repsol YPF Shell Espana Union Fenosa		
Sweden	Fortum Göteborg Energi Lunds Energi Öresundskraft	Swedegas	Gasforeningen
UK	Amerada Hess BG Group BP British Gas (Centrica household supply) British Gas Business Centrica Group Chevron Europe ConocoPhillips EDF Energy Eni E.ON UK ExxonMobil UK Gaz de France UK Gazprom Marketing and Trading	National Grid Transco Interconnector UK Centrica Storage BBL Company (Netherlands-UK) Interconnector (Belgium-UK) Ormen Lange project (Norway-UK) Premier Transmission (Scotland-Northern Ireland) Dragon LNG Grain LNG South Hook LNG	IGE

Country	Gas Company / Shippers / Traders	Infrastructure-related Stakeholders / TSOs	Association / Union
	Maersk Marathon Oil Noble Energy Perenco Phoenix Natural Gas (Northern Ireland) Ramco RWE Dea UK RWE npower Scottish & Southern Energy ScottishPower Sempra Energy Europe Shell Shell Trading Star Energy Statoil UK Talisman Energy Total Warwick Energy Wingas		