Continental European Gas Hubs: Are they fit for purpose?

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NG 63

June 2012

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ISBN

978-1-907555-51-0

Preface

In 2010 Patrick Heather published his paper 'The Evolution and Functioning of the Traded Gas Market in Britain' which described the genesis and development of Britain's traded gas market for which the political and financial imperatives of the early 1980's, as much as the desire to create a competitive market, were a key factor.

In Continental Europe both the drivers for change and the challenges to be overcome have been markedly different. Nevertheless the combination of the desire at an EU policy level to encourage competition through an evolving regulatory framework, the catalyst of the economic recession in creating a preference for hub based price formation mechanisms and, not to be understated, the sea-change in the acceptance of trading as being central in the procurement and risk management of natural gas portfolios have all contributed to an astonishing development in European gas hubs over the past few years.

Based on extensive research and discussion with the key actors intimately involved, the paper provides deep insights into the characteristics of the individual hubs, the reasons behind their particular evolutionary path and the prospects for their further development. These are discussed in qualitative terms but also through a quantitative assessment of churn rate and bid-offer spread indices. With well discussed justification the paper categorises the European hubs as 'Trading Hubs' (NBP and TTF), 'Transit Hubs' (ZEE and CEGH) and 'Transition Hubs' (GPL, NCG, PEGs and PSV); a framework which assists the reader in better understanding the current and future role of each.

The paper provides a comprehensive and timely review of gas market developments against the backdrop of the on-going transition from long term oil-indexed contracts to hub based contracts. In anticipation of this transition reaching its logical conclusion, the question in the paper's title i.e. "are the European gas hubs fit for purpose?" relates to the ability of the hubs to provide a reliable basis for hub-based pricing in long term contracts. After studying the development in trading liquidity and the close correlation of prices between the hubs, the answer from this paper is an emphatic 'yes' although the exact roles of the individual hubs will probably continue to differ.

Howard V Rogers

Acknowledgements

It would not have been possible to research and write this paper without the considerable help and guidance from many individuals and organisations. I have received much encouragement and support from my colleagues at the Oxford Institute for Energy Studies and I extend my particular thanks in this respect to Jonathan Stern who helped put my ideas into perspective. I must also thank the British and Dutch TSOs for their invaluable help and assistance throughout this project (Peter Parsons, Gary Dolphin and John Cummins at National Grid Gas; Sybren de Jong and Bert Hovens at Gas Transport Services). I also visited during the course of my research various TSOs and regulators in all of the North West European countries, who provided me with data and valuable explanations of how their respective gas systems operate and their plans for future development. Finally, I could not have evaluated the whole picture without the input on trading from ICIS-Heren, LEBA, and the Exchanges: APX-Endex, CEGH, ICE and Powernext.

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1. Introduction

In this paper, we will explore whether the Continental European[1] gas hubs are ready to offer a market price mechanism for gas trading in North Western Europe[2] and indeed, more importantly, what has to happen for them to become credible price creation, discovery and reference points?

This paper is the natural successor study to The Evolution and Functioning of the Traded Gas Market in Britain[3], and in it we will examine the current status and stage of development of the Continental European gas hubs and describe their various roles ('trading' hubs; 'transit' hubs; 'transition' hubs). We will then analyse whether there has been a change in the attitude towards trading in the respective countries from the regulatory point of view as well as that of sellers and buyers of gas. The role of the exchanges is also very important in the development of hubs and we will look to see how their activities have helped to promote gas trading.

From this base, it is possible to try and determine the future of the hubs in a market priced environment; how balancing and marginal volumes will be traded; which hubs will be most active; which will be the benchmarks and whether there will evolve a single European price for gas or whether pricing will remain disjointed across the region. Finally, we will examine the commercial prospects for the European gas market as it transitions from the 2010s to the 2020s and beyond in a changing global gas environment.

2. Contextual background

2.1 Findings from the 2010 paper on the traded gas market in Britain

The previous paper on the liberalised British gas market was written in 2010, some 15 years since its inception.

Much had happened since the opening of the British gas market in 1996 and the first tentative trades in the newly-formed liberalised environment. With the rapid acceptance by traders of the National Balancing Point (NBP) as the delivery point of choice (eschewing the original 'beach' trades) and the development of the NBP'97 contract to assist them in standardising these OTC[4] trades, the market was ready to welcome new participants and methods of trading. The ICE gas futures market, based on the NBP'97 contract, was quick to establish itself in 1997 and to gain a significant market penetration. Brokers and the trade press helped to disseminate information both at the time of trading and in daily reports, which served to create greater transparency and in turn gave confidence to market participants that it was 'safe' to trade NBP gas.

Trading was gathering momentum in the late 90's with the number of participants increasing almost monthly, volumes growing exponentially and, in addition to the 'traditional' OTC deals, the types of trades included futures, swaps, even a few options. With the opening of the IUK interconnector pipeline to Belgium in 1998, UK traders believed that they were

[1] This paper deals primarily with the natural gas hubs in Austria, Belgium, France, Germany, Holland and Italy.
[2] In this paper "North West European" or "NWE" includes Britain/the British Isles.
[3] Heather (2010)
[4] OTC: Over-The-Counter trades: bilateral, standardised and non-regulated deals.

spearheading a European drive which would create a pan-European gas market within the next 2-3 years. Of course, some would say that this all happened too quickly and the market had set itself up for a fall. This did occur in 2001 with the collapse of Enron and trading turmoil ensued, especially within the American trading houses who did not know whether to try to pick up the pieces or to simply exit the market.

In the autumn of 2002, after the near collapse of Eastern Gas Marketing (owned by TXU Europe) and the consequent loss of confidence in the market, gas trading suffered another setback with lower trading volumes for a four year period, while lawyers and risk managers worked out how to limit their companies' financial exposures, while at the same time utilising trading strategies to help optimise their portfolios.

From around 2006-2007, gas trading in Britain began to recover and its second wave of development and growth began to attract new players including several Continental European companies and an increasing number of financial institutions. 2010 saw the greatest number of companies trading in the market's 15 year history. Volumes and churn rates increased such that by 2010 they had almost returned to their previous highs[5]. Even the 2008-2009 recession seemed to have little overall effect on the market (in terms of volumes traded as opposed to price levels), although it prompted a change in the shares of OTC and Exchange trades, with the regulated futures contracts accounting for nearer 30% of the total.

From an infrastructure point of view, the past five years have also seen many changes, including additional pipelines to the UK (Langeled and BBL), new LNG receiving terminals, NTS upgrades and a major upgrade to the IUK interconnector pipeline. The UK had ceased to be a gas island and became increasingly connected to the outside world.

The paper concluded that, even in Britain where there is a fully open gas market with a high churn rate, the majority of trading is still based on physical delivery, either actual or implied through the contracts used.

While the paper focussed on the evolution of the traded gas market in Britain, it also demonstrated that by 2010:

- gas trading had already expanded to continental North West Europe,
- there was no reason to assume that geographical limits had been reached; and so:
- trading could reasonably become a pan-European phenomenon.

The key question remained, however, whether the British market would continue to dominate European gas trading, or whether such activity would properly establish itself within the major national gas markets of Continental Europe.

At the time of writing the 2010 paper, I believed that there was still potential for growth in the NBP market and that it could lead the way towards a more unified North West European gas trading system. As Continental European markets open up I believed that there would be a gradual separation of the 'physical' from the 'financial' and that a greater range of financial trading instruments would develop including swaps, based on hub indices, and options. These would become increasingly necessary as more physical gas was transacted on a 'flat' basis[6].

[5] A description of "churn rates" in Heather (2010), p6; the 'previous high' referred to was a churn of 21 in 2001. Also, see Glossary.
[6] Gas traded and delivered at a constant flow rate throughout the delivery period.

2.2 Questions posed regarding European gas trading and the debate about market pricing

While the vision of an imminent pan-European traded market which fired imaginations in the late 1990s proved to be premature, Continental European trading hubs did emerge and grow, albeit slowly. Ever since the opening of the IUK interconnector in 1998, many traders had expressed the desire to see a pan-European traded gas market, not so much perhaps as an emulation of the multi-hub trading geography of the North American gas market, but at least to provide the opportunity to build trading strategies in response to changing patterns of supply and demand across an inherently complex regional gas market with multiple sources of production, imports and transit flows. Of course, this would necessitate the development of one or more of the existing Continental gas hubs and this is primarily what we will explore in this paper.

Since 2008, there has been a growing debate about the future of oil indexation in the traditional long term contracts (LTCs) in Continental Europe, as well as the topic of benchmark hub(s) from which to price gas deliveries of any 'new style' European physical contracts (one of which already existed in the UK[7]). The NBP for some time has had the liquidity and transparency to become a pan-European benchmark, but this has met with resistance from Continental European traders who would prefer to use a Continental hub, traded in €/MWh as a more appropriate price marker than the NBP's pence/therm[8].

However, this still leaves the question regarding the LTCs and whether they will move towards a market price formulation. Large scale expansion of LNG import capacity and growing LNG import flows in the 2010 to 2011 timeframe have been a major factor in creating the conditions to markedly improve price relationships between the North West European hubs. Increasingly traders are able to physically move gas between the hubs through improved infrastructure access and will therefore develop cross-market trading instruments to facilitate this. As trading hub liquidity increases, so too will the ability to balance physical requirements between the various regions. The influx of LNG into northern Europe since the last quarter of 2009 created a mini 'gas bubble' and that has enabled Continental end-users to source marginal requirements at spot (hub) prices. This in turn has led to a change in attitudes towards trading, by sellers and buyers, as we will discuss in Chapter 4.

I believe that European gas markets are in transition towards market, or hub-based, pricing which will require a robust and reliable marker price. For a hub to develop to become a price reference it needs to have amongst other attributes, depth, liquidity and transparency and to be able to readily attract a significant number of market participants. These and other relevant points are examined in depth in Chapter 3 and will enable us to determine those hubs that have a potential to offer a benchmark price.

The two key questions addressed by this paper are:

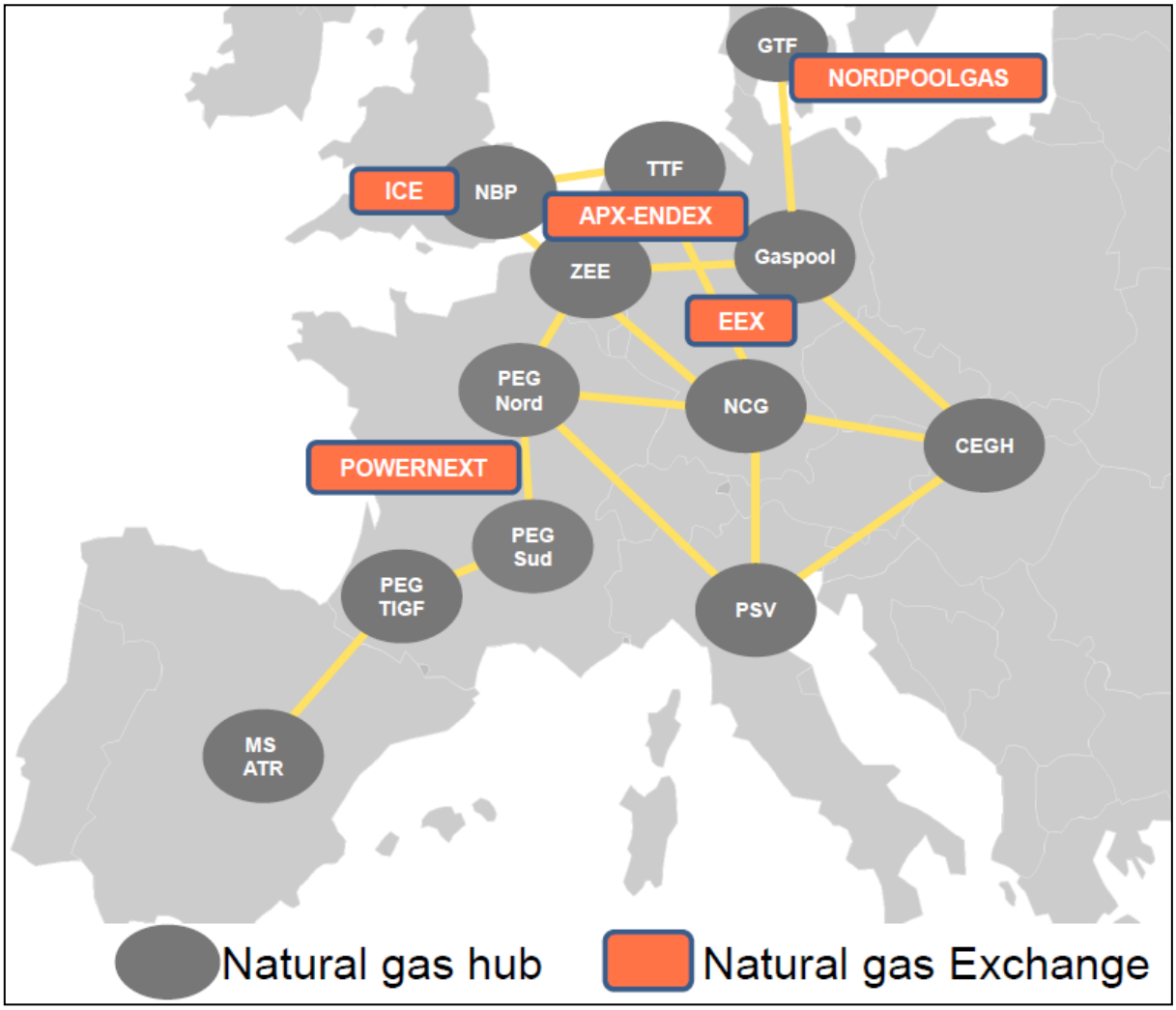
- Are Continental European gas hubs ready to play the role they need to in a market priced European gas business?, and,
- If they are not, what needs to happen if they are to become credible price creation, discovery and reference points?

[7] See description in Heather (2010), p30, under "Post 2000 contracts".
[8] NBP trades are priced in UK pence per therm, introducing currency exchange rate risk for Continental players.

3. Continental European national gas hubs: status and stages of development

The North West European (NWE) gas markets have seen significant evolutionary change over the past 10 years both in terms of construct and growth; indeed, in 2002 only two NWE countries had an operational gas hub, Britain's NBP (since 1996) and Belgium's Zeebrugge (since 2000), and in Germany HubCo[9] had just been established. There then followed, one by one, gas hubs in each of the other NWE countries: the Dutch TTF and the Italian PSV in 2003; the French PEGs in 2004; the Austrian CEGH in 2005; the German EGT[10] in 2006; the German Gaspool and NCG in 2009. Therefore, the current 'hub landscape' was complete by 2009 and has shown signs of accelerated development in the last couple of years, especially since early 2010, through 2011 and the Winter of 2011-12.

Figure 1: European gas hubs and gas exchanges



The situation across all these markets now looks quite different, not only in comparison to a few years ago, but also to that which presented itself only a year ago in the Spring of 2011. This is especially true of the Dutch and German markets but there have also been some

[9] This gas hub was the forerunner of BEB (2004), which later became Gaspool in 2009.
[10] The E.on Gas Transport network's market was incorporated into the new NCG hub in 2009.

important plans developed in Central Europe. Even in other countries, where progress has been slower for various reasons, there has nevertheless been growth in the traded gas markets. I have chosen to place the various hubs into three distinct categories in order to analyse their development: 'trading' hubs, 'transit' hubs, and 'transition' hubs.

I define Trading Hubs as those which have reached a certain level of maturity and which are already being used for the financial risk management of gas portfolios. They are based on virtual trading points, have open and easy access to trade to a wide number and variety of participants, have good transparency and reporting and have proven to be reliable markets.

The second category of Transit Hubs includes those hubs that are actual transit locations, or physical points, at which market participants can choose to trade gas; however, their primary role is to facilitate the transit of large quantities of gas for onward transportation.

The final category is that of Transition Hubs by which I mean hubs that are based on a virtual trading point but have not yet reached a mature level. They are for the most part (but not all) attracting more volumes year on year and are showing signs of progress towards becoming a 'marker price' for their respective national markets. Indeed, they are (again, for the most part) already being used as 'balancing markets' for shippers delivering or taking gas in those grids. However, with this hub category there are reasonable doubts as to whether they will develop sufficiently to become more than just national markets.

It is also important to note the development of the exchanges that provide a regulated and anonymous market place and how they have contributed to the growth of the hubs. This is particularly the case in Britain and the Netherlands with the ICE and APX-Endex exchanges, although the French Powernext and the German EEX exchanges have also encouraged the growth of gas trading in their respective markets. Across all the markets, the exchanges have helped create new business and we will examine these developments in more detail in Chapter 4.

3.1 The "Trading Hubs": NBP and TTF

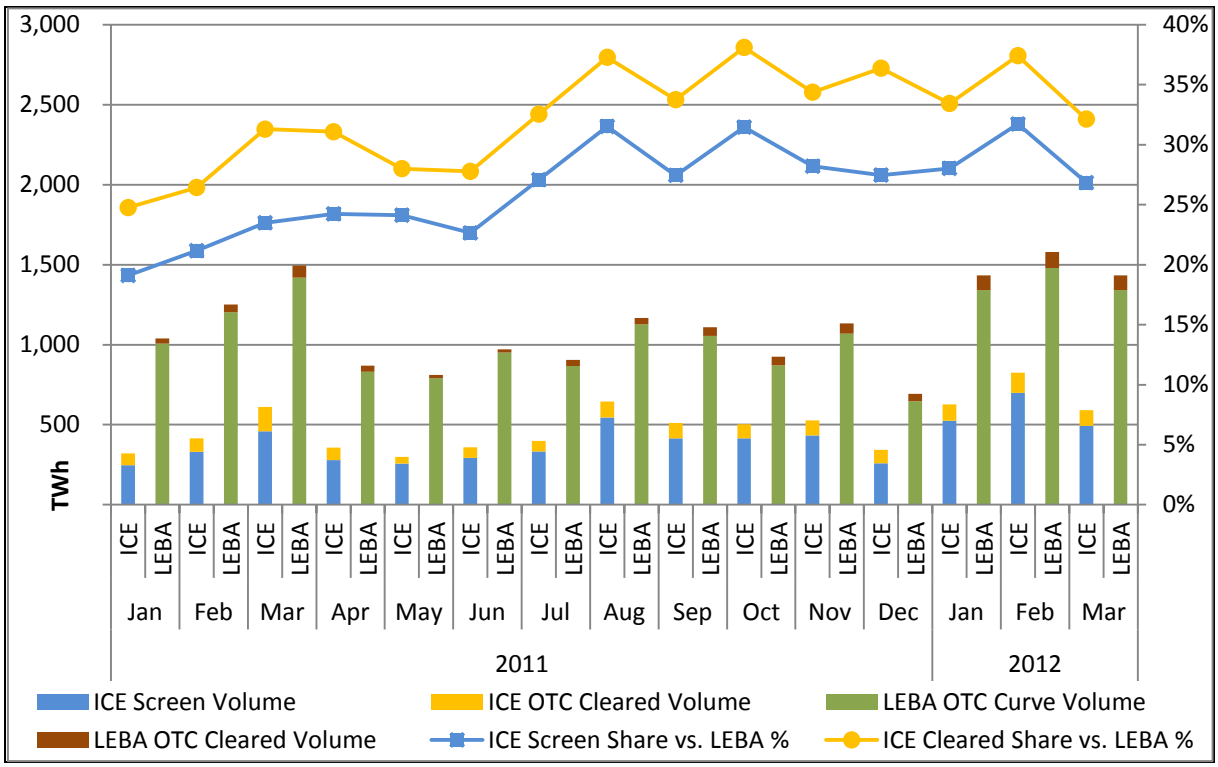
The "trading" hubs of NBP (Britain's National Balancing Point) and TTF (the Dutch Title Transfer Facility) have continued to be buoyant throughout this period from early 2010 through to Spring 2012. Whilst NBP is still by far the most active traded hub in Europe, its lead over TTF is slowly diminishing. This is mainly due to increased volumes on the Dutch market whereas the British market has been more modest in its volume development.

3.1.1 The National Balancing Point (1996)

The NBP market has been a 'mature' market for over 10 years now and therefore its potential for further growth might be expected to be more limited. Nevertheless, the NBP has managed to continue to grow in recent years, attracting yet more new participants, including for the first time, in the past 2-3 years, companies who have not become Shippers in order to trade. These companies can and do only trade NBP on the ICE futures. This is a departure from the first 15 years of NBP trading where every trade was conducted by a Shipper, even if that company had no intention of ever participating in physical gas transactions. Although there have been a few new participants in the OTC market, the biggest increase in 2011 was on the

regulated ICE futures market where there are now an estimated 130 active participants[11] (not including individual 'local' traders for which there are no statistics but there is anecdotal evidence from brokers that a number of locals are trading on the NBP futures). The futures trades, as a proportion of the total number of NBP trades, are still growing. From having accounted for around 10% for most of the period 1997-2004, rising to about 15% by 2008, its share has now jumped from early 2009 levels and has continued to increase since then. In the first half of 2011 the ICE share of the NBP market was around 20-25% and by the Winter 2011 that share had grown to about 1/3rd of the total (see Figure 2), a level which it retained in early 2012.

Figure 2: ICE share of the NBP market



Source: Intercontinental Exchange
Note: LEBA: London Energy Brokers' Association; see glossary for more detail

Overall NBP traded volumes in 2011 have grown marginally year/year but the pattern of trading has been more volatile, with a high volume spike in March, another in October (both quite usual months for higher volumes, but they were higher in 2011 than in the previous year) and two lesser peaks in June and August. However the average traded volumes over the year, compared to 2010, were up between 5-10%, depending on the source of the data (National Grid matched trades vs. Heren reported trades). The NBP 'churn' ratio is on average in the high 'teens and in certain months well into the low 20's; over the Q1-2012 period, the NBP gross market churn reached over 21 times[12]. Over the Winter period there appears to have been a resurgence of activity, with the combined OTC and exchange volumes seeing a growth of 33%[13] in January 2012, compared to January 2011.

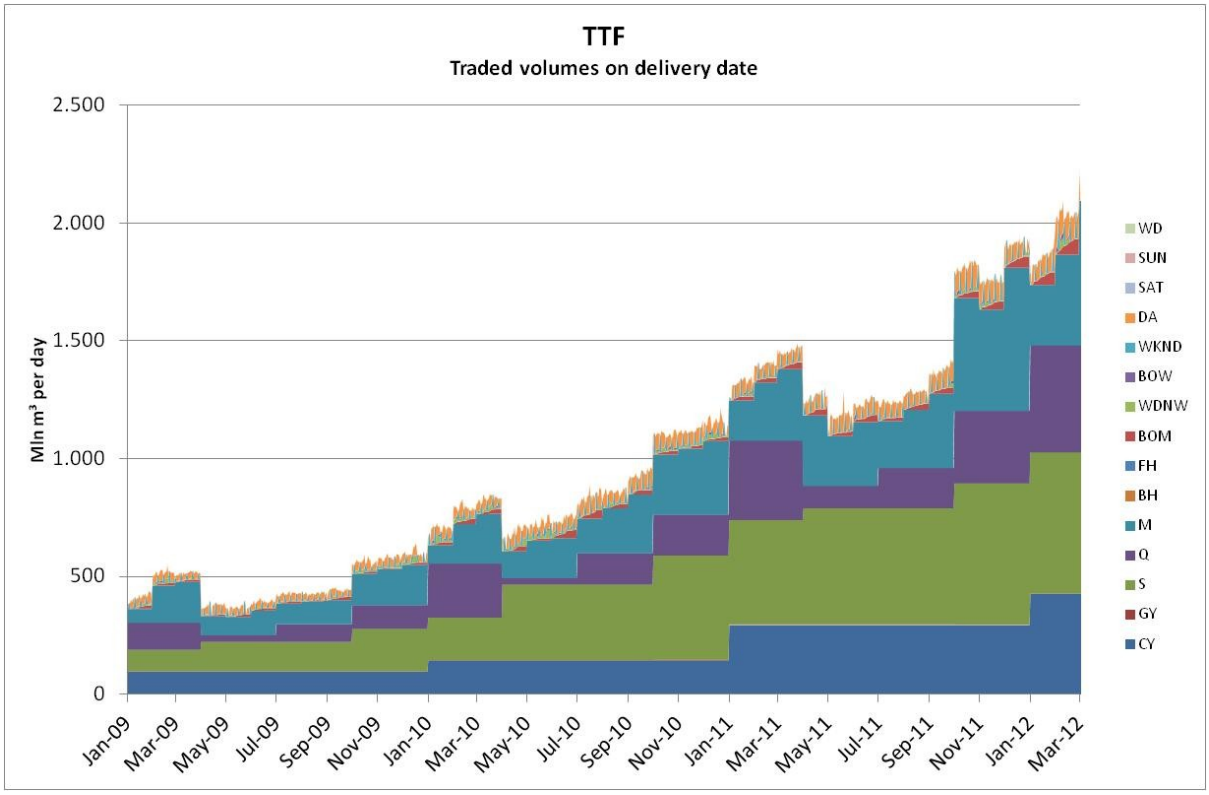
[11] Source: the Intercontinental Exchange.
[12] See Table 3 in section 4.3 "Trading and Exchanges" below.
[13] Source: LEBA January 2012 volumes in gas power emissions and coal.

3.1.2 The Title Transfer Facility (2003)

The Dutch TTF market has been a success story this past year, consolidating further on the increase in volumes it saw in 2010 compared to 2009, itself the first year of renewed growth since the market opened in 2003. Indeed, for a while it had seemed that the TTF, which saw quite rapid growth from the start but then appeared to stagnate for four years or so, had reached its potential, despite operating in an open transparent regime.

The Title Transfer Facility is a virtual trading point, effectively the whole of the Dutch gas grid[14], although Shippers can choose whether to 'enter' the virtual point or to stay outside of it; for instance, if they are transiting gas from a border Entry Point to another border Exit Point, without wanting to trade within the Dutch system, they can currently choose not to enter the TTF and so avoid paying an extra fee[15]. However, there are plans to evaluate the potential benefit of creating a single entry/exit VTP for all gas in the Netherlands, whether transiting or for domestic use, similar in concept to the British NBP/NTS set up.

Figure 3: Traded OTC volumes at TTF: January 2009 – March 2012



Source: GasTerra

Note: Product acronyms: The spot and prompt contracts cover days or groups of days such as Within Day (WD), Day Ahead (DA), Balance of Week (BOW), Working Days Next Week (WDNW), Balance of Month (BOM) and the Month Ahead (MA) contract, also known as the first or front month. The curve trades in months (M), quarters (Q), seasons (S) and years (both calendar (CY) and gas year (GY)).

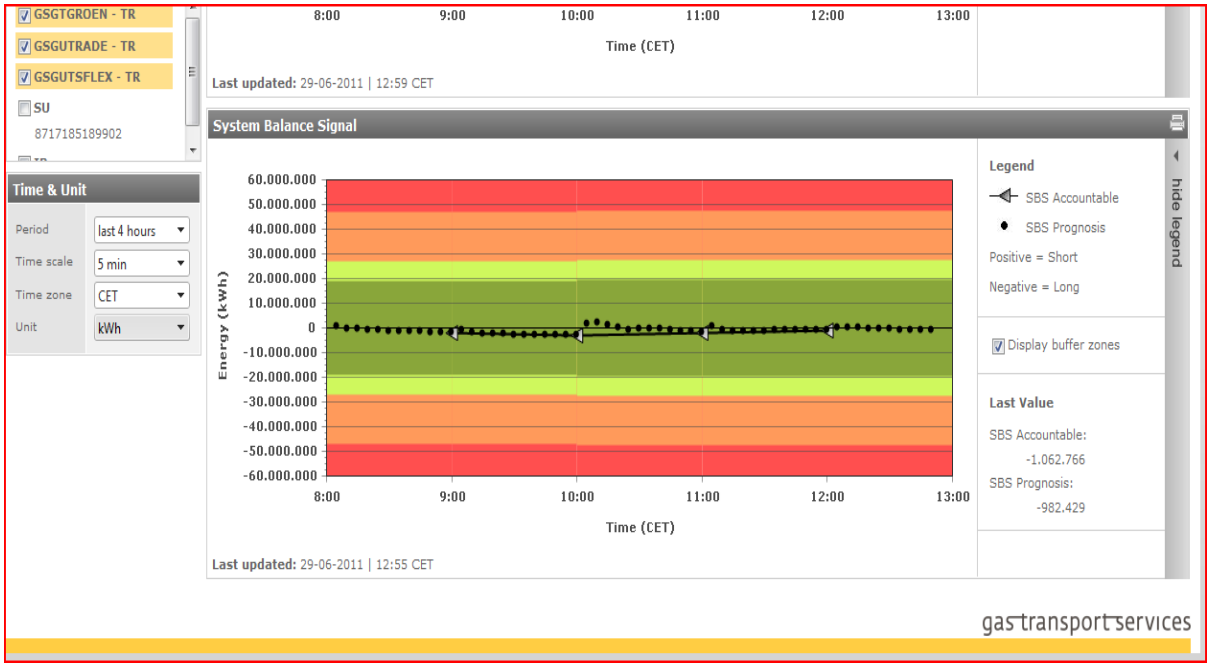
There have been several important factors which have nurtured the development of gas trading in Holland. In July 2009 the TSO, Gas Transport Services, allowed for 'quality conversion' at the TTF which meant that traders could then supply to the system or take from

[14] See Appendix E for a map of the Dutch gas grid.
[15] More information can be found at: **http://www.gastransportservices.nl/en/shippers/tsc**

it either High Calorific or Low Calorific gas; from that date they were simply trading energy, not a type or quality of gas. Although it took a while for the Shippers to get used to the new regime and, more importantly, to have confidence that it could and would cope with the quality variations, they soon realised that TTF offered a reliable, convenient, robust way to trade gas in Holland. This first step saw by 2010 a marked increase in traded volumes, although still a long way behind the NBP. However, an important point was that these increased volumes were not just Within Day or Day Ahead trades, but trades enacted along the forward curve, certainly up to 3 years out and, in some cases even further. This is important because it shows that traders were using the TTF market for hedging as well as for balancing purposes. The increase in traded volumes and the range of products that made up the total can clearly be seen in Figure 3. Note also that there is a large component of Calendar Year trades, which is in contrast to the NBP market where there are relatively few Year trades done.

The second point of note when looking at gas trading in Holland and the TTF market is the balancing regime change that was put in place in April 2011. This is when the TSO implemented an innovative 'real time' balancing regime, known as "Market Based Balancing"; it is the first of its kind in Europe and, according to many sceptics, 'unworkable'. Available on the GTS Gasport[16] electronic screen, the System Balance Signal is modelled on the hourly electricity regime. It is aimed at getting market participants to offer operational flexibility on a 'stand-by' basis for which they are rewarded, using a 'neutral' gas price based on APX Spot trades. They do this by monitoring their own portfolio balance with regard to the total system balance, all in near real time (see Figure 4: the aim being to manage their own portfolio whilst keeping the GTS grid balance within the green area). This system of "Causers and Helpers" is in contrast to the old 'stick' model of penalties in arrears for being out of balance which is still the norm in most other countries, including Britain.

Figure 4: GTS Gasport SBS (System Balance Signal) screenshot



Source: Gas Transport Services

[16] Gasport is the electronic platform operated by the Dutch TSO (GTS) used by shippers for nominations and balancing.

The reality has been that this innovative approach to balancing the gas grid has worked very well so far and that, by its very nature, it has increased the availability of market information to all participants. Apart from a technical glitch in the first week of operation when the system was switched off for one hour, the TSO has to date, never had to take forced balancing actions and the system has never been at risk. This was even the case during the spell of very cold weather in February 2012. This second step has helped to consolidate last year's increase in traded volumes and has also helped to enhance the trust in the TTF market and thereby attract new participants, especially more financial players[17].

There is also a third point of note to consider when explaining the reasons behind the large increase in TTF volumes in 2011. This is that GasTerra, who have a legal cap on their production of 425bcm over 10 years (up to 2015) and who are owned (as shareholders) by the Dutch government, Exxon and Shell, have been keen to monetise their assets and have been actively selling large quantities of gas. Whereas they, like all other Continental producers, used to sell their production on Long Term Contracts with the price determined by an oil indexation based formula, they are now increasingly satisfying their customers' demands by delivering and pricing flat gas at the TTF hub. This is a straightforward transaction at a known price, rather than the alternative of entering into physical deals at border points or at industrial clients' factory gates, which involve more time in negotiating the contracts. Such contracts are also less 'clean' in that they usually include volumes variance and nomination rights and finally, the price is not always known on the day of trade. GasTerra has stated publicly[18] that it was keen develop more TTF-based traded products and that it fully supports the TTF market.

Another important factor adding to the attractiveness of TTF as a traded hub, is the first cross-border 'market coupling' scheme[19] between two EU Member States, due to become operational on 22nd May 2012. By combining the transport services of the two Gasunie owned TSOs, the Dutch GTS and the German Gasunie Deutschland (GUD)[20], it will no longer be necessary to enter into two separate transport agreements and capacity payments when transporting gas through the Oude Statenzijl border point in north east Holland. Indeed, it will be possible to book one bundled service to transport gas from, say, the Danish border at the Ellund entry point, or gas entering the GUD network from the NordStream pipeline, all the way through to say, the Julianadorp exit point (for the BBL pipeline to the UK), or the Zelzate exit point (for onward transportation to Belgium), or the Bocholtz exit point (for onward transportation to Germany)[21]. The cross-border bundled capacity can be bought for gas transportation in either direction, on a firm day-ahead service. It is further planned to extend the market coupling initiative from 1st April 2013, to include Denmark, Germany, Belgium and France for which GTS is currently in discussion with the relevant TSOs; all bundled trades are planned to take place on the same electronic platform[22].

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[17] GTS estimates that there are about 95 market participants as of Q1-2012.
[18] At the European Gas Hub Market conference, Frankfurt, 5th December 2011.
[19] See GTS press release, 23rd March 2012: **http://www.gastransportservices.nl/en/corporate/news/gasunie-tsos-auction-bundled-cross-border-capacity**
[20] See Appendix F for a map of the GTS/GUD network.
[21] The exact locations of these entry/exit points can be viewed on the ENTSOG European Natural Gas Network Map downloadable from: **http://www.entsog.eu/mapsdata.html**
[22] These transactions will be effected on TRAC-X secondary, the web-based platform for trading natural gas transmission capacity on the secondary market, operated by TRAC-X Transport Capacity Exchange GmbH: **https://secondary.trac-x.de/tracx/index.do**

These factors essentially form part of the Dutch government's ambition to develop the country as the 'Gas Roundabout'[23] of Europe. This strategy is based on: the country's geographical location at the heart of Europe as well as being a major gas producer with an LNG import facility; its strong gas industry and infrastructure knowledge; a developed gas transport network, including storage and potential for further storage capacity; a liquid trading hub and improved market model and balancing regime.

The strategy will be delivered by: increasing the gas transport capacity; better interconnections with neighbouring countries; market coupling with neighbouring grids; investments in LNG terminal and grid infrastructure; facilitating investments in gas storage facilities; strengthening the role of the TTF market; developing GasTerra into a gas 'trading house' for Europe. In essence, the Gas Roundabout strategy is aimed at maintaining the leading role of the Netherlands in the European gas industry in a period when the country will become a net importer of gas, from the mid 2020's.

It is impossible to ascertain whether any of these or indeed other 'soft' reasons may have led to the large rise in TTF traded volumes but the fact is that they have risen by over 62% year/year[24], from an average of 28.5bcm/mth[25] in Gas Year 2009, to 46.3bcm/mth[26] in Gas Year 2010, to about 50bcm/mth[27] by the end of 2011. As with the NBP market, there appears to have been a resurgence of activity over the Winter 2011-12 period, with the combined OTC and exchange volumes seeing a growth of 71%[28] in January 2012, compared to January 2011. In absolute terms, this means that in January 2012 the volume of gas traded at the TTF was 696 TWh, which was just under a half of that traded at the NBP (1479TWh)[29].

The great majority of the trading at the TTF is still OTC but there has been an increase in exchange trading too, although from a very low base. Indeed, total futures volumes have increased 3.5 times from 90 TWh in 2009 to about 320 TWh in 2011. This of course is still a very small proportion of the total number of trades done at the TTF but is certainly showing a marked increase. The number of companies registered to trade gas at the TTF on the APX-Endex exchange has also risen sharply in 2011, to 60 companies, accounting for 86 'Memberships'[30] ('spot' and 'futures' are different categories of membership).

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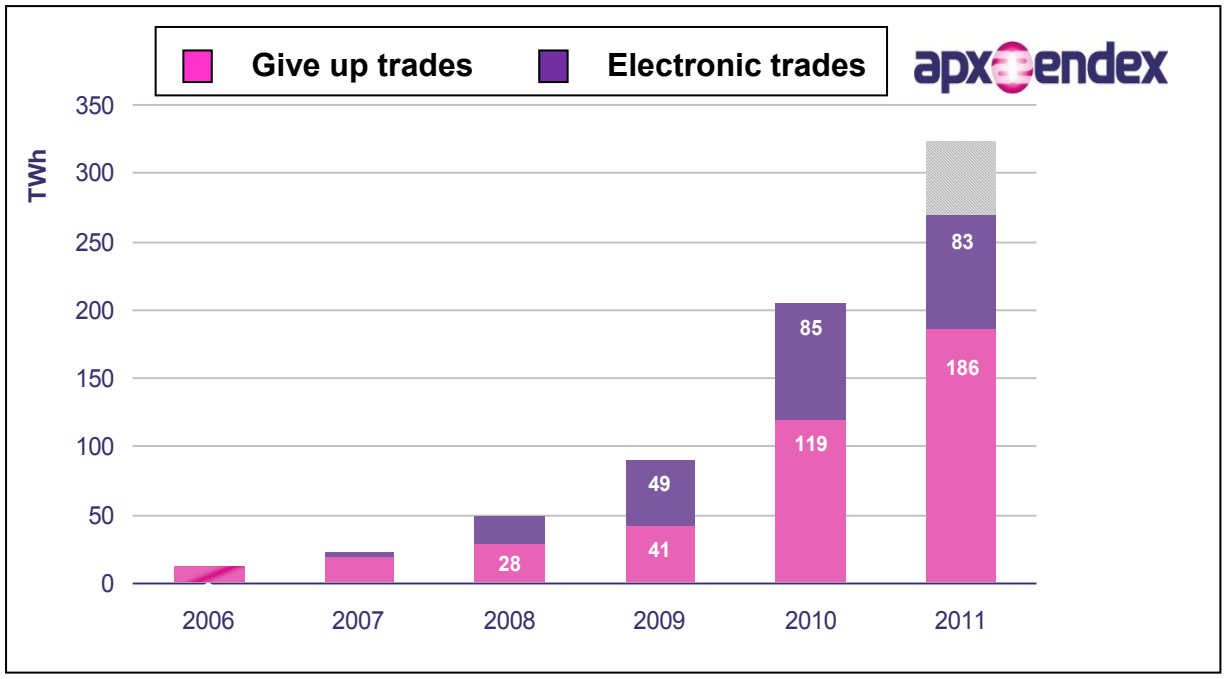
[23] For more detailed information, see:
Foreest (2010)
Ministry of Economic Affairs: The Netherlands as a Northwest European Gas Hub; November 2009: **http://www.apxendex.com/uploads/Corporate_Files/APX_Quarterly/Government_Report_-_The_Netherlands_as_a_Northwest_European_Gas_Hub.pdf**
Ministry of Economic Affairs: Economic Impact of the Dutch Gas Hub Strategy on the Netherlands; December 2010: **http://www.rijksoverheid.nl/documenten-en-publicaties/rapporten/2010/12/08/dutch-gas-hub-strategy-on-the-netherlands.html**
Various references and information at the GTS website:
http://www.gastransportservices.nl/en/zoekpagina?q=gas+roundabout&x=7&y=8
Oil and Gas Financial Journal report; The Netherlands: the energy hub of Europe; April 2010:
http://www.ogfj.com/articles/print/volume-7/issue-4/focus-reports/The-NETHERLANDS-the-energy-hub-of-Europe.html
[24] Source: Gas Transport Services.
[25] idem
[26] idem
[27] idem
[28] Source: LEBA January 2012 volumes in gas power emissions and coal.
[29] idem
[30] See Appendix K for the membership of TTF Gas at APX-Endex at the end of 2011.

Figure 5: APX-Endex TTF futures volumes 2006 - 2011



Source: APX-Endex
Note: "Give up trades": see Footnote 104

The large increase in total traded volumes, which appears to be sustained, means that the 'churn' ratio on the TTF has increased also and is now above 10x, the level considered by many to be the threshold which defines a mature market. Indeed, over the Q1-2012 period, the gross market churn reached almost 15x[31] and so I believe that the TTF market has achieved the necessary attributes to deserve the title of a mature market:

- it has good access to the traded market;
- it has a large and growing number of market participants;
- it provides a forward curve for financial risk management alongside very active spot markets used primarily for balancing;
- it is based around a solid and robust gas infrastructure;
- it has reliable, market based balancing regime;
- it now effectively has a single gas quality, with all conversion costs socialised since 2009;
- and it has good access to storage.

There may still be a few issues to iron out but there is willingness, on the part of the Government, the regulator, the TSO and the Shippers, to make TTF the Continent's 'premier' gas hub, part of the 'Gas Roundabout'. It appears to me that these parties are well on the way to achieving this goal. TTF has come a long way since 2003 and it can certainly now be considered as a mature market.

3.2 The "Transit Hubs": ZEE and CEGH

The "transit" hubs are hubs that are actual transit locations, or physical points, at which market participants can choose to trade gas; however, their primary role is to facilitate the

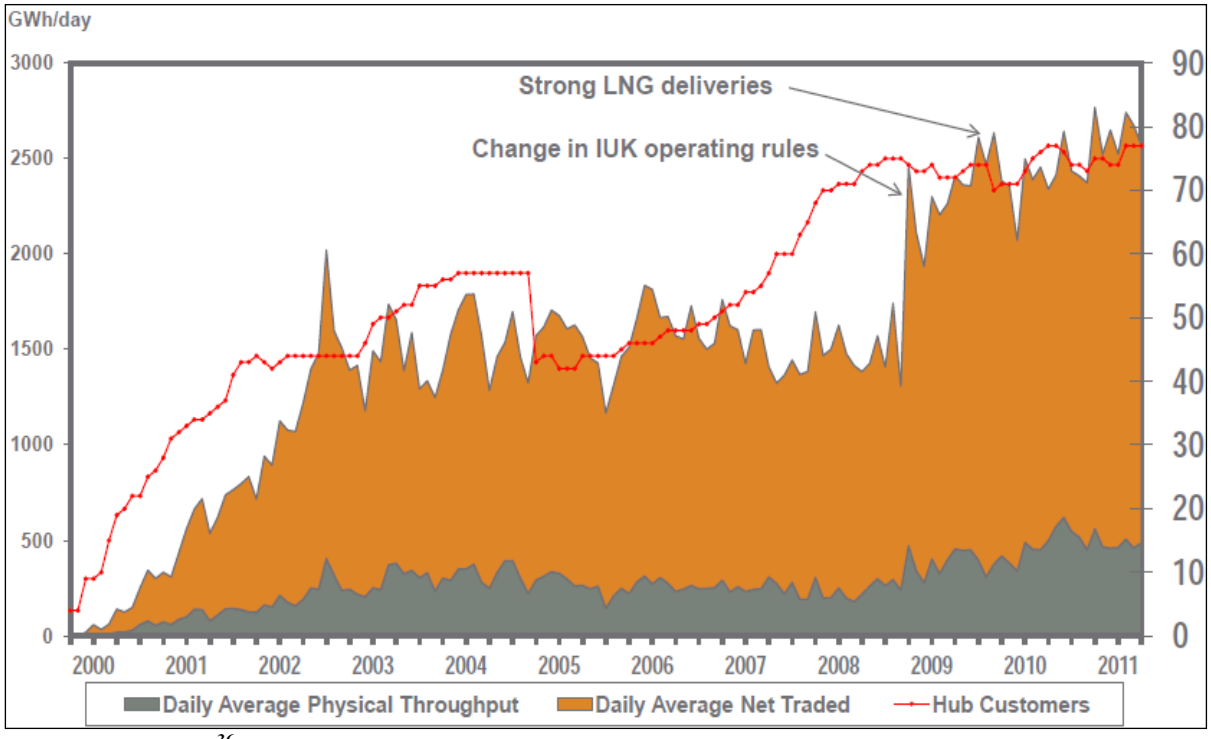
[31] See Table 3 in section 4.3 "Trading and Exchanges" below.

transit of large quantities of gas for onward transportation. Indeed, the two transit gas hubs of North West Europe, Zeebrugge in Belgium and Baumgarten in Austria have the capacity between them to handle some 130bcma, or around 45% of the demand in the downstream countries they provide gas to[32]. This makes these two locations very important in the physical context of gas deliveries to Western Europe; however, the nature of their formation means that trading has not developed as much as in neighbouring hubs.

3.2.1 The Zeebrugge hub (2000)

ZEE is a physical hub centred on the actual location of the gas installations and meter points outside of the town of Zeebrugge in north western Belgium[33]. Trading at ZEE was lacklustre for many years, saw a marked increase in 2009, as did all the gas hubs, continuing to rise slowly since then (see Figure 6). In absolute terms though, the traded volumes at ZEE lag a long way behind the British NBP and its immediate neighbour, TTF, and are currently similar to the traded volumes of the German NCG hub. Its traded volumes have advanced only marginally this past year and its re-trading ratio[34] is in the order of 4 times. Nevertheless, the number of participants has continued to grow, reaching 78 member companies in 2011[35].

Figure 6: Zeebrugge traded volumes, physical throughput and Members: 2000 - 2011



Source: Huberator[36]

Ever since its inception in 2000 ZEE has been closely linked to the British NBP to which it is physically linked by the Interconnector UK pipeline; ZEE hub even trades in pence per

[32] 2010 total demand in downstream countries: 292.3bcm (Sources: BP Statistical Review 2011: Austria: 10.1; BeNeLux: 63.0; France: 46.9; Germany: 81.3; Italy: 76.1; BMI Croatia Oil & Gas Report, Q3-2011: 3.0; BMI Slovenia Oil & Gas Report, Q4-2010: 1.0).
[33] See Appendix C for a diagram of the Zeebrugge hub.
[34] See "Churn" in the Glossary: in this Paper, re-trading ratio is not the same as gross market churn.
[35] See Appendix L for the membership of Zeebrugge Hub at the end of 2011.
[36] Huberator provides access and associated services to the Zeebrugge Hub; **http://www.huberator.com/**

Therm and is often referred to as the 'NBP across the Channel'. The currency issue is now proving a setback for this hub as Continental European traders who want to risk manage their gas portfolios, do not want to incur an additional currency risk.

The purely physical set up has its advantages for the transportation of large quantities of gas and ZEE is indeed ideally placed geographically to take advantage of gas flows to and from France, Britain, Norway, the Netherlands, Germany and the adjacent LNG terminal and Belgian gas grid[37]. However, the fact that it is not a virtual hub, covering all of the Belgian grid and that trading and the balancing regime at the Zeebrugge hub is subject to shortfalls and pro-ration of volumes, has left this hub trailing behind as other Continental European hubs advance in respect to their trading activities.

However, Belgium's regulator is pushing for changes and the TSO, Fluxys, is looking at ways to improve market coupling with Holland and also France and Germany, with several schemes being evaluated. However, as with the TTF/GPL market coupling, this is unlikely to result initially in larger trading zones but will improve physical flows across borders and so help to strengthen the already good price correlation between traded hubs. It has already, since December 2008, been operating a joint venture with the French TSO, GRTgaz; the electronic platform called Capsquare[38] can be used for trading capacity on four grids, those of: Fluxys in Belgium, GRTgaz in France (PEGs Nord and Sud only), Open Grid Europe and GRTgaz Deutschland in Germany (NCG only). This electronic platform can be used for trading secondary capacity on either the Fluxys or GRTgaz networks but, more importantly, can be used to buy 'bundled' capacity products on the four available grids. Several products are available but those that concern the Belgian gas system are the Bundled Fluxys-GRTgaz market and the Bundled Fluxys-OGE market, offering Month Ahead capacity from ZEE => PEG and Day Ahead capacity in either direction between ZEE ⇔ NCG and ZEE ⇔ PEG.

One major change planned by Fluxys is to introduce a new natural gas transmission model, due to be implemented from 1st October 2012, an important part of which is the creation of a new one-zone Belgian virtual trading point, presently called the ZTP[39] (Zeebrugge Trading Point). At the time of writing (March 2012) it is not yet clear what rules will govern the movement of gas between the ZEE and the ZTP and what cost, if any, will be incurred by traders. The proposal that Fluxys has put before the Belgian regulator, CREG, is for one single trading hub where both virtual and physical services will be available. However, doubt had been expressed by traders both individually and through their representative body[40], the European Federation of Energy Traders (EFET) that two hubs would dilute liquidity and affect their potential success. It appears that Fluxys has taken note of this but it is still unclear whether ZTP will be priced in pence/Therm or in €/MWh. It now remains to be seen whether this radical move is too little too late, as Belgium's neighbouring countries have established virtual trading hubs and some, especially the TTF, are successful.

[37] See Appendix D for a map of Belgian gas grid.
[38] See the Capsquare website for more details: **http://www.capsquare.eu/**
[39] See ICIS-Heren ESGM 19/3/12: "Zeebrugge set to be a single virtual and physical natural gas hub": **http://www.icis.com/heren/articles/2012/03/19/9542968/gas/esgm/zeebrugge-set-to-be-a-single-virtual-and-physical-natural-gas-hub.html**
[40] See ICIS-Heren EGM, 15th March 2012, p.2: "Belgium's new virtual gas hub considers switch to Euros"

3.2.2 The Central European Gas Hub (2005)

In Austria, there are some very interesting moves afoot which could lead in time to the emergence of a genuine central European gas hub. The current CEGH (Central European Gas Hub) is not a virtual trading point but, like Zeebrugge, is a physical location; it actually comprises 6 tradable locations[41] across Austria of which Baumgarten is by far the most important and the one that registers the most trades. Baumgarten is situated in the east of the country on its border with Slovakia. The import terminal itself is vast[42] and is owned and operated by Gas Connect Austria[43]. Approximately one third of all Russian gas supplies to Western Europe come through Baumgarten for onward transportation to Germany, Italy, Slovenia and Hungary, as well as for supplying the national market. Austria is probably the most complex country in Europe in terms of its gas network. It is actually 3 separate networks, known as Control Areas[44] ; the main one in the east containing the transit pipelines[45], a high pressure transmission grid and a high and low pressure distribution grid. There are two further, much smaller networks in the west central and west of the country: Tyrol and Voralberg. These two Control Areas are not physically connected to the Eastern Area, nor to each other but have direct pipeline connections to Germany and so can be considered as separate distribution grids off the German NCG system. A further complication is that the Austrian gas industry works to three different gas days: starting at 8am for transit gas from Russia; at 6am for Austrian transmission; and midnight for Austrian distribution.

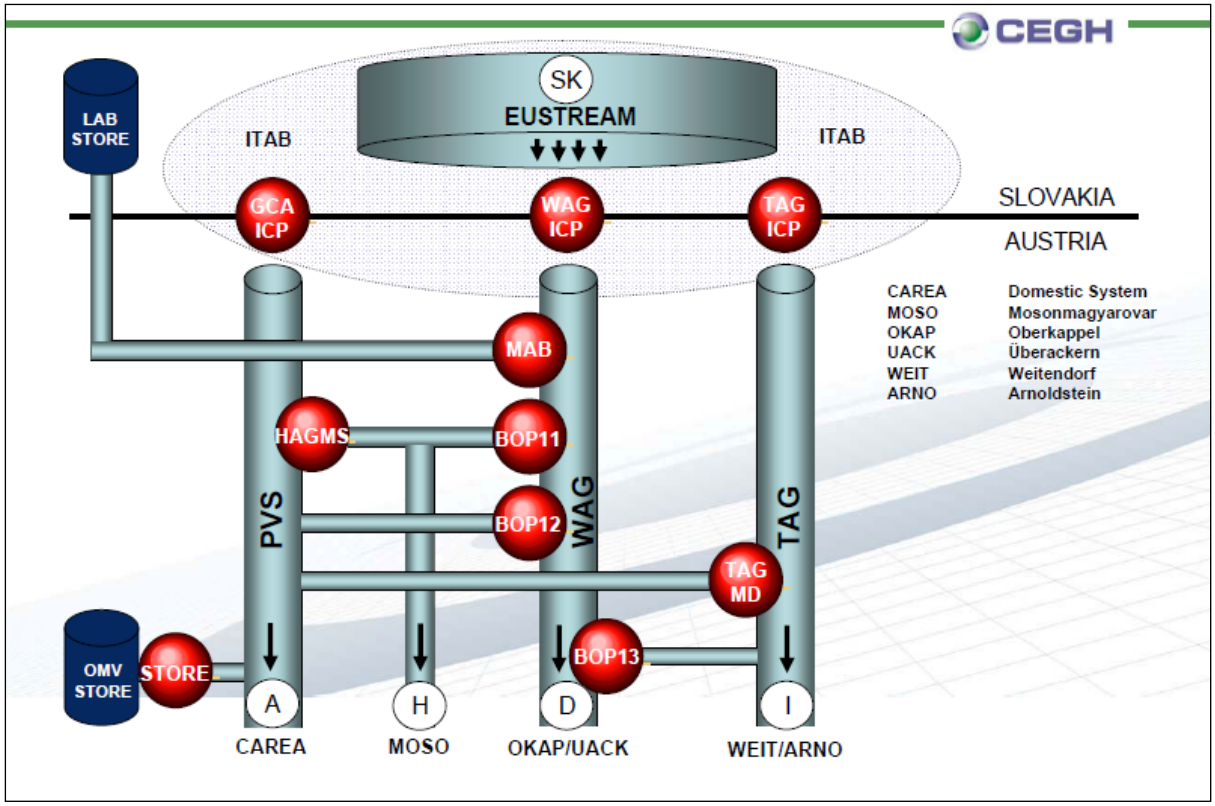
Baumgarten is the largest by far of the Austrian physical hubs that can all be traded at the CEGH and currently consists of 13 different 'locations', mainly flanges, where one can trade gas (see Figure 7). All of these locations are connected via Wheeling Services[46] that CEGH provides as auxiliary services to the main product, Title Transfer Service. Due to the very physical nature of the current system, the CEGH has developed a rather complicated structure of trading to accommodate each of the different types of participant who might want to trade gas. It therefore offers some quite interesting trading solutions and provides a service to importers of gas, shippers of gas and traders of gas alike in three distinct layers: anonymous exchange trading[47]; OTC trading for Shippers and Traders to transact and Title Transfer from Shipper to Shipper.

The Exchange offers different types of contracts. It started a Spot market in December 2009 and added a Futures market a year later in December 2010. It now hopes to introduce a Within Day market during the course of 2012. It operates an electronic trading platform which is linked to Trayport (the industry standard used for aggregating the prices of all brokers/traders/exchanges for any given market) and that has actually helped it to generate some additional traded volume. However, the traded volumes and the estimated churn are relatively low, although there is much debate here due to the huge difference in volume between Austria's gas demand (8-9bcma) and the total flow volume of gas transiting the

[41] It is possible to trade at: Baumgarten, Oberkappel, Ueberackern, Weitendorf, Murfeld and Mosonmagyaróvór
[42] Baumgarten Terminal has a total import capacity of 89bcma
[43] Known as OMV Gas GmbH prior to 14th December 2011, the name change was part of the unbundling of the Austrian gas sector following the passing of the National Gas Act in October 2011.
[44] See Appendix B for a map of the Austrian gas grids, divided in to 3 Control Areas.
[45] See Appendix A for a map of Austrian high pressure and transit pipelines.
[46] This service manages the transfer of gas quantities between different flanges at certain trading locations, including Baumgarten. CEGH handles the necessary wheeling nominations and performs the corresponding matching procedure as well as transportation and the monitoring and reporting of the related gas quantities.
[47] See Appendix M for a diagram of the trading 'layers' at Baumgarten.

country (30-32bcma). Even so, the lowest estimates are of a re-trading ratio[48] of around 2x and the highest around 4x.

Figure 7: Diagram of interconnections at Baumgarten Terminal

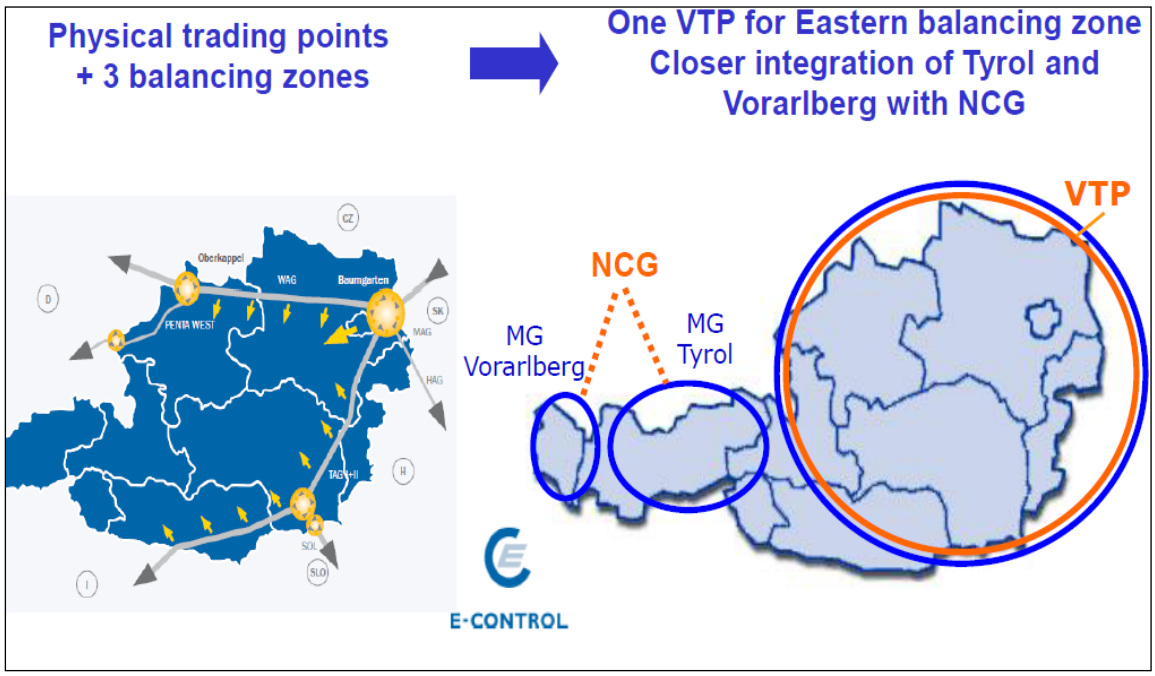


Source: CEGH Exchange

As in the Netherlands, the Austrian government and regulator are pushing for reform of the network and for changes in commercial practices. After thorough consultation with the industry and discussion, the parliament voted through a new Austrian Gas Act[49] in October 2011. Its main purpose was to incorporate into Austrian law the requirements outlined in the EU's third energy package and will in practice create a merged transit and distribution network, harmonised balancing rules and a virtual trading point. The three existing Control Areas will become Market Areas (MAs), with the Eastern MA being a new single entry/exit zone which will serve as a proper virtual trading point, as from 1st January 2013 (see Figure 8) and the Voralberg and Tyrol MAs gradually being integrated in to the German NCG[50]. There is also provision for commercial hub services, for providing back up/back down services, and for cooperation with exchanges and clearing houses.

[48] See "Churn" in the Glossary: in this Paper, re-trading ratio is not the same as gross market churn.
[49] The "GasWirtschaftsGesetz 2011" (GWG-2011) was adopted by parliament on 19th October 2011.
The original document can be accessed at:
http://www.parlament.gv.at/PAKT/VHG/XXIV/I/I_01081/fname_208203.pdf
More detailed information, in English, can be found at: International Comparative Legal Guide:
http://www.iclg.co.uk/index.php?area=4&country_results=1&kh_publications_id=228&chapters_id=5091
E-Control Discussion paper, November 2011: **http://www.e-control.at/portal/page/portal/medienbibliothek/gas/dokumente/pdfs/Punktation_Marktregeln_v11_en.pdf**
[50] See ICIS-Heren EGM, 15th March 2012, p.4: "Austrian market areas to be integrated into German NCG".

Figure 8: Development of Austrian gas Market Areas from 1st January 2013



Source: E-Control

The creation of an Austrian VTP will be a big step forward in developing the trading volumes at this important physical gas transit point and represents a radical move forward for Austria and also for Central Europe. E-Control's vision is to promote stepwise integration over the coming decade of the Baumgarten VTP with the neighbouring countries in order to create one Regional VTP. They are the only country in Europe seriously looking at creating a regional Market Area and VTP which would include, in successive moves, Slovakia (2014-15), the Czech Republic (2015-16), and possibly even Hungary (2017-19). This 'super single area', along with one virtual trading hub may still only be a regulator's vision of the future but, if it does turn out to become reality, it would certainly become a true Central European Gas Hub, as its name implies!

3.3 The "Transition Hubs": GPL, NCG, PEGs and PSV

The "transition" hubs include the remaining hubs in North West Europe and are those that I categorise as having started to liberalise and to offer trading products but which have yet to show their full potential. Indeed, some may never achieve the same openness as the leading hubs of NBP and TTF although it can be argued that this is not necessarily essential within the overall framework of European gas trading. Germany has two gas hubs, Gaspool and NCG, in France there are three Points d'Echange de Gaz and finally, in Italy there is the Punto di Scambio Virtuale.

Germany is the second largest gas market in Europe, is well positioned geographically and has good infrastructure connections with its neighbouring countries; these attributes should have given it a head start in being the focus for a (North West) European traded hub which in time could even be a 'benchmark'. However, the reality to date has been somewhat different. Due to its historical gas structure, comprising 19 zones and having two major pipeline systems, progress has been slow, even after a period of rationalisation from 2009 to 2011. In 2010 the gas market areas in Germany were reduced to 3 high calorific gas and 3 low

calorific gas zones; in 2011 there were two further changes, the first implemented on the 1st April, reducing the number of zones to three: 2 H-cal and 1 L-cal, then on 1st October, the last merger was effected, creating the current situation of a 2 Market Area system[51]: Gaspool and NetConnect Germany, each with both high and low calorific gas networks which are still being balanced individually. The costs of energy conversion are expected to be 'socialised' by 2016.

It must be remembered that the German set-up is quite different to the rest of NWE, whereby both the NCG and the GPL are each run by 6 TSOs. The proposed final merger, of NCG and GPL, has become a very political issue and the regulator, BNetzA[52], has stated[53] that it would see the increased benefits of a unified system but that for now was leaving it up to the TSOs to decide if/when to proceed – all 12 of them. If the German market cannot unite into one Market Area, this could be a major stumbling block preventing a German hub from becoming the Continental European gas price benchmark.

3.3.1 The Gaspool Balancing Services hub (2009)

GPL is operated as a physical hub rather than a virtual one and that the hub operator uses "balancing services" in its title is indicative of the physical nature of this hub. Although it does cover a large geographical area, it is mainly used by traders to adjust their storage portfolios and in relation to the other German hub, NCG. Nevertheless, traded volumes which had remained more modest than the main NWE hubs, have seen a burst of activity in the first quarter of 2012, rising 119%[54] over the same period last year and in so doing, overtaking in absolute terms the volumes traded at the French PEGs[55].

The latest incarnation of Gaspool was formed on 1st October 2011 by the merger of the Aequamus L-Cal zone and the Gaspool H-Cal zone; the new company has 6 TSO shareholders[56], each holding an equal 1/6th share. One development is that Gasunie Deutschland (one of the 6 shareholders) is proposing a 'market coupling' with the Dutch TTF grid although it should be pointed out that this is not the same as creating a unified one entry-exit area. However, if successful, it should enable shippers to 'one-click/one trade' gas from an entry point in GPL to an exit point in TTF (or vice-versa) with all associated transit/border capacities included. This would augur well for trading but would probably lead to more volumes on the more established and advanced market, TTF.

3.3.2 NetConnect Germany (2009)

The 'new' NCG was formed on 1st October 2011 by the merger of the Thyssengas H-Cal zone and the NCG H-Cal zone; the new company has 6 TSO shareholders[57], each holding an equal 1/6th share. NCG had been considered until only recently as the 'most promising' of the NWE gas hubs and indeed, total traded volumes have increased significantly: traded volumes have

[51] See Appendix I for a map of the German Gaspool and NCG gas grids.
[52] Bundesnetzagentur.
[53] BNetzA presentation at the European Gas Hub Market conference, Frankfurt, 5th December 2011.
[54] Source: LEBA March 2012 volumes in gas power emissions and coal.
[55] Idem (GPL 136.61TWh vs. PEG 74.24TWh).
[56] The 6 TSO shareholders are: DONG Energy Pipelines, GASCADE Gastransport (formerly Wingas), Gastransport Nord (formerly EWE Netz), Gasunie Deutschland Transport Services, Nowega (formerly Erdgas Münster) and ONTRAS – VNG Gastransport.
[57] The 6 TSO shareholders are: Bayernets, Fluxys TENP TSO, GRTgaz Deutschland, Open Grid Europe GmbH, Terranets bw (formerly GVS Netz), Thyssengas GmbH.

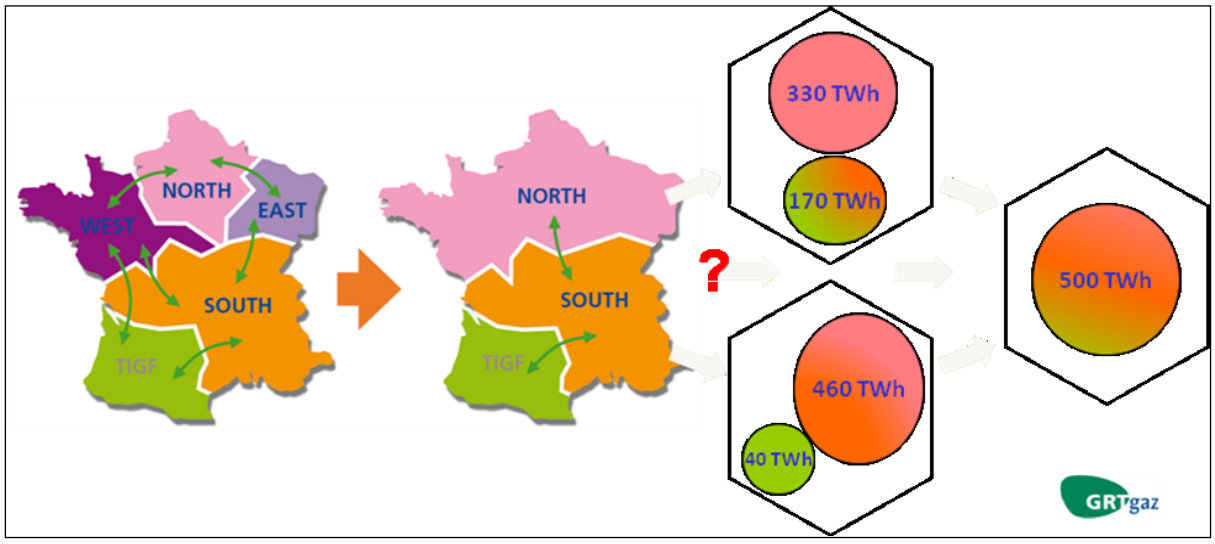
risen by just under 26% year/year, from an average of 73.6TWh/mth in Gas Year 2009, to 92.6TWh/mth in Gas Year 2010. The increase in traded volumes is continuing into the current Gas Year 2011, to an average of 134.8TWh/mth over the Winter-11 period, over 34% higher than the same period a year earlier[58]. What is important to note in this case though, is that until quite recently most of the volume was concentrated in the Day Ahead (DA) contract, a reflection of the German balancing regime which requires Shippers to calculate their off-take loads on day ahead forecasts, thereby creating the need for DA trading. Nonetheless, it is also a reflection that this is being done increasingly through the market mechanism rather than cross-TSO as used to be the case.

When taking both the Gaspool and the NetConnect Germany hubs together to form an 'all German' metric, despite the large rise in traded volumes this past year, the re-trading ratio[59] is in the order of 7 times but the gross market churn is only about 1.3x[60], indicating that the market needs to grow substantially before it could challenge TTF's current dominance on the Continent.

3.3.3 The Points d'Echange de Gaz (2004)

In France, the PEGs are quietly trading without creating much of a 'stir'. Volumes have slowly improved since this hub was started but are still relatively low compared to their neighbouring markets. Despite some unification on 1st January 2009 from the original model to the present three zones, there are also high and low calorific contracts tradable in PEG Nord. PEG Nord H (high cal) is the most traded market, followed by PEG Sud and finally PEG Nord B (low cal) and TIGF in the south west. There are two TSOs, GRTgaz covering PEGs Nord and Sud, as well as Total for PEG TIGF. The consolidation of the French gas zones is shown in Figure 9.

Figure 9: Development of French zones in 2009 and future consolidation?



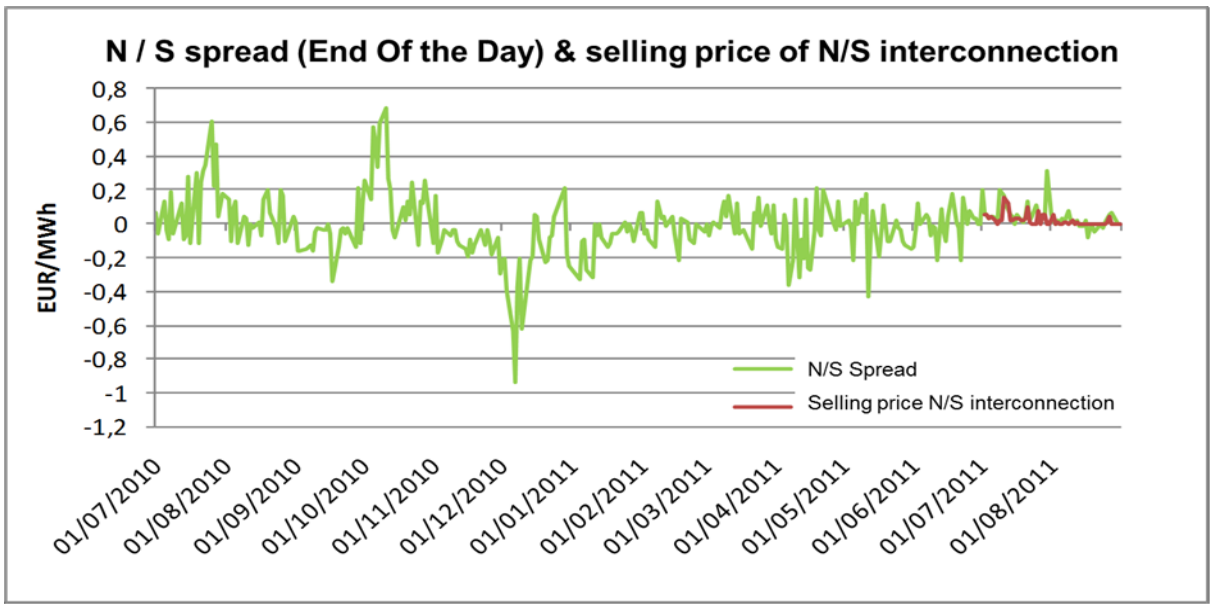
Source: GRTgaz

[58] Source: NCG Data Services: **http://datenservice.net-connect-germany.de/Handelsvolumen.aspx?MandantId=Mandant_Ncg&rdeLocaleAttr=en**
Total traded volumes recorded are: Gas Year 09: 883,013.6 GWh; Gas Year 10: 1,111,738.9 GWh; Winter 10: 602697.4 GWh; Winter 11: 808981.6 GWh.
[59] See "Churn" in the Glossary: in this Paper, re-trading ratio is not the same as gross market churn.
[60] See Table 3 in section 4.3.

Somewhat more problematical is the proposed merger of TIGF and PEG Sud. GRTgaz has stated that the initial merger of its zones to create the present Nord/Sud configuration cost over €300million but that the outcome has been seen as a positive benefit; they believe that further infrastructure investment to strengthen the north/south capacity would also be financially rewarding; the same cannot be said of merging the TIGF and PEG Sud zones despite there being no capacity restriction. It is quite simply described as being a "conflict of interests between the two TSOs" and the French regulator, the CRE[61], is not optimistic about seeing a fully merged VTP – so it is unlikely to occur for some time, if ever.

There exists a physical transportation bottleneck between the north and south zones, although this has in part been resolved by the French trading exchange, Powernext, offering in conjunction with the TSO, GRTgaz, a virtual spread between the two zones, which is subject to the TSO being able to physically balance the zones accordingly. Since this came into being in July 2011, the price differential between the two zones has diminished from >€1/MWh to virtually zero on most days, as shown in Figure 10.

Figure 10: Effect of market coupling on price of PEG Nord/Sud spread



Source: GRTgaz

This spread trade contract has attracted new participants to enter the French market and shows how important cross-border facilities are to enabling wider trading. Furthermore, GRTgaz has until now (March 2012) always been able to provide the service.

Another development that has benefited the French traded gas market has been the availability on the Capsquare trading platform (see section "3.2.1 The Zeebrugge hub (2000)" for more details) of several bundled capacity products. As well as those between the French and Belgian systems, there are also two products between the French and German TSOs, GRTgaz-OGE[62] market, offering Month Ahead capacity in either direction between PEG N ⇔ NCG and, since 17th January 2012, Day Ahead capacity in either direction between PEG N ⇔ NCG.

[61] La Commission de Régulation de l'Energie.
[62] Open Grid Europe; see section 3.3.2 "NetConnect Germany (2009)" above.

All of these efforts have resulted in improved tradability on the French market but, despite the efforts in particular of GRTgaz and of Powernext, traded volumes are proving rather disappointing. 2011 did prove to be an encouraging year for the French traded gas markets, with volumes and the number of participants increasing; the start of 2012 however appears to tell a different story: traded volumes in the first Quarter have dropped 39%[63] compared to Q1-11, leaving the PEGs as the smallest traded gas hub in NW Europe. This could be a sign that the PEGs will certainly be used by shippers for balancing trades but that they will perform their risk management trading on a more liquid hub.

3.3.4 The Punto di Scambio Virtuale (2003)

When Italy announced the formation of the PSV, there was great hope amongst the gas trading fraternity that this could be the beginning of truly pan-European trading. The Italian Network Code for gas is almost identical to the British one, although entry capacity is not as flexible. However storage is on an open access basis and in fact all gas entering the system goes through the PSV. However, only a very small percentage of all that gas is actually traded at the hub and the National incumbent, ENI, does not trade at the PSV at all.

From the viewpoint of foreign traders there has been much scepticism across northern Europe as to whether the Italian gas market is actually opening up and much discussion of the difficulty of trading there. It has even been alleged that the situation in Italy is the result of the incumbent gas company "playing the game well", often with the tacit support of the Italian government. The reason for these comments is that most of the rules governing the gas market and in particular those relating to Third Party Access, capacity trading and storage, are not available in English (unlike most other NW European countries) and in some cases involve complicated processes in order to achieve the desired goal. There have been some very serious shortcomings, such as TAG and Transitgas pipeline capacity not available on a short term basis, (even on an interruptible basis), and that balancing cashouts were based on storage costs not on the market price, amongst others. All these factors lead to a situation where the market was performing, but in an inefficient manner.

However, this situation appears to be changing. On the positive side, there have been a number of changes recently that have already made a difference and which might allow the PSV to develop in the future, including the new balancing regime, operated through the PB-Gas platform[64], which started 1st December 2011 and has been producing rather benign cashout prices, the result of which has been that traded volumes of PB-Gas increased nearly 5-fold in the first three months[65]. Further proposed changes should help secure trader confidence; in Gas Year 2009 the TAG pipeline was upgraded by 6bcma and that extra capacity was bought by about 100 shippers[66]. The pipe operator has now started to offer on its website[67], since 1st March 2012, day ahead capacity auctions, usually making available some 50-60mcm/d of which about 15mcm/d are being bought. This has naturally led to price convergence of PSV towards Baumgarten and the other European hubs and indeed, the spread between the two hubs is now running at or close to the short term marginal cost of transportation which is in the order of €2/MWh (see Figure 11).

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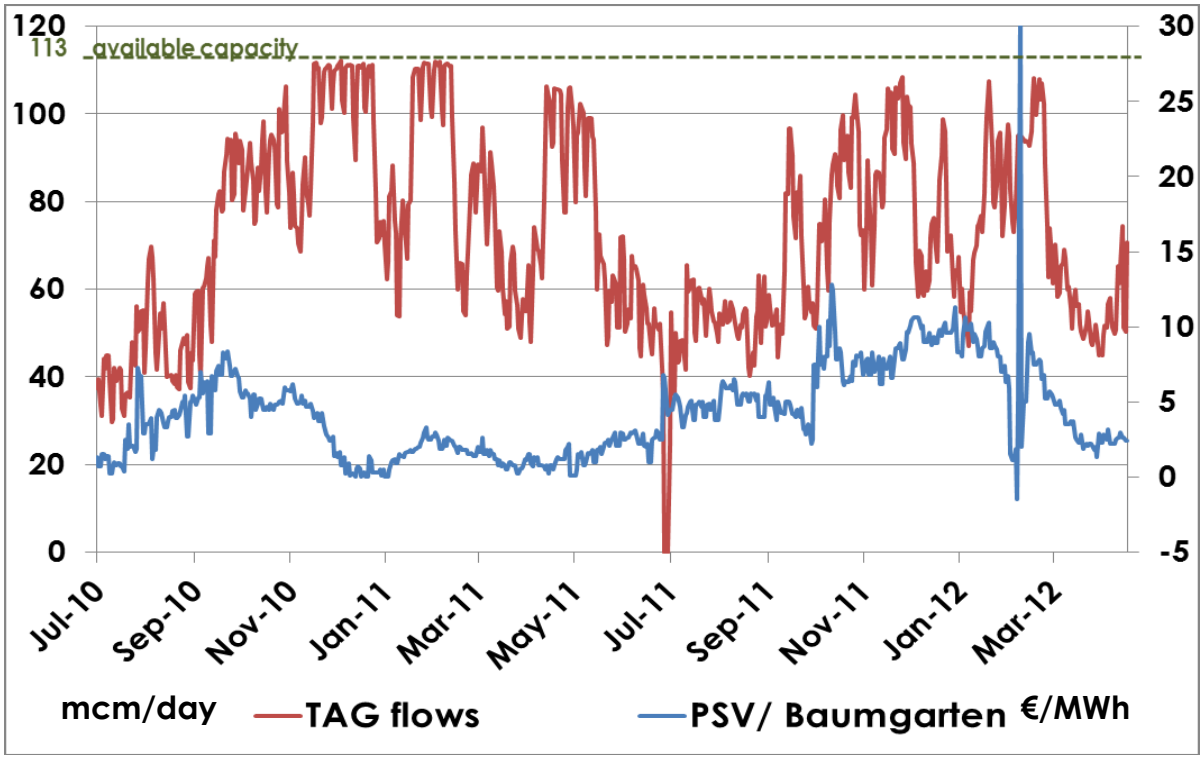
[63] Source: LEBA March 2012 volumes in gas power emissions and coal.
[64] There are three Italian traded natural gas markets: PB-Gas (balancing market), M-Gas (spot trades) and P-Gas (forward trades). For more information, see: **http://www.mercatoelettrico.org/En/Mercati/Gas/MGas.aspx**
[65] Platts European Gas daily, April 4th 2012, p.4: "Italy mulls changes to balancing system".
[66] Source: Alba Soluzione: **http://www.albasoluzioni.com/**
[67] **www.taggmbh.at**

Figure 11: Italy/Austria spread vs. available border capacity



Source: Alba Soluzione

The 'opening' of TAG means that there is now an extra 6bcma of long term capacity and 15mcm/d of short term capacity and shippers have been keen to use this for commercial ends and to profit from the price arbitrage between Italy and the other European countries. However, as Gazprom refuses to sell short term gas to shippers at Baumgarten, it is mainly the large wholesalers such as E.On, GdF, RWE, et al, who are profiting by taking LTC volumes from Russia (thereby supporting their ToP obligations) and selling to Italian importers, replacing any volumes needed in Germany or France with hub gas. The subsequent reduction in the price arbitrage can be seen in Figure 18.

The PSV is slowly transforming from an inefficient market towards a more trader-friendly one; it remains to be seen whether it will progress further, possibly one day being a southern Europe reference hub.

4. A change in attitude towards trading

Part of the reason for, and in some cases the success of, the development of the gas hubs in Continental Europe has been the result of a change in attitude towards trading. The EU has shown a keen interest in the liberalisation of the European energy markets for many years but their efforts have been redoubled recently and there is now a tight framework in place to ensure that the goals are achieved. However, legislation alone could not and would not effectively deliver the changes required to create a successful free and open traded market environment. It is essential that the participants of the market in question are willing to see change and that they actually embrace it; it is apparent that since 2010 there have been changes in attitudes to gas trading both by sellers and, especially, by buyers. A final

contributor to the changing gas market in Continental Europe has been the push by the exchanges to open up the markets by offering new products on 'easy to trade' electronic platforms.

4.1 Legislation and Regulation

There are several political and regulatory efforts now in place to help deliver efficient and competitive energy markets within Europe. This may seem like a cumbersome structure to achieve the goal but is in keeping with the European political model and, although it may take a little longer to reach the target, the result is sure to have been thoroughly researched and tested and, of course, approved by all the Member states.

The political driver behind all these efforts is the goal to transform the European gas market, by integrating the various national markets, into a single liberalised market. The legislation to achieve that goal was set out in the so-called '3rd Package' Directive of 13th July 2009[68]. This package provides for legally binding network codes in order to create a single gas market, and the various national energy regulators were given the task of supplying the detail of the new market structure. From there, the regulators went a step further and, through the Council of European Energy Regulators (CEER), they set out their 'vision' of the future gas market structure. This vision came to be known as the 'Gas Target Model' (GTM)[69]. Not surprisingly, as this vision is set out by regulators, the GTM focuses on operational issues such as enhancements in capacity allocation, congestion management, interoperability and balancing, to achieve market linking and integration.

Since July 2009 progress has been fairly swift considering the task involved and the implications that this radical change will have. The Madrid Forum[70] initiated a process in September 2010 to establish the GTM and to explore the interaction and interdependence of all Network Codes; the European Commission set out its timetable for market reform in February 2011, setting a target of 2014 by when the EU will have a fully functioning, interconnected and integrated internal energy market, allowing gas and electricity to flow freely. On 23rd March 2012, the Madrid Forum endorsed the Gas Target Model of the Council of European Energy Regulators[71].

There is still a long way to go, in defining the rules and regulations that will permit such a unified market, in ironing out capacity bottlenecks to allow a market mechanism to work properly, and in writing and implementing coordinated Network Codes across the EU and, not least, getting the approval of all the Member states. However, much has already been achieved and it now looks as though the overriding goal as set out in the 3rd Package may indeed be achieved.

Another important piece of legislation was passed in October 2011, known as 'REMIT'[72].

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[68] See European Union: Directive 2009/73/EC.

[69] A full account of the GTM is described in: "A vision for the EU target model: the MECO-S Model", J.-M. Glachant, Florence School of Regulation, EUI Working Papers, RSCAS 2011/38, June 2011: **http://www.florence-school.eu/portal/page/portal/FSR_HOME/ENERGY/Publications/Working_Papers/2011/RSCAS_2011_38.rev.pdf**

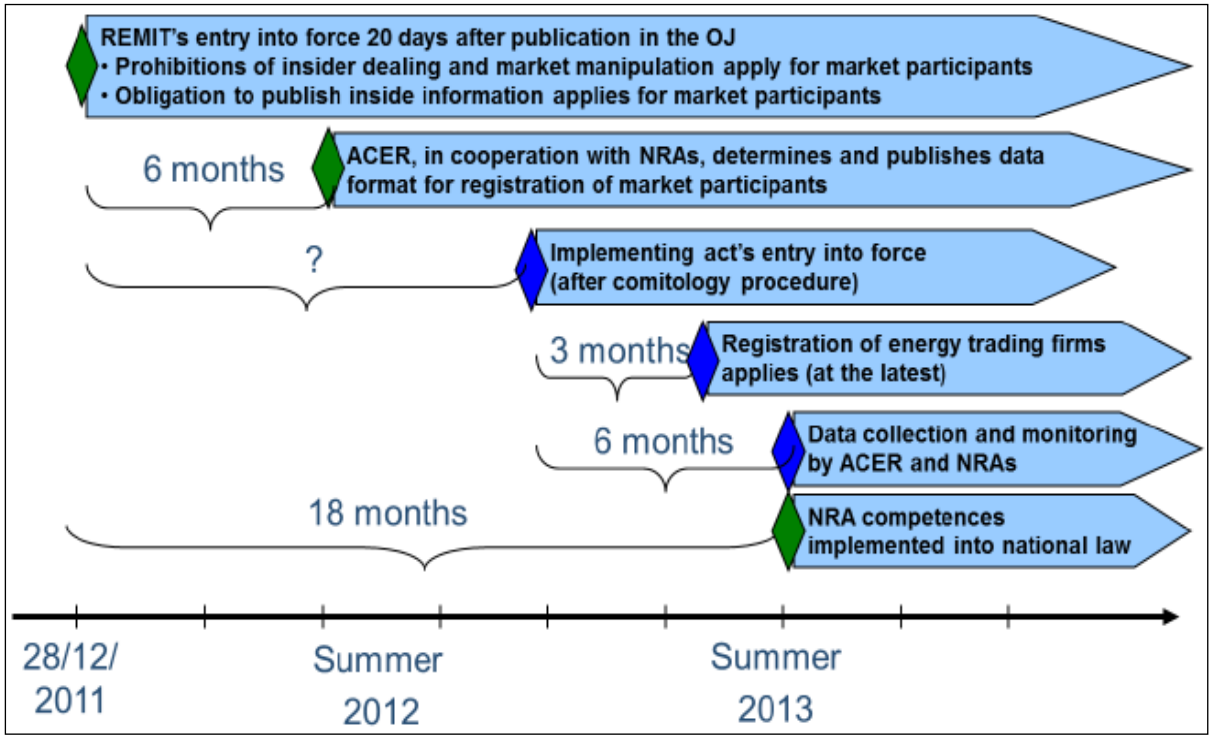
[70] Properly known as 'The European Gas Regulatory Forum'

[71] European Energy Review, 23rd March 2012: "Madrid Forum endorses the Gas Target Model": **http://www.europeanenergyreview.eu/site/pagina.php?id=3602**

[72] See European Union: Regulation (EU) no 1227/2011.

This sets out the rules to prevent market abuse and to reinforce transparency in the traded markets. Furthermore, it will permit coordinated investigations into cross-border manipulation. This is seen as an important piece of legislation and is expected to assist the regulatory bodies in adopting and enforcing the new market structure as set out in the 3rd Package and the GTM. Figure 12 shows the provisional timeline of REMIT's implementation which is aimed at providing the necessary regulatory tools in time for the single liberalised gas market in 2014.

Figure 12: Provisional timeline of REMIT implementation



Source: ACER

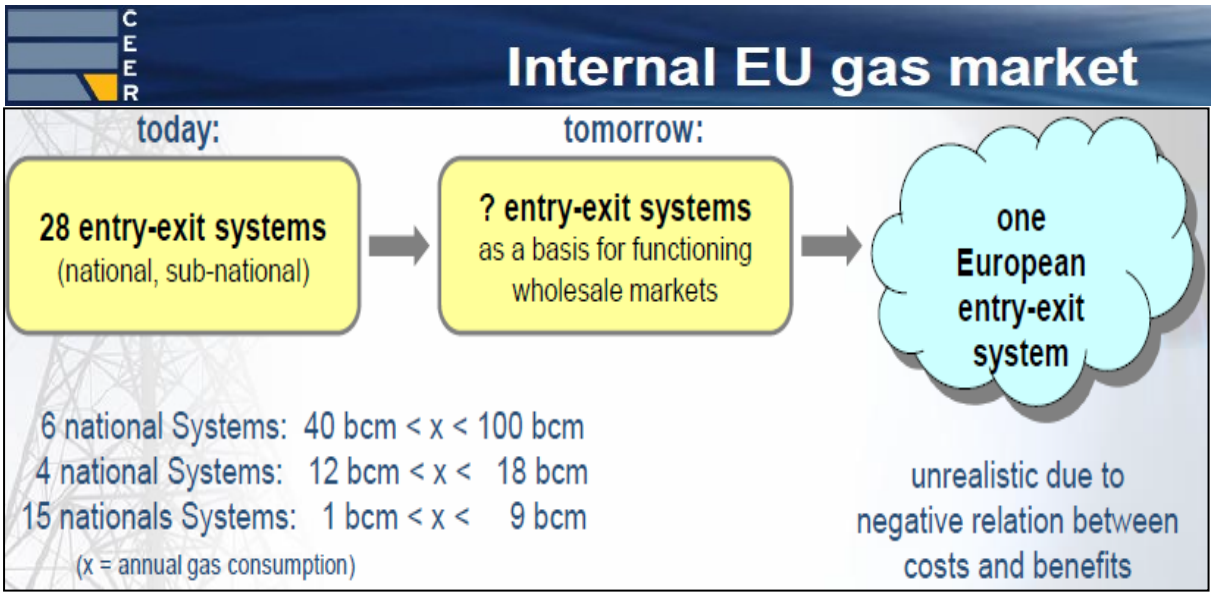
There are three main bodies overseeing and implementing the legislation involved in delivering the 3rd Package: CEER, ACER and ENTSOG. Although each of their roles is clearly defined, there are inevitable overlaps and, in any case, they need to work cooperatively if they are to succeed.

The Council of European Energy Regulators (CEER) was formed to facilitate the creation of a single, competitive, efficient and sustainable EU internal energy market that works in the public interest[73]. It was CEER that was tasked by the European Commission to deliver a target model for a European gas market which was delivered in December 2011 and it was endorsed in March 2012 (see above). The Gas Target Model contains a suite of recommended steps to achieve a single EU gas market by the 2014 deadline as set by the European Council, as well as dealing with longer term issues. In the short term, they have set out a full programme of tasks for 2012[74]. Their vision is illustrated in Figure 13 and acknowledges that for now it is actually unrealistic to hope that Europe could have just one entry/exit system;

[73] More information can be found at: **http://www.energy-regulators.eu/portal/page/portal/EER_HOME**
[74] CEER 2012 Work Programme, 24th January 2012: **http://www.energy-regulators.eu/portal/page/portal/EER_HOME/C11-WPDC-22-06_public%20WP2012_24-January-2012.pdf**

however, they think it possible to have 7 'regional' markets by 2014-15. Their vision for a sustainable Internal Energy Market in gas is founded on three pillars: to enable functioning wholesale markets; to tightly connect the markets; to enable secure supply patterns. These pillars are to be supported by "improving the effectiveness (of integrated markets) by realising economic pipeline investments". CEER works closely with and supports the work of ACER.

Figure 13: European Gas Target Model vision: towards a single EU gas market



Source: CEER

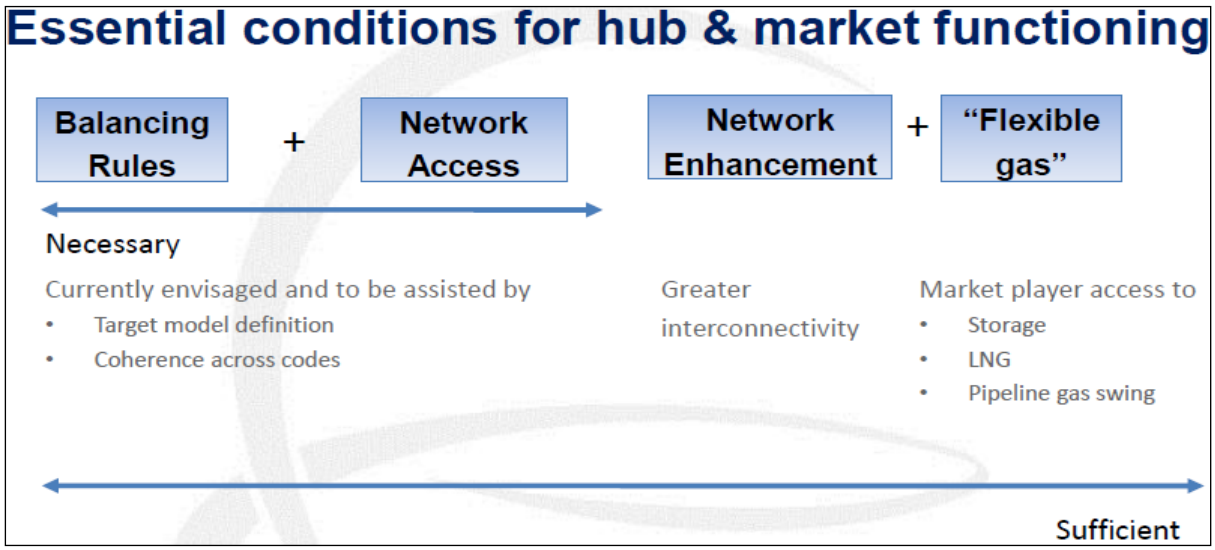
The Agency for the Cooperation of Energy Regulators (ACER) was set up following the introduction of the 3rd Package. Their role is to "work towards a competitive, sustainable, secure and transparent Internal Energy Market to the benefit of all EU consumers"[75]. Their mission is to assist National Regulatory Authorities in exercising, at EU level, the regulatory tasks that they perform in the Member states and, where necessary, to coordinate their action. Therefore, ACER cooperates closely with NRAs but also EU institutions, and European associations of stakeholders, and market participants, especially the European Networks of Transmission System Operators (ENTSOs), to deliver a series of instruments for the completion of a single EU energy market. Their activities are focused on three main areas: supporting European market integration; advising EU institutions on trans-European Energy infrastructure issues; Energy market monitoring. They too have published a full programme of tasks for 2012[76].

The European Network of Transmission System Operators for Gas (ENTSOG) is the grouping of 39 gas TSOs and 2 Associated Partners from 24 European countries and 3 Observers from EU affiliate countries to ensure early progress towards the single European gas market[77]. The organisation's objectives were defined in an EU Parliamentary

[75] More information can be found at: **http://ec.europa.eu/energy/gas_electricity/acer/acer_en.htm**
[76] 2012 Work Programme of the Agency for the Cooperation of Energy Regulators, September 2011: **http://www.acer.europa.eu/Official_documents/Acts_of_the_Agency/Publication/ACER%20Work%20Programme%202012.pdf**
[77] More information can be found at: **http://www.entsog.eu/**

Regulation[78], introduced alongside the 3rd Package Directive. ENTSOG hope to promote the completion and functioning of the internal market and cross-border trade for gas by ensuring the optimal management, coordinated operation and sound technical evolution of the European natural gas transmission network. They differ from CEER and ACER in that they take a far more commercial approach to meeting their objectives, which includes: enhancing cross-border transmission access and the promotion of gas trading; supporting interoperability of the European transmission systems; supporting development of policy to promote market solutions and security of supply; contributing to the setting of a stable public policy framework; contributing to a safe and reliable European transmission system suitable for meeting present and future transportation needs. They have set out some essential conditions that they believe are necessary to achieve a successful single gas market in Europe; these are illustrated in Figure 14.

Figure 14: ENTSOG's 'conditions' for a successful single European gas market



Source: ENTSOG

4.2 Sellers and buyers

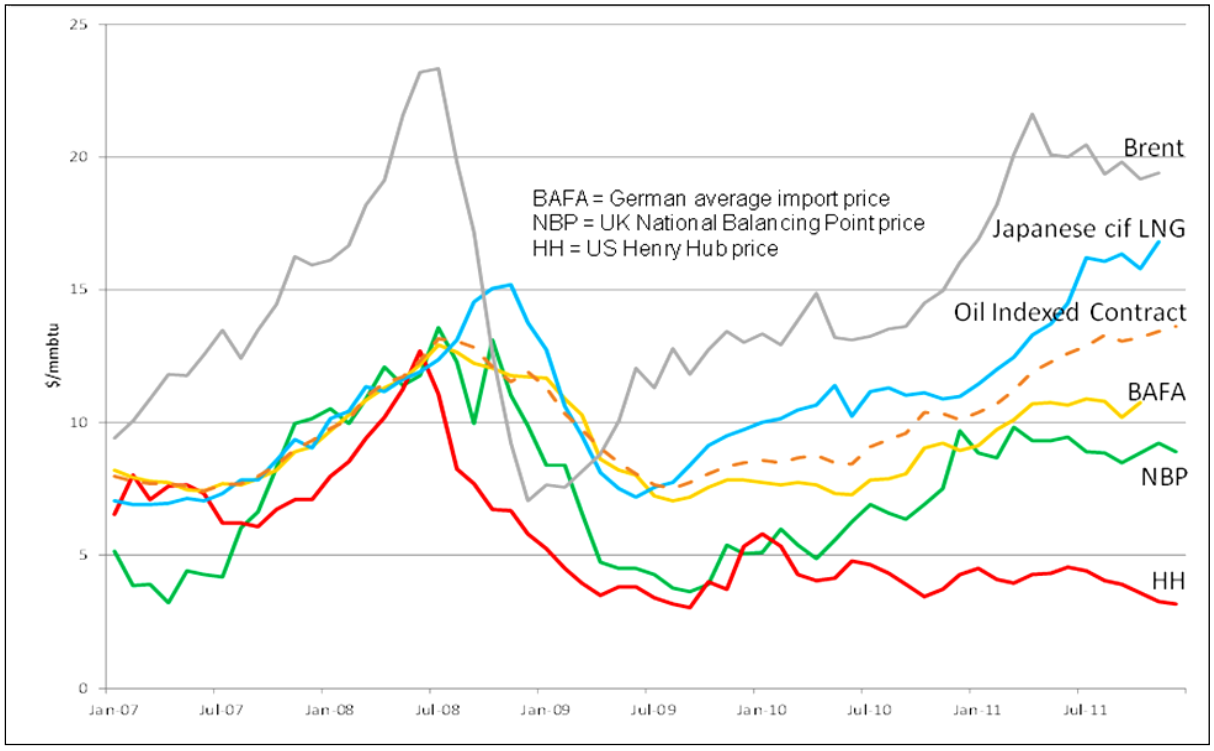
Legislation and regulation are important factors in supporting the development of the gas hubs into liberalised markets but they alone cannot create a successful new market environment without there being the desire to embrace change from the market participants. Despite many years of European Commission intervention and the issuance of Energy Directives, the Continental European gas markets failed to take off in the way the British NBP did. Change was to finally hit the Continent from early 2009 as a result of several factors combining to create the right conditions for (some) gas hubs to develop.

The recession of 2008-09 led very quickly to a major downturn in demand for gas across Europe[79], followed in the autumn of 2009 by the commissioning of the two Qatari LNG import projects in Europe[80] which then saw large volumes of LNG being imported, especially into the British South Hook terminal. Across the Atlantic, the shale 'revolution' in the US reduced North America's LNG import requirements, such that cargoes of LNG previously

[78] See European Union: Regulation (EC) No 715/2009.
[79] For greater detail see Honoré (2010).
[80] South Hook LNG, South Wales, capacity 21.5bcma; Adriatic LNG, off the Veneto coastline, capacity 8bcma.

destined for the US were diverted mainly to Europe; also, in the same period, there were several other large LNG export projects coming to market such as the Tangguh, Yemen and Sakhalin liquefaction plants, that added to the wave of surplus gas. Combined, these four factors created a mini gas 'bubble' in Europe. At the same time, world oil prices were recovering from early 2009, leading to a marked increase in the price of oil-indexed LTC gas coming in to Europe from summer 2009 onwards. Finally, there were two significant German legal decisions that galvanised the change in attitude towards traded gas markets and to gas hubs in Continental Europe: already in June 2006, the higher regional court of Dusseldorf had upheld a Federal Cartel Office decision declaring that long term contracts between E.On and its distributors were illegal and imposed limitations on the duration of any future supply contracts; then, crucially, in March 2010, the German Federal Court of Justice[81] declared that prices for natural gas for private clients were no longer allowed to be immediately linked to the price for heating oil[82]. These two pieces of legislation, along with vociferous complaints by industrial users and their ability to purchase spot gas at the hubs are key factors which caused the German end-user market to open up.

Figure 15: Global gas and Brent prices: January 2007 – December 2011



Sources: Argus, BAFA, EIA, ICIS Heren, H.V. Rogers

Figure 15 shows global gas prices over the past 5 years, expressed in $/mmbtu, alongside the price of Brent crude oil. One can clearly see the effect on gas prices of the recession, with gas prices everywhere plummeting from summer 2008 through to the summer of 2009. Then, with a 6 month lag, the price of LTC gas started to rise steadily following the rise in oil

[81] Bundesgerichtshof ("BGH").
[82] German Energy Blog, 24th March 2010: "BGH Declares Oil Price Linkage Clause in Gas Contracts Void": see article at: **http://www.germanenergyblog.de/?p=2278**
BGH ruling 61/2010, can be accessed at: **http://juris.bundesgerichtshof.de/cgi-bin/rechtsprechung/document.py?Gericht=bgh&Art=pm&Datum=2010&Sort=3&nr=51371&pos=2&anz=63**

prices. The average German import price, as calculated by BAFA[83], started to diverge from the LTC price from that point, indicating that less oil-indexed long term contract gas was being imported and more gas was being bought as spot volumes at the hubs; in turn this extra hub demand from Continental Europe increased the price of NBP, although that hub is still on average the lowest priced hub in Europe (see Figure 18).

The large wholesale energy companies are no longer simple 'intermediaries' between producers and end-users and have evolved to become energy trading companies with complex gas and power and coal portfolios[84]. They can no longer pass through their costs in their sales prices and have been forced by both legislation and consumer demand to be more competitive and to have a pricing structure that reflects the true price of gas – that shown in the open markets at the hubs. These energy companies now need to financially hedge their exposures and therefore use the markets not only to buy and sell balancing volumes of gas but also to risk manage, thereby adding liquidity to these hubs. The big change in attitude from the large energy companies is that they now recognise that liquid markets actually help them to manage their businesses.

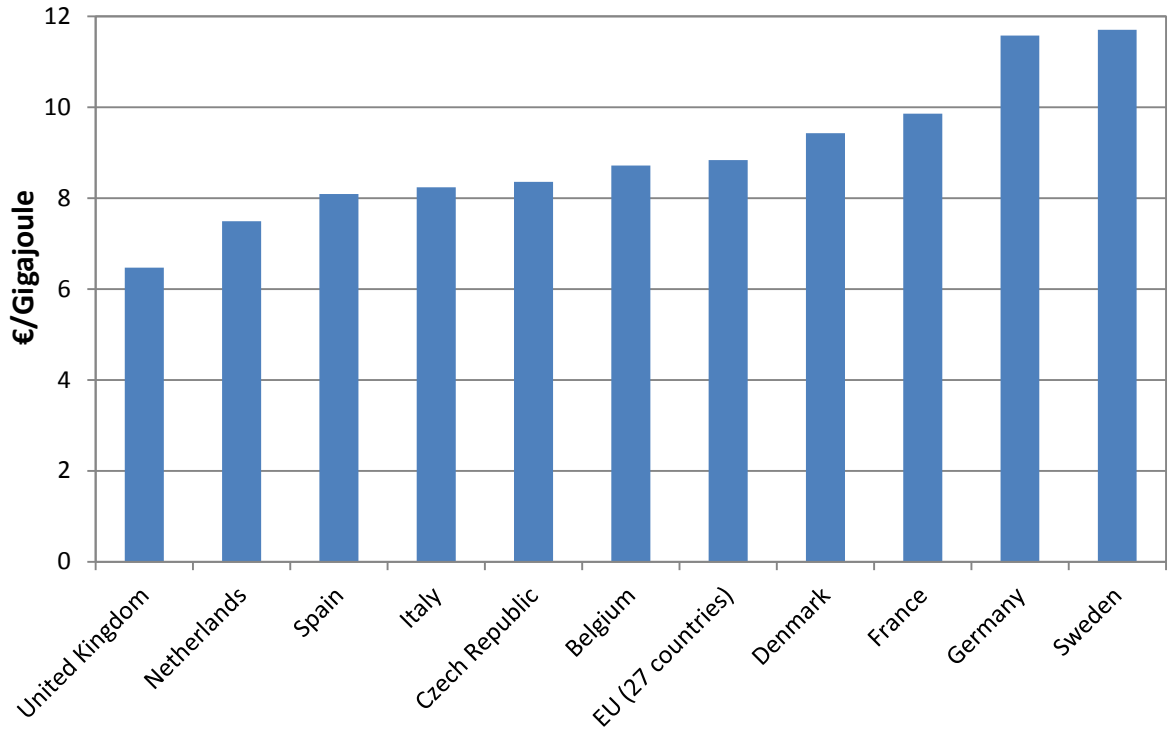
As mentioned above, end-user demand for change was crucial to the overall change in attitude across the Continent towards traded markets. As industrial users are demanding fairer pricing structures, they are switching towards hub-based contracts. This is not simply because of the decoupling of hub prices from the oil-indexed prices but because hub markets offer a more transparent, more natural way of buying energy. It is much easier for an end-user to make commercial comparisons in a hub market environment with transparent reporting of prices, easily accessible in electronic media and usually in real time. However, the larger industrials are also learning that to take full advantage of a hub market environment, they need a much deeper knowledge of the gas markets in order to take good trading decisions and many of these companies have indeed set up trading teams/departments for that purpose. Figure 16 shows how the lowest European prices of gas to industrial consumers in 2011 were in the two mature gas markets, namely Britain and the Netherlands.

Of course, larger multi-national companies have plant in several countries and it has been they in particular who have been fighting to see change in the way they buy their gas. Two pertinent examples were presented at a public conference[85] where Hydro Aluminium and Yara International pleaded their case for being able to purchase gas at gas market prices.

Hydro Aluminium[86], a major user of gas with 9 industrial plants across NW Europe stated that it wished for a simple and transparent gas contract structure, which would allow it to operate more efficiently. It agreed the need to keep long running 'frame' contracts as to overall volumes, thereby affording a degree of supply and demand security to the two parties, with supply contracts of 2-5 years in duration; however, it also said that there was an urgent need for flexible gas sourcing, and if necessary selling too, allowing for fast actions, and reactions, to changes in market circumstances. Finally, it put forward the dream of one hub, and having all of its European gas needs serviced by one contract, priced at one hub.

[83] BAFA = Bundesamt für Wirtschaft und Ausfuhrkontrolle = Federal Office of Economics and Export Control.
[84] For more detailed information, see: Stern/ Rogers (2011).
[85] European Gas Hub Market conference, Frankfurt, 5th December 2011.
[86] Norsk Hydro ASA is the fourth largest integrated aluminium company in the world.

Figure 16: Gas prices for industrial consumers (2011)



Source: Eurostat

Yara International[87], a major fertilizer producer has already been active in the spot gas markets since 1998 but has observed the disparities across European hubs: it is particularly worried by the low liquidity in Southern Europe and the fact that Continental hubs are still influenced by oil linked gas prices; it also feels that in some hubs producers and big players can manipulate the price level. Yara buys some 4.65bcma of gas including demand of 1.2bcma in Britain and 1.8bcma in the Netherlands and so would welcome a change in Europe to market pricing. Indeed, it too told of its dream: to have a fully liberalised European gas market without dominant players and where the price is defined by supply/demand.

The change in attitude towards trading across Europe has been primarily a 'bottom up' demand for change, but there are signs that some sellers are also prepared to change. In response to the presentations detailed above made by two large consumers of gas, there was a presentation given by one of Europe's major producers, GasTerra[88]. It said that it was responding to its customers' demands for more market pricing and that it has therefore agreed with many of them to change the point of delivery from the 'factory gate' to the TTF hub. It went on to show how it is supporting both the hub and its customers by the role it is playing in helping make the TTF more transparent and liquid. Table 1 shows GasTerra products on the TTF market even including being a Market Maker[89].

[87] Yara International ASA is a Norwegian-based chemical company, its largest business area being the production of nitrogen fertilizer.
[88] GasTerra is an international trading company operating in the European energy market, making a significant contribution to the supply of gas in the Netherlands. Its shareholding is: State of the Netherlands 10%; Energie Beheer Nederland 40%; Shell Nederland BV 25%; Esso Nederland BV 25%
[89] Market Maker: where a market participant agrees to make bid/offer spreads, within certain agreed parameters, in order to increase liquidity for all other participants.

Table 1: GasTerra products on TTF

Product range on TTF 2011	Front office	Facilitator	Start
Storage	APXENDEX	GasTerra	1st quarter 2011
Within day	APXENDEX	GasTerra	1/4/2011 Market maker 1/11/2011
Standard (OTC)	GasTerra		Existing before 2011
Non standard year	GasTerra		1/4/2011

Source: GasTerra

As well as its direct involvement in the TTF market, GasTerra proceeded to showcase the products that it now offers its customers that include TTF pricing/indexation (see Table 2). This is evidence of a positive and calculated change towards market pricing its gas portfolio in response to customer demand.

Table 2: GasTerra products using TTF Indexation

Products GasTerra on TTF 2011 delivery 2012 (non standard)	Duration years	Index	Start
baseload	1-4	TTF-QA/MA	1/4/2011
(any) fixed profile	1	TTF-QA/MA	1/4/2011
fixed profile	2,3	gasoil/fuel oil/brent	on request
temperature dependant profile	1	TTF-QA/MA	1/4/2011
alternative temperature dependant profile	1		on request
spark spread dependant profile	1		on request

Source: GasTerra

This is a significant change in attitude towards gas trading as it comes from a Dutch company selling Dutch gas. The Dutch were, of course, the first to market natural gas in the 1960s and the ones who 'invented' oil indexation as a means of marketing their new product[90]. That is why it is so important that it is GasTerra that is now committed to selling its production on the TTF or on contracts priced at the TTF hub.

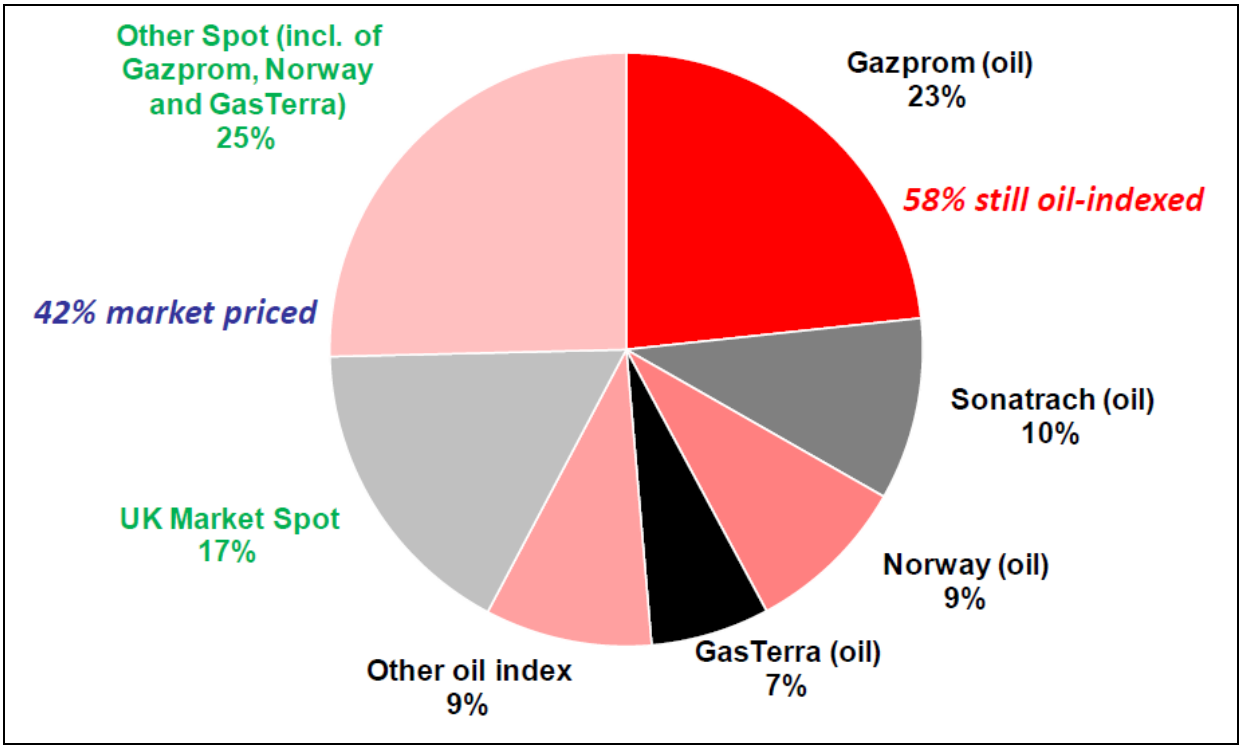
Of the other gas suppliers in to Europe, Norway is already selling a proportion of its gas at hub prices[91] and is well placed to embrace a pan-European market-priced environment as and when the change occurs. LNG is sold both at hub prices and on contracts with pricing

[90] For a history of oil indexation in gas contracts, see Stern (2007).
[91] All gas sold to Britain is market priced and a percentage of European contracts is also indexed to hub prices.

formulae, depending on where it is landed and who the seller is, but will most probably migrate towards the 'norm' of hub pricing if and when that happens. The last stumbling block to moving easily towards a market priced situation is Russia (see Chapter 5), which is for the time being holding out for the 'traditional' oil-indexed contracts[92].

Despite this, the split in the pricing of gas supplies to Europe has moved inexorably towards market pricing, as demonstrated recently in analysis conducted by the French bank, Société Générale. Figure 17 shows how in 2011, the split across Europe has moved to just 58% of gas still priced against oil indexation which means there is 42% which is market priced. The moves in Holland described above as well as the willingness of Norway to sell on a gas-to-gas basis are the main reasons for this. As more gas is sold this way, it necessarily follows that there will be more trading on the hubs, not from additional physical trades but from the trading associated with financial risk management. If the trend continues, and especially if Russia agrees to selling even part of their volumes on a gas-to-gas basis, then the volumes traded will rise rapidly at those hubs used as the reference price in the physical contracts.

Figure 17: Estimated split of European gas supply in 2011



Source: SG Cross Asset Research

4.3 Trading and Exchanges

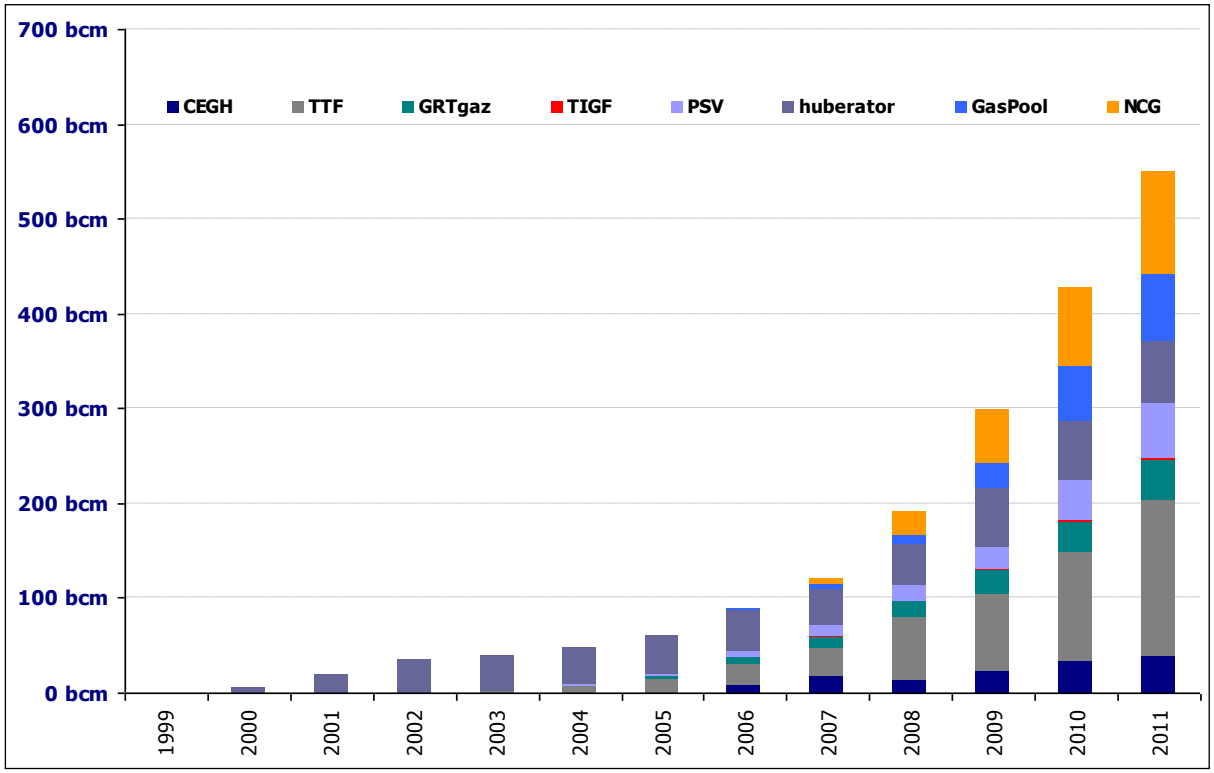
The effects of the changes in attitude discussed above can readily be seen throughout Europe in the ever-growing volumes of gas being traded at the hubs, both in the OTC markets and on the exchanges[93]. Indeed, all of the European exchanges have been instrumental in helping develop the markets by offering new products on 'easy to trade' electronic platforms.
The European gas markets have continued to develop and the situation across Europe is

[92] For more detailed information, see Stern/Rogers (2011).
[93] For a description of different methods of trading, see "Routes to Market" section p.24 in Heather (2010).

actually quite different in Q1-2012 to that of just a year ago: there have been exciting developments but also some disappointments. Progress towards traded markets has been progressively positive in the Netherlands and to a lesser extent in Germany but progress has been poor in Italy and Spain. Nevertheless, traded volumes have grown overall and in almost all markets and the exchanges are helping to create new business.

It can be seen in Figure 18 that from a purely traded volume perspective, the Continental European markets are virtually unrecognisable from just some 5-6 years ago. Indeed, since Zeebrugge started in 2000, total traded OTC volumes have gone from less than 5bcm in that first year, to over 55bcm in 2005, to over 425bcm in 2010 and last year, the total OTC volume across Continental Europe reached about 550bcm. These figures are taken from the TSOs of the respective hubs and differ in some cases from those obtained from trading sources such as LEBA. In the case of the total traded OTC volume across Continental Europe, LEBA quotes a figure for 2011[94] of 814bcm, including 600bcm for TTF, 74bcm for NCG, 28bcm for GPL and 30bcm for PEG gas; by comparison, total OTC volume for NBP was 1,159bcm. One explanation given for the discrepancies is that LEBA record all types of trades executed on a given market, including financials, which the TSOs do not see (as financial trading does not usually result in physical nominations). What this does show is that there is a substantial amount of trading being done on the TTF market which does not result in physical nominations and therefore it can be assumed that it is being done solely for risk management purposes. Whichever sources are taken, this recent growth really is impressive and shows that attitudes have changed towards an acceptance of traded markets.

Figure 18: Continental European hubs OTC volumes: 2000 – 2011



Sources: CEGH from TSO data

[94] Source: LEBA December 2011 volumes in gas power emissions and coal; conversion factors: NBP @ 10.835 TWh/bcm, TTF @ 9.826 TWh/bcm, with NCG, GPL and PEG @ 10.763 TWh/bcm.

This is phenomenal growth but, of course, represents still a small percentage of the total volume of gas consumed in Europe. This brings us to the thorny subject of 'churn' ratios[95]. Thorny because there is no standard definition of the churn and no accepted methodology for calculating it[96], leading to spurious claims by various market participants in the differing European countries as to what the churn rate actually is at any given hub. What the churn should show is the amount of liquidity in a given market expressed by dividing the total traded volume by the net traded (delivered) volume for a specific time period. However, that would only be a representative number if all the volume of the underlying commodity was traded in the market place. This is not the case with European gas as there is a very large component of 'contract' gas that is not currently part of the traded volume total and thus leads to a discrepancy when comparing figures between the various European countries. However, it is also possible to show with the churn, depending on the methodology, the uptake of trading within a predominantly contracted market place such as European gas, if the denominator is changed from the net delivered traded amount to the net delivered total amount (i.e. including gas under long term contract). This latter calculation has by and large been the figure quoted for the British NBP hub, resulting in a current churn rate of approximately 21 times and is the definition quoted by the EU 2007 Energy Sector Enquiry[97]. However, on the Continent, where traded volumes have been very low compared to the physical throughput, TSOs, Exchanges, even Regulators have taken to expressing 'their' churn rates as per the strict definition of the ratio between the total traded volume and the net traded volume: this has given some quite 'acceptable' results despite the trading element of the total delivered gas still being extremely small.

Table 3 shows the relative churn rates for some selected[98] European hubs using both criteria: according to the usual trading definition of comparing the total traded volume to the net delivered traded volume, giving what is termed a net re-trading ratio; and according to the EU approach of comparing the total traded volume to the net delivered total amount, represented by the hub area's physical demand[99] volume, termed the "gross market churn". These can be used to compare the hubs, and to see the progression of trading within each hub from Quarter 1/2011 to Q1/2012.

What we observe is that, whilst the physical demand figures were slightly lower on warmer average temperatures, there was a marked increase in traded volumes in almost every category and country; the one notable exception being France. When using the same methodology across each of the representative countries in Table 3, it is clear to see that there are indeed only two hubs that can be called 'mature' ; the others being much less developed on this quantitative basis.

[95] Churn, churn ratio, re-trading ratio: A measure of the number of times a 'parcel' of a commodity is traded and re-traded between its initial sale by the producer and final purchase by the consumer. The 'churn' is a good measure of a given market's liquidity and depth and, as a general indication, commodity markets are deemed to have reached maturity when the churn is in excess of 10. Also, see Glossary.
[96] This is certainly the subject of another paper!
[97] EU Energy Sector Enquiry 2007, p.34, para.70, note 52: "'Churn' here means the ratio between total volume of trades and the physical volume of gas consumed in the area served by the hub": **http://ec.europa.eu/competition/sectors/energy/inquiry/full_report_part1.pdf**
[98] These are the 5 hubs that have futures contracts and also account for 96.41% of total European OTC trades.
[99] Note: 'Demand' is not 'consumption' and includes gas needed by the system to balance domestic consumption and exports to storage or to system exit points for onward transportation.

The gross market churn at the NBP, rising from the mid-to-high teens in 2010-11 to the current low 20's is once again at the level that the market had first reached back in 2001. The gross market churn at the TTF has grown rapidly since about 2009-10, when it was in the order of 3, to being very nearly 15 today. On this methodology, the German and French hubs are demonstrably immature, registering gross market churn rates of about 1.

Table 3: Selected European gas hubs: "net re-trading ratio" and "gross market churn" – Quarter 1/2011 and Quarter 1/2012

Volumes in TWh	Σ OTC (less cleared)	Σ Exch. futures	Σ Exch. spot	Σ Traded	Net traded	Re-trading ratio	Σ Demand	Gross market churn
NBP 11	3855.20	1346.05	31.83	5233.08	156.83	**33.4**	313.67	**16.68**
NBP 12	4229.93	2042.37	32.84	6305.14	147.62	**42.7**	295.25	**21.35**
Δ Britain	**+9.72%**	**+51.73%**	**+3.17%**	**+20.49%**				
TTF 11	1468.83	117.37	1.03	1587.23	50.13	**31.7**	151.91	**10.45**
TTF 12	1974.19	142.44	4.50	2121.13	49.12	**43.2**	148.86	**14.25**
Δ Holland	**+34.41%**	**+21.36%**	**+4.37%**	**+33.64%**				
NCG+GPL 11	233.74	7.11	5.19	246.04	48.11	**5.1**	320.74	**0.76**
NCG+GPL 12	386.79	11.60	8.05	406.44	46.19	**8.8**	307.91	**1.32**
Δ Germany	**+65.48%**	**+63.15%**	**+55.11%**	**+65.19%**				
PEGs 11	105.42	47.44	5.89	158.75	29.10	**5.4**	194	**0.82**
PEGs 12	71.49	19.96	9.27	100.72	27.94	**3.6**	186.24	**0.54**
Δ France	**-32.18%**	**-57.92%**	**+57.38%**	**-36.55%**	**'Net traded' (as % of total demand): Britain @ 50%; Holland @ 33%; France and Germany @ 15%.**			
GB/NL/D/F 11	5663.19	1517.97	43.94	7181.16				
GB/NL/D/F 12	6662.40	2216.37	54.66	8878.77				
Δ GB/NL/D/F	**+17.64%**	**+46.01%**	**+24.40%**	**+23.64%**				

Sources: LEBA volumes in gas power emissions and coal: Jan, Feb, Mar 2011 and Jan, Feb, Mar 2012; TSOs; Intercontinental Exchange; author's calculations.
Note: See Appendix N for the calculation of the physical demand figures.

Interestingly, when using the re-trading ratio methodology, these last two countries register average figures of 7 and 4.5 respectively over the past year. Although still not very high, these are similar to the churn rates we are used to seeing quoted by the TSOs and others for those countries. Both methodologies have their merits but they should not be quoted interchangeably as they do refer to very different underlying market definitions.

Table 3 therefore shows that there has been a large increase in traded volumes (OTC, exchange futures and spot) but it is only in Britain and Holland that the total traded volumes are large enough to indicate a representative churn well over ten times and so classify those markets as 'mature'.

There are some quite important differences emerging between the development of the various hubs in terms of their OTC traded volumes as well as exchange and spot trades and, together, the proportion that trading represents in the total gas demand of each area. NBP is still by far the leader in all respects, although other hubs are growing fast and TTF is already 1/3rd the size of NBP on the basis of the volume of trading. The one big exception is France, where despite a growth of over 57% in spot trading, there was a similar fall in exchange futures and about a third less OTC trades, resulting in the total amount of gas traded at the PEGs falling by over 36% from Q1-2011 to Q1-2012. This might be an early indication that French shippers are using the PEGs to balance their portfolios but are not risk managing at the French hubs. The situation in Germany could be misleading, as the trading volume numbers rose between 55% and 65% but the gross market churn was only 1.3, indicating that there would need to be significant increases in the future to bring Germany up to par with Holland or Britain.

The liquidity of a traded market is crucially important. NBP has led the way for many years but TTF has been catching up and even briefly overtook it in the Heren Tradability Index[100] which measures the bid/offer spreads[101] along the whole trading curve at the various hubs. This is a useful measure of liquidity. When there are many market participants wanting to transact, the competition they create narrows the difference between the bid price and the offer price of any given contract. This encourages further trading as there will be greater confidence that the price achieved will be at or close to the price indicated before a new trade is initiated. Conversely, if there are few traders wanting to transact, the bid/offer spread will be much wider and so a potential trade will be harder to conclude at the expected price. In Q1-2012, NBP again leads with a maximum 20/20[102] and TTF has 19/20; third place goes to NCG (16/20) which has been improving fast but the PEG score (13/20) is not reflected in its poor traded volumes. The other hubs are still some way behind and PSV does not score at all. What these scores clearly demonstrate is that there is good liquidity all along the traded curve at the NBP and TTF hubs where there is already a sizeable volume of risk management trading being done. At the other extreme of PSV and CEGH (4/20) the bid/offer spreads are much wider along the curve implying that there are a limited number of participants wishing to transact.

An interesting development is that, despite there being an increasing disparity in traded volumes between the hubs, the price correlation between them is very tight. This shows that some of the hubs are being used for price risk management whereas others are simply being used to balance shippers' portfolios, especially as 'delivery day' approaches. Shippers can do this safe in the knowledge that they can risk manage at a high volume hub and benefit from the added liquidity and ease of trading there, whilst managing their volume risk locally on their own hub which is trading at or very near the same price.

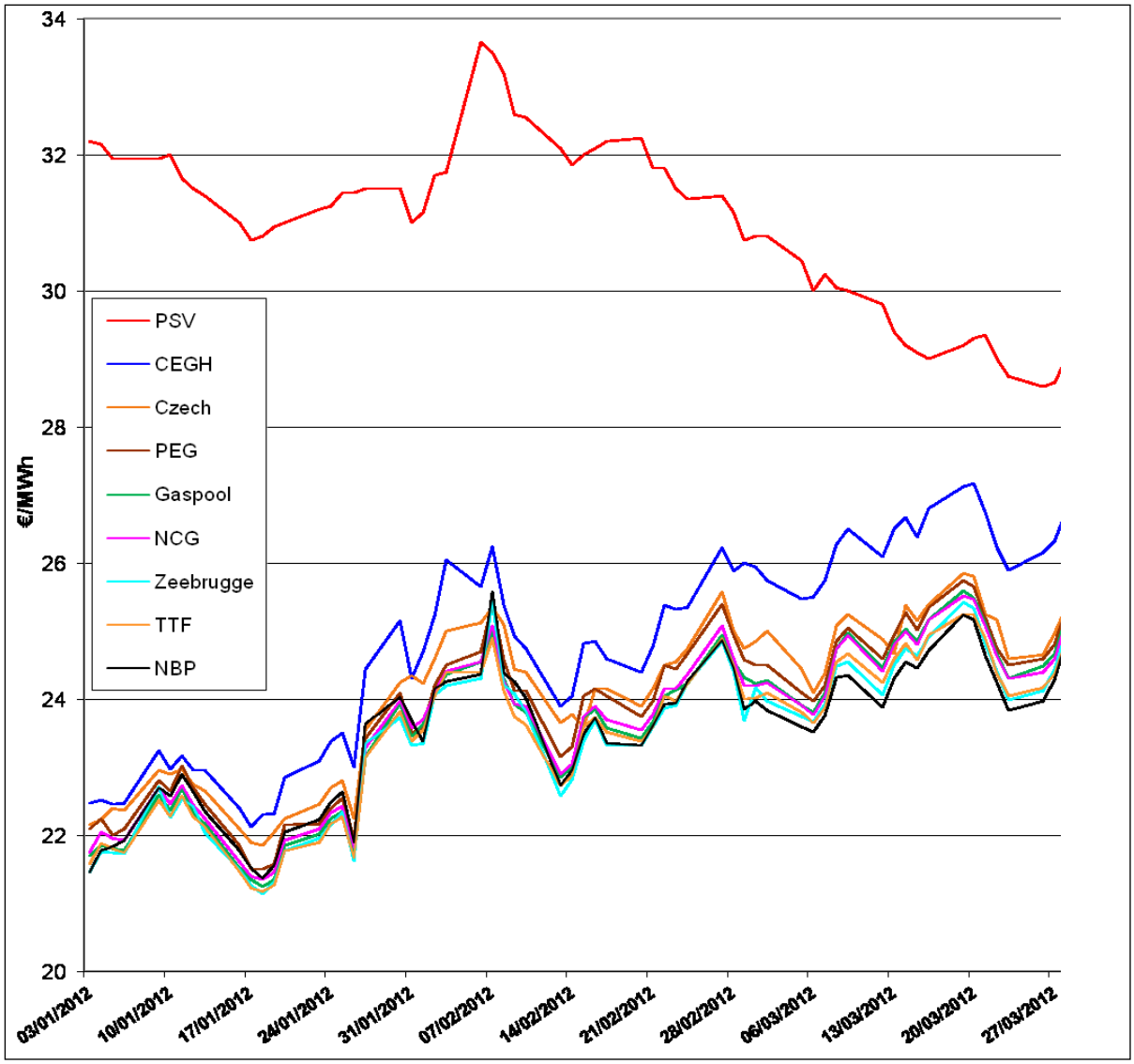
There are two notable exceptions to the price correlation across NW European gas hubs (see Figure 19): the Austrian CEGH hub and the Italian PSV hub. PSV has always been higher priced than the rest of the hubs since it started in 2003; CEGH had also been a little higher than the rest although it seemed to have aligned itself by 2011. However, since early 2012, it is apparent that CEGH is being pulled higher and PSV is being dragged down. One explanation for CEGH being at a premium to NCG is that large quantities of Russian gas

[100] See AppendixO for the ICIS-Heren Tradability Index chart for Q1-2012
[101] The difference between the bid/buy/buyer price and the ask/offer/seller price in the trading quote.
[102] The Index is quoted as a score out of a maximum 20 points: the full methodology can be viewed at: **http://www.icis.com/energy/gas/europe/hub-report-methodology/**

coming through Baumgarten in Q1-12 and intended for Germany were redirected and sold to Italy; indeed Germany has even been exporting gas to Austria. This price arbitrage is therefore being traded and the gap in hub prices between Italy and Austria is starting to narrow.

Despite the range of prices between the NW European hubs being within about ½ to 1€/MWh, it is also apparent that most of the time, the two most intensively traded hubs (NBP and TTF) have the lowest prices, with the lowest traded volume hub, PEG, being dearest.

Figure 19: European Month Ahead prices: Q1-2012

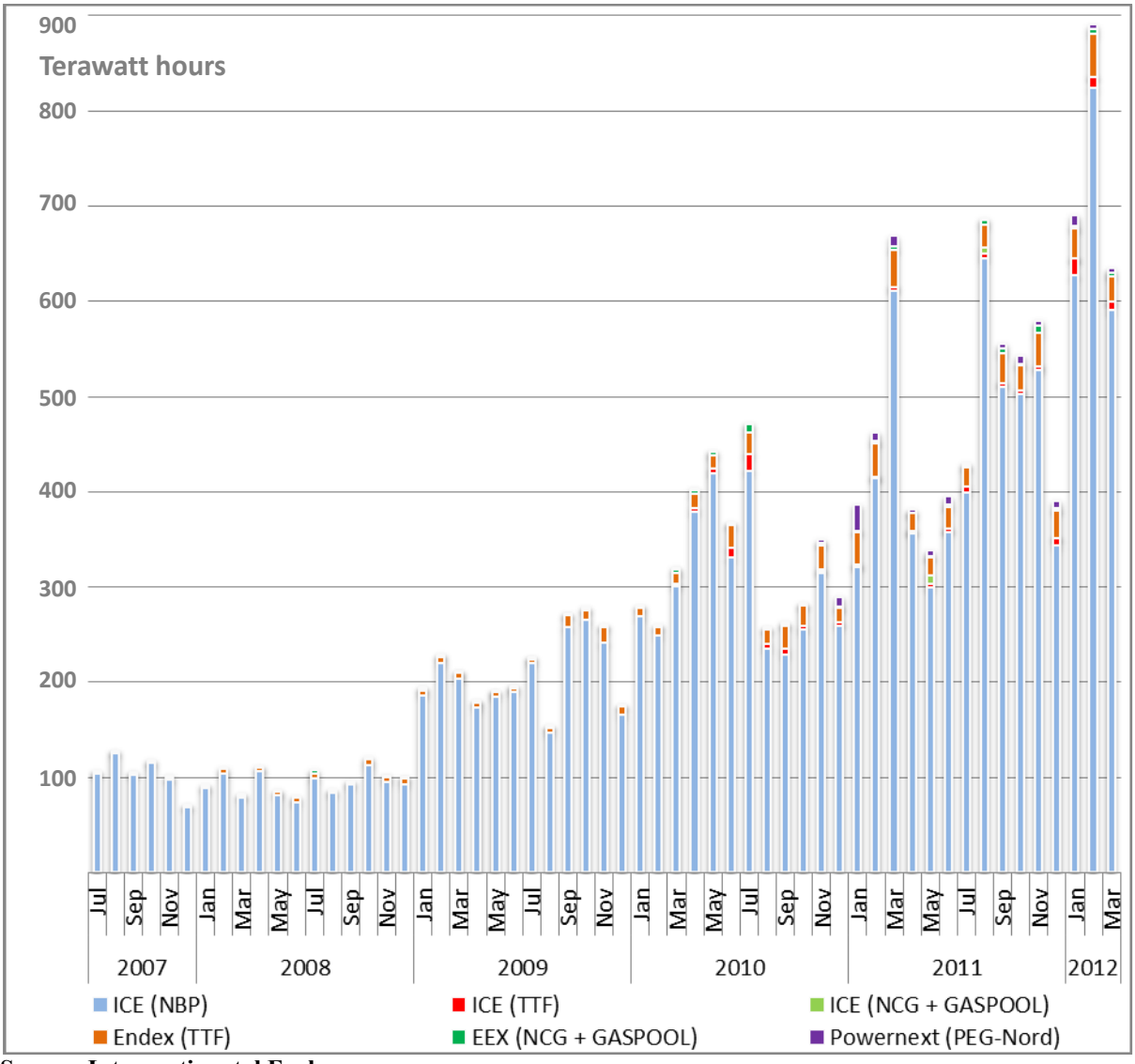


Sources: ICIS-Heren, P. Heather

Another important aspect of trading is the part played by the exchanges, offering futures contracts on 5 of the hubs: NBP, TTF, NCG, GPL and PEG Nord. These are provided by 4 exchanges: ICE, Endex, EEX and Powernext respectively, although ICE now also offers contracts for the TTF and German hubs. As with OTC trading, volumes on the exchanges have grown rapidly since 2009 (see Figure 20) and, as with the OTC market, it is a very different story across Europe: the established NBP leads the field by far, TTF is second, followed by PEG Nord but there is very little exchange trading on NCG and Gaspool.

However, the exchanges themselves have a commercial impetus to help the hub markets develop and they have many marketing tools to assist them in their goals. The Dutch exchange, APX-Endex claims to be the "largest gas exchange for Continental hubs", which is backed up by its trading figures for the first 3 quarters of 2011, showing: Endex TTF - 212TWh; Powernext PEG - 72TWh; ICE TTF/NCG/GPL - 43TWh; and EEX NCG/GPL - 18TWh. It is keen to assist the TSO in the development of the Dutch Gas Roundabout and to this end is also ready for market coupling. APX is very important to both the British and Dutch gas grids as it provides balancing services for both markets.

Figure 20: Exchange traded European natural gas volumes: 2008 – 2011



Source: Intercontinental Exchange

The Austrian CEGH exchange is working with the regulator to provide trading services for the new VTP due to start in January 2013. For that, it will develop a market based balancing platform and in future hopes to provide a cross-regional balancing platform.

The German EEX is trying hard to develop curve trading for the German hubs and will launch in 2012 an OTC clearing service. It also established in early 2011 the EGIX, an index based on 'all German' prices, quoted on NCG and Gaspool, in the hope that it might be used as a market indicator in the LTC formulae. This has not proved to be a success, probably because the focus is now on trying to change the LTCs completely in their construct rather than to 'tinker' by introducing new components to already complicated formulae.

The British ICE is consolidating its premier position in European gas trading and has steadily increased its European futures contracts as well as continuing to promote the 'original' NBP futures, launched in 1997. It launched NBP gas options in February 2011 and over 204,000 lots had traded by the year end. This contract is still growing with nearly 50,000 lots traded in March 2012, with a month-end open interest figure of 134,750 lots. The NBP futures contract remains very successful and traded 672,405 lots in March 2012, an increase of 22% compared to the previous year. It renewed its Market Maker scheme for the TTF contract which is slowly growing but remains very small in comparison: in March 2012, 11,850 lots traded but a new open interest record was set at just short of 40,000 lots. However, their NCG contract is faltering.

The French Powernext has also been very proactive in trying to get the French PEGs to develop but, despite its many efforts, volumes have fallen in Q1-2012 by a staggering 58% compared to the same quarter the previous year. It is keen to publicise its good relationships with the two French TSOs, with whom it has devised new products: in April 2007 it first offered GRTgaz market based balancing, followed in July 2011 by the innovative 'virtual' Nord/Sud market coupling, backed by GRTgaz. Since January 2012 TIGF has started balancing interventions in its zone. Powernext has also promoted Market Maker schemes to help gain liquidity but with limited success.

Finally, with the ability on some exchanges to 'clear'[103] (or to 'give up' (for clearing)), OTC trades in order to avoid counter-party credit risk, the share of exchange trading has been growing especially in Britain but also on the Continent. The exchanges will continue to play an important role in the development of European gas trading.

5. The future of the gas hubs in a Market Priced Europe

5.1 Contracts

Any review of the future of gas hubs in a market priced Europe must also address the future of existing Long Term gas Contracts. This topic has been hotly debated for a few years now and despite the erstwhile prevailing view that oil-indexation would remain on the Continent, in reality since 2008 the situation has already started to change and, in 2012, is at a pivotal point in the transition towards 'new style' market priced contracts[104]. This transition will be a painful one as were its precedents in North America and Britain but it is a change that increasingly appears to be inevitable[105]. Why are 'new style' contracts so important? As explained in section "4.2 Sellers and Buyers" above, the large Continental wholesalers and distributors can no longer pass through an oil- indexed price to their gas buyers. The losses

[103] Clearing: Term used in the futures markets to describe the process of anonymously matching buyers and sellers who trade on the Exchange or who trade OTC and then ask for the deal to be 'given up' for registration.
[104] For a full account of the move from oil-indexation to market pricing see Stern/Rogers (2011) .
[105] Idem

incurred by the large gas importers from buying oil-indexed gas at prices higher than the hub related prices that they sell to their customers are significant and unsustainable at the levels seen in 2011 and 2012. Most importers are in negotiations with their suppliers and some have taken their cases to arbitration. The crucial point here is not the absolute price level differential but the imbalance in the price formation of their upstream contracts versus their downstream ones. Klaus Shaefer, C.E.O. of E.On Ruhrgas made three important quotes at the 2010 Offshore North Sea conference[106] when he stated that "hubs are the reference point when customers talk to us"; that "LTCs in their current form no longer reflect the market"; and that "We have to re-engineer the LTCs to anticipate the future needs of the market: price levels, indexation and review mechanism". As Stern/Rogers state in their Paper[107]: "Our argument is that a single price formation mechanism needs to be established which will be the same for all gas buyers, with differences reflecting either transportation costs or entry/exit tariffs; that mechanism is hub-based pricing". How long the transition will take is uncertain but competitive forces will favour the transition to gas-to-gas pricing.

In Britain, the transition phase was completed some time ago[108] and all of its gas supplies are priced against the NBP[109], whether contracted gas or traded gas. The new contracts have been largely motivated by security of supply needs and therefore concentrate on securing volume rather than securing price. These are still bilateral, negotiated deals but are now conducted within the competitive market framework that exists in Britain, with gas usually delivered at the NBP on a "flat" basis with limited force majeure on both parties, even in the event of upstream problems. Those supply contracts which are in the public domain, are of 8-10 years' duration and the price is invariably indexed to the NBP. This type of contract is now widely used in Britain, where the IEA estimated in 2007 that just over 50% of the gas consumed in the UK had been traded[110]; as far as can be ascertained, this figure has remained fairly steady since.

5.2 Balancing and marginal volumes

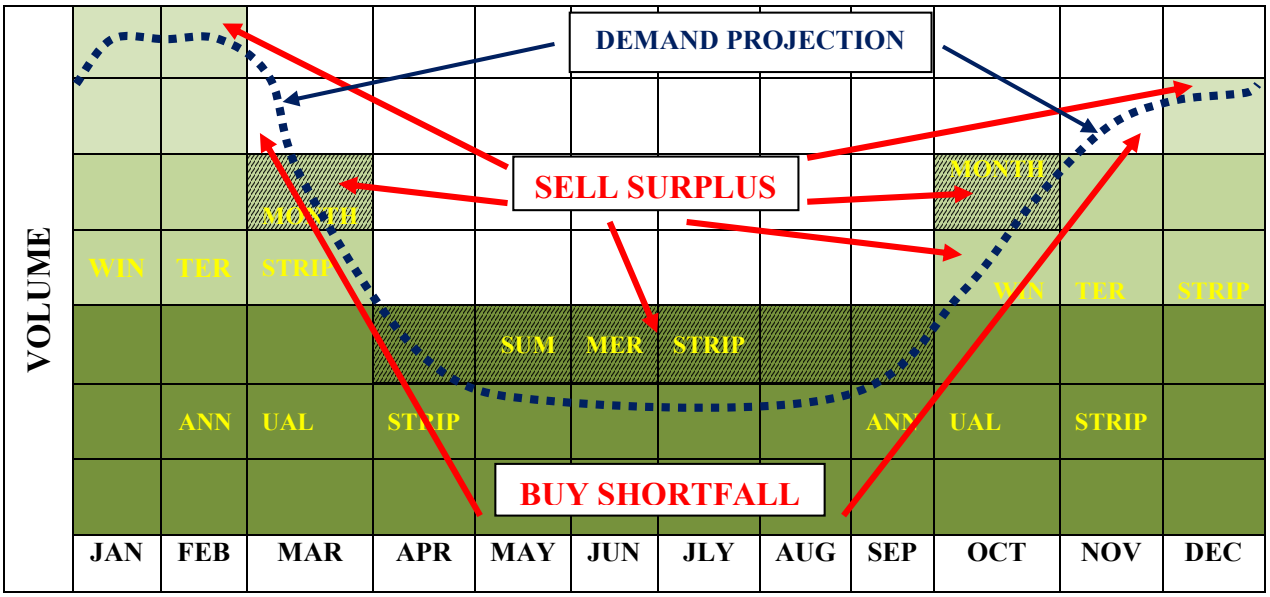
As the hubs increasingly provide the mechanism needed to take European gas trading to a market priced environment, the bulk of the trading in volumes, especially along the curve, will be done for risk management purposes, allowing market participants to hedge their portfolios one, two or more years in the future. The physical volumes may still be, by and large, traded on 'new style' LTCs but with the pricing calculated at the time of delivery against an agreed reference point, usually a hub's Month Ahead or Day Ahead Index. Both buyers and sellers will want to trade at the hubs but their trading will be at differing times and for varying volumes, thereby creating the initial liquidity. Liquid markets attract non-physical players and in turn the trading that they generate creates yet more liquidity, i.e. a virtuous circle forms.

If the new LTCs are of a similar construct to those in Britain and are for 'flat' volumes of gas, then both the sellers and the buyers will 'layer' volumes of gas to create their overall selling/buying needs, rather than relying on Force Majeure, contractual flexibility and Take or Pay clauses. As can be seen in Figure 21, marginal volumes are then bought and sold either side of the contracted volumes to balance the portfolio in ever greater precision as the

[106] Klaus Shaeffer's speech can be seen at: **http://www.ons.no/index.cfm?event=doLink&famId=129516**
[107] See: Stern/ Rogers (2011): Summary and Conclusions, p.36, para. 2, note 101.
[108] For a description, see the "Bilateral Contracts and Their Indexation" section, p.29 in Heather 2010.
[109] As confirmed in discussions with market participants.
[110] IEA 2007 Natural Gas Review, p.208; FSA energy market review, 2009.

delivery day approaches. In this example, the Gas Company has forecast its demand over the next year and has bought for its trading portfolio three Annual gas strips, two Winter strips, two 'Jan+Feb' and one 'Dec' monthly contracts. This overall 'layering' of contracts to meet the projected demand is easy to achieve in a liquid market and can then be 'fine-tuned' as the actual demand varies from the projected one. In this case, Gas Company has re-sold a Summer strip (from the Annual gas previously bought) and two months, March and October (from the Winter gas bought) and will also 'balance' in the spot market its surpluses and shortfalls throughout the year. Of course, as gas trading becomes a normal commercial activity, shippers can and will buy and sell short term gas to balance their requirements. Indeed there is anecdotal evidence that many Continental European companies have already traded marginal volumes of gas at the hubs and some have even set up trading desks.

Figure 21: Portfolio 'layering' example



Source: P. Heather

It is the 'fine tuning' of their portfolios that will make shippers enter the markets regularly with varying quantities to trade, in this case at the prompt/spot end of the trading curve.
Balancing may also need to be done by the TSO for safety reasons but minimal intervention is likely to be required if the market is working well; this has been the case in Britain and also, recently in Holland, despite their 'real time' balancing regimes.

Not all the existing hubs will grow to become pricing, or benchmark, hubs as the total market volume needs to be concentrated in just a few locations for a traded model to be efficient and effective. However, because of the tight price correlation between most neighbouring Continental hubs and the need for shippers to balance their portfolios near delivery, there will likely be as many hubs in ten years' time as now, but some will be used for risk management, and others just for balancing. It will be those few hubs that participants use for risk management that will become the benchmark hub(s).

5.3 Benchmarks in a European network of market priced gas

Against this background there is a strong case for Continental European gas LTCs to be re-engineered but negotiations and arbitrations are now underway and the gas markets are changing. This is a consumer led change but to work, the new style market priced contracts will require robust and reliable marker prices. A credible marker hub must have good liquidity from spot to several years forward; it must be transparent, fully open and accessible to a wide range of participants. The most liquid of the European hubs will be those with the most traded volumes and it is likely that one or two of these will then become 'benchmark' hubs, which will be used to price gas delivered to other regions or countries.

The Gas Target Model[111] contains a suite of recommended steps to achieve a single EU gas market by the 2014 deadline as set by the European Council and, although this timescale is acknowledged by some to be unrealistic, it is hoped that there might be 7 regional markets in place by then. With this framework being aimed for by the regulators and with the continuing move in NW Europe towards market priced gas, then it is feasible to envisage 5-7 regional markets in future.

When looking at the development of the various Continental hubs and considering their plans for future growth, a future European gas trading landscape could be as follows:

- British Isles and the Channel LNG ports: The NBP is firmly established after over 15 years of a liberalised market and will continue to provide a benchmark price for all gas supplies to Britain and Ireland, priced in Sterling. In addition, it will continue to be used to price LNG imports, not only to Britain but possibly also to other Channel ports such as Zeebrugge, Gate and Dunkerque.

- North West Europe: A 'front runner' candidate to be the leading traded hub in this region already appears to be emerging, the Dutch TTF hub. If its recent growth continues and it continues to consolidate on its relative advantage over neighbouring hubs, then TTF is likely to become a benchmark hub, priced in Euros, for gas supplies to Benelux, Germany and France.

- Central Europe: This region is 'sandwiched' between the 'old' and 'new' worlds in gas trading terms, as well as being a vital importation point into western Europe for Russian gas. If the CEGH does achieve its goal in truly becoming a *central European gas hub* then it is certainly possible that it could become a benchmark for gas supplies to Austria, Slovakia, Czech Republic, Hungary, Slovenia and, possibly, Italy (but see below).

- Southern Europe: In the context of gas markets, it is very unlikely that Spain and Italy would ever be linked;

    - Spain's gas market is isolated geographically and commercially from the rest of Europe, its traded market is struggling to get started and the country is over-contracted with supplies of LNG and pipeline gas, mainly from North Africa. In one sense therefore, it could be deemed to already be a separate region in the context of the Gas Target Model.

[111] See section 4.1 "legislation and regulation" above.

- Italy on the other hand is better connected to the rest of Europe by pipelines as well as having a variety of imported pipeline gas from the south and LNG import facilities. It currently receives most of its gas needs through the two major pipelines from the north, the TAG[112] from Baumgarten, today bringing Russian LTC gas (but this could change), and the Transitgas[113] pipeline from Switzerland, bringing North Sea and Dutch gas via the TENP line and the French connection. An important potential development that could lead to Italy becoming a benchmark hub are plans to build reverse flow capacity into the Transitgas pipeline[114] which could see in future years gas imported to Italy from Algeria, Lybia, LNG (and possibly South Stream) flowing to northern Europe. Italy already has a diverse gas supply portfolio and this could become even more flexible in future, putting it in a good position to be a regional hub.

- Eastern Europe: There is still very little trading of gas in eastern Europe, with the majority of supplies being met from LTCs, mainly from Russia. However, there have been some important moves to creating a more diverse gas supply to Poland, to Lithuania and the region generally:

  - Poland has been very keen to diversify its supplies and to that end is building an LNG terminal in the north-west of the country close to the German border; the Polskie LNG terminal at Świnoujście[115] should be completed by the end of June 2014 and will have an initial export capacity of 2.5bcma, rising in later stages depending on demand, to 5bcma or even 7.5bcma. Polish gas consumption is around 16bcma. There have also been infrastructure improvements to allow the reverse flow of gas from Germany to Poland. Finally, the prospect of being able to tap in to Europe's largest reserves of shale gas[116] has brought many IOCs and independent energy companies to the country and extensive exploration is under way. Unfortunately, initial exploration results have been disappointing and estimated reserve levels have been adjusted down[117]. The Polish regulator is contemplating starting a gas exchange to promote the trading of gas in the country and to help set an independent gas price. All of these projects could not only help give Poland more security of gas supply but also help diversify the supplies of gas to the Baltic States, the Czech Republic, Hungary and Slovakia.

[112] Trans Austria Gasleitung GmbH: a pipeline system consisting of three lines, five compressor stations, auxiliary equipment and several Intake and Offtake Points, from the Slovakian - Austrian border near Baumgarten to the Austrian - Italian border near Arnoldstein and covering a length of about 380 km. It is owned and managed by Cassa Depositi e Prestiti (CDP) (89%) and Gas Connect Austria (11%).
[113] Transitgas AG: a pipeline system crossing central Switzerland and the Alps from north to south, connected to France in the west and covering a distance of about 220 km. It is owned by Swissgas AG (51%), FluxSwiss (46%), and E.ON Ruhrgas AG (3%).
[114] Petro Industry News, February 29th: "Transitgas pipeline could flow south to north": **http://www.petro-online.com/news/flow-level-pressure/12/breaking_news/transitgas_pipeline_could_flow_south_to_north/18916/**
[115] For more information see: **http://en.polskielng.pl/terminal-lng-w-polsce/**
[116] See Appendix P for table of European shale gas reserves; source: EIA (2011).
[117] Bloomberg: "Shale Boom in Europe Fades as Polish Wells Come Up Empty", March 26, 2012.

- Lithuania has recently signed agreements to give it 'total' gas independence[118].It is building its own LNG receiving terminal at Klaipeda where it will install a Floating Storage and Regasification Unit leased over ten years from Norway's Höegh LNG from late 2014, with a capacity of 2-3bcma. To supply it, Klaipėdos nafta[119] has signed a memorandum of co-operation with the US company Cheniere Energy, to guarantee gas supplies to Lithuania from 2015 at a price 30% lower than the price for which gas is bought from Gazprom.

There is still a very long way to go before there is a vibrant traded gas market in eastern Europe but there is certainly scope, in time, for a regional hub.

- South East Europe: Both Greece and Turkey have expressed interest in developing their gas markets and in providing a gas hub for the region. Until now however, there have been many political, commercial and logistical reasons why this is not really practical. The opportunities are not diverse enough to create trading potential and to attract market participants; this is primarily because of a lack of infrastucture and of supply optionality which would help create a market. There are several pipeline connections planned which could alter the situation in future but the formation of a market is still unlikely to happen this decade. In the meantime, it is more feasible that south eastern Europe will have gas priced at a differential to one of the the other regional hubs, such as Italy, central Europe or even eastern Europe.

6. From the 2010s to the 2020s and beyond

6.1 Commercial prospects for the European gas market

This is a particularly interesting time for observers of the European gas markets: the post-recession dip in energy demand has reversed the concerns of only 5 years ago regarding "where is the gas going to come from?" Globally, as energy intensity lessens, the respective shares of world primary energy sources are converging to ~27% each for the carbon fuels (coal, oil and gas) and ~7% each for the 'clean' fuels (hydro,nuclear and renewables)[120]. This implies that global gas demand will continue to rise over the next 15 years or so.

In Europe the picture is somewhat different, as can be seen in Figure 22; projected demand for gas will rise only very slowly, with some 80% of growth coming from the power sector[121]. In turn, the demand for power is very much dependant on economic growth and the outlook is weak to the mid-teens at least.

Markets will therefore be increasingly important in helping parties to manage their gas portfolios and optimise them both physically but especially financially. Even during the transition period from old world LTCs to new style contracts, as a greater percentage of volume is priced against gas rather than oil, there will by necessity be an increase in the volumes traded on the hubs for risk management purposes.

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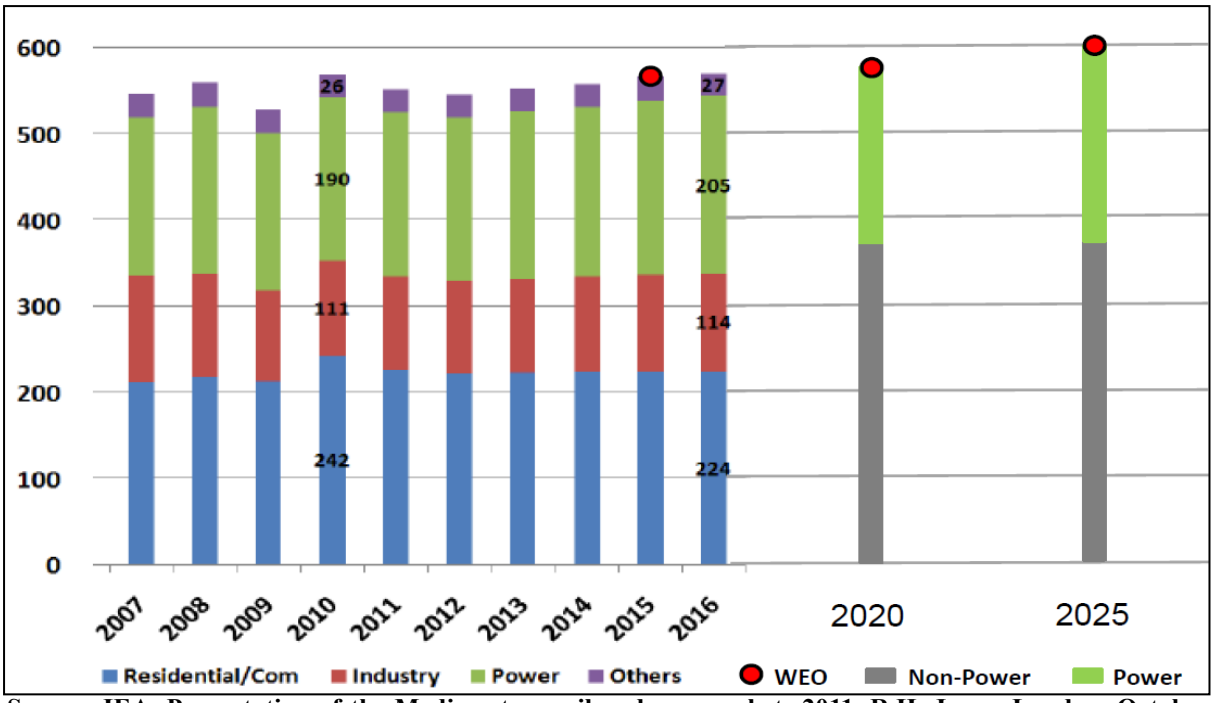
[118] OSW-Centre for Eastern Studies 7th March 2012: "The Lithuanian LNG terminal in Klaipeda is to be operational in 2014": **http://www.osw.waw.pl/en/publikacje/ceweekly/2012-03-07/lithuanian-lng-terminal-klaipeda-to-be-operational-2014**

[119] For more information see: **http://www.oil.lt/index.php?id=lng&L=1**

[120] BP Energy Outlook 2030; see Appendix P for relevant graph.

[121] For a detailed account of future European gas demand, see: Honoré (2010).

Figure 22: Gas demand in Europe, by sector, in bcm: 2007-2025



Source: IEA, Presentation of the Medium-term oil and gas markets 2011, R.H. Jones, London, October 2011; WEO New Policy Scenario 2010

These traded volumes will be made up of traditional OTC contracts, of exchange futures contracts and also of financial contracts. This last category took quite some time to establish itself in the British market and has only started to show strong growth since about 2009, and more so since the ICE opened an options contract on NBP futures in March 2011. Banks and trading houses are actively promoting bespoke products including option strategies and swaps, all of which are financially settled at maturity. There is anecdotal evidence from brokers and traders alike that these products are now also being offered on the TTF market and, should another hub emerge as a pricing reference (CEGH?/PSV?) in future, then there will already be an existing trading model to copy, which should mean that any future such hub should establish itself more rapidly than the time it took NBP or TTF.

Of course, as Continental Europe moves away from oil indexation and embraces gas market pricing, along with the policy makers' wishes for more regional markets, there will be an even greater need than at present to strengthen the gas infrastructure to allow for the free flow of gas according to both physical requirements and also pricing signals. From a purely trading point of view, the more flexibility there is in the transportation system, the more optionality there is to trade between hubs and to arbitrage differentials, thereby equalising both the price and the volumes across areas larger than the individual hubs. Some of these changes will result from legislation linked to the Gas Target Model and some from commercial investment by system operators or even shippers.

The European Commission's vision of a single European gas market may never be fully attainable but the creation of regional hubs is a distinct possibility, as set out in chapter 5. After the already established British region and the fast emerging North West Europe region centred on TTF, further progress is likely to develop south and east over time, all the while adding greater flexibility and therefore commercial opportunity for the European gas community.

Lastly, the European gas market is going through a period of transformation. When it emerges in the mid to late 2010s as a fully competitive market with some 600bcma of demand being met by many different sources of supply, and with the ability to move gas around relatively easily from region to region, it is then that the real value of a few major, successful, traded hubs will be felt. In addition, with Europe placed between the North American and Asia-Pacific regions and hence able to participate in arbitrage via flexible LNG flows, I believe that its commercial prospects in gas trading are very positive indeed.

7. Summary and Conclusions

At the start of this paper I asked whether the Continental European gas hubs are ready to offer credible price creation, discovery and reference points, i.e. are they fit for purpose?

The past ten years or so have seen much development in the European traded gas markets culminating in some significant changes since about 2009. However, not all the hubs have developed in the same way or at the same pace. In 2012 we observe that Britain's NBP is at the forefront, with a liberalised, fully mature traded market, offering reliable marker prices. In Continental Europe TTF has emerged as the pre-eminent hub. Britain's gas supplies are by and large all market priced whereas Continental Europe has lagged behind with most of its supplies still on LTCs which have oil indexation formulae as their pricing mechanism.

In ten years' time, there will probably be as many gas hubs as currently, possibly even new ones in eastern and south eastern Europe but, importantly, they may not necessarily all be 'marker' hubs for the pricing of physical gas supplies. It is most likely that there will be a limited number of very liquid and high volume traded hubs, used for risk management purposes and used to set the price of gas in their region; and there will be the national hubs as today, with tight price correlation to the regional hubs but with lesser traded volumes, mostly spot and prompt, used by the shippers in that area to adjust and balance their physical portfolios.

The traded volume graphs alone do not show the 'culture' behind the data and there are very different attitudes to trading right across Europe. Generally speaking, there is a willingness in the northern countries to embrace a more hands-on approach to portfolio management by actively trading positions, by adopting new-style contracts that better reflect the current market environment, and constantly looking for new commercial opportunities. Further south and east, there has been a suspicion of traded markets along with a reluctance to change from the 'standard' or established way of doing business. There is also the situation that in many of these countries, the wholesalers were able, until quite recently, to pass on their costs in tariff based contracts, thereby safeguarding the status quo. There are three regions where the prevailing conditions are such as to encourage hubs and for gas trading to further develop:

The British and the Dutch are, and historically have been, trading nations and it is therefore no real surprise that these are the two countries in Europe that have mature trading hubs. The British NBP is the price setter for all the other Continental hubs, with the possible exception of the Italian PSV. The NBP traded market is still growing in overall size as well as developing new products and attracting new participants so that in Q1-2012 it now boasts a gross market churn of over 20 times, with a third of the volumes coming from the regulated futures market and a growing number of purely financial trades.

The Dutch TTF, despite being only 6 years old, is now the most established hub on the Continent and it too can now truly be called mature as its gross market churn rose above 10 times in 2011 and has continued to do so, so that by Q1-2012 it had reached about 15 times. There is a strong willingness to adapt to the changing gas markets, with strong cooperation between all of the interested parties, as well as guidance and support from the Dutch government's gas roundabout strategy. The TTF market is growing at a brisk pace and the stage is set for yet more growth as market coupling with neighbouring grids gets under way.

Austria is at the crossroads of eastern and western Europe. It may be a surprising contender for this first grouping of hubs as until now CEGH has had relatively low traded volumes alongside very large transit volumes of Russian LTC gas. Furthermore, it does not yet have a single entry/exit model in the country; however, all is set to change in 2013 with the creation of the Eastern VTP which will include all the gas within its Market Area, including transit gas. Due to strong cooperation between the government, the regulator and the exchange and a willingness to make things happen at this vital transit point, including the establishment in time of a regional VTP, there is every hope that this hub will become one of the marker price hubs in Europe.

The situation in the other European countries is quite varied. Germany and France have both seen good progress over the past few years but, from a trading point of view, are today still relatively immature. Belgium is the oldest of the Continental hubs but is now lagging far behind in the race to be a marker hub. Finally, Italy's PSV has been languishing at the bottom of the list although there is potential for improvement with a more diversified supply mix.

Germany, Europe's second largest gas consumer, has the potential to become a major pricing hub but it still has many issues that will need resolving first. It has progressed well in the rationalisation of its many zones into the present NCG and Gaspool zones, albeit still each with separate high and low calorific balancing, with an associated cost of conversion which will not be socialised until 2014. On a positive note, traded volumes have increased sharply at both hubs and on NCG there has also been a tightening of the bid/offer spreads all along the curve; however, despite this, the churn ratio is still very low.

France too has been busy since 2009 reducing the number of zones to the current three but it is quite unlikely at this stage that TIGF will merge with either other hub, although it would be feasible for Nord and Sud to merge once grid strengthening work is finished. PEG Nord, with the greatest consumption, is by far the most liquid; however, despite significant increases in traded volumes from 2009 to 2011, there has been a pronounced fall again over the Winter 2011 period. It is too early to speculate as to whether this is a reverse of the previous positive trend for the French hubs but it certainly does not look promising.

Belgium is a bit of a quandary. The first of the Continental hubs to start, in 2000, it was seen by traders at that time to be the beginning of a 'trading path' across Europe. In reality, after a very promising start, it quickly reached a plateau of trading, closely linked to the NBP with which it shared its pricing, in pence per therm. Belgium is now trying to propose various market couplings with its neighbours and is set to introduce a second VTP hub, the Zeebrugge Trading Point, alongside the existing Zeebrugge hub. There are many industry misgivings over this plan and in any case, ZEE is already overshadowed by TTF and is unlikely to be able to come back to the fore.

Italy's PSV was created in 2003, the same year as the TTF but their development could not have been more different. Whilst the TTF attracted the trading community from the start, the PSV suffered from many restrictive practices, resulting in a totally inefficient market. However, 2012 could be the year in which the Italian hub's fortunes turn and it progresses towards an effective traded hub. The PSV has already shown early signs of real change towards a more trader friendly market and, given its geographical location and potential importance in helping secure European security of physical gas supply, it could indeed become one day a reference hub for southern Europe.

The hubs then are at very different levels of development and only a very few will progress to becoming reference hubs providing marker prices for new style long term contracts. Liquidity and transparency are key elements in deciding which hub(s) will succeed. Assessment needs defined measures and criteria and these may not be as easy to devise as it at first appears: reliable and transparent data sources which are up-to-date and preferably real time; reliable OTC and futures volumes and indices and standardised and comparative churn ratio methodologies across all the markets. Although it is hoped that the Gas Target Model and the various initiatives that it has generated will enable these criteria to be met in the medium term, most of the changes will be organic and result from commercial necessity, and therefore from the trading community, albeit with the help and assistance of the regulators and legislators.

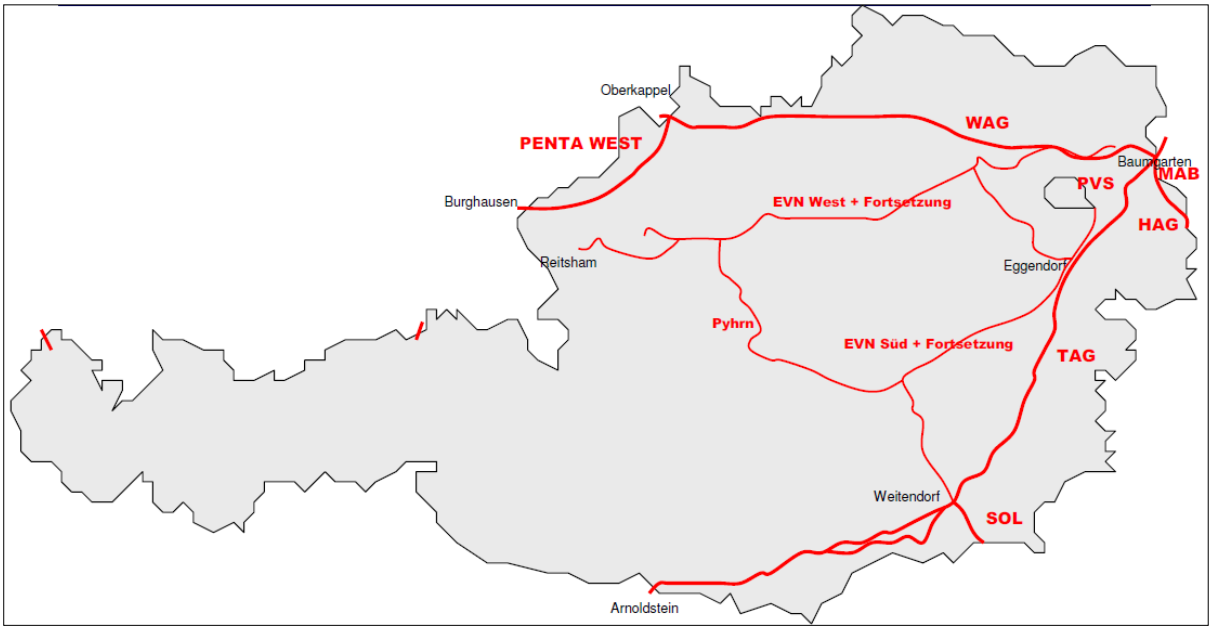
Oil indexed pricing has not reflected market fundamentals for some time but the recession and a period of gas oversupply has now made the situation untenable. The existing Long Term Contracts for gas must change to reflect the changes in the market, although there is a misconception by some that this will mean the end of long term contracts. This is not so. The price formation mechanism within long term agreements will change to market pricing based on a marker gas hub. Both sellers and buyers will continue to want security of demand and security of supply and these re-engineered contracts should be encouraged for the benefit of both parties; it is simply that they each need to know that they are receiving or paying the 'right' price for the gas being transacted.

In the long term, irrespective of pricing mechanism, it is likely that energy prices in general and gas prices in particular, will rise due to declining indigenous European production and rising global demand. This makes it all the more necessary that the price of the gas is related to its own supply and demand factors. It must also be recognised that in a liberalised traded market, the price will often be more volatile, as already experienced in North America and in Britain. Therefore it is crucial that any new style contracts for gas in Europe are priced on the right marker:

As to the question "are the European gas hubs fit for purpose?", the general answer has to be an emphatic 'yes', although they may not all serve the *same* purpose in the future. NBP will probably remain the Sterling benchmark and TTF the Euro benchmark, for gas into North Western Europe, with the CEGH a strong contender for Central European supplies and possibly the PSV, at a later stage, for gas supplies from the south. The other hubs probably will not be price markers but will still be used for the balancing of physical portfolios and all the hubs will have closely correlated prices. It remains to be seen whether the same degree of development can occur across eastern and south eastern Europe as the Commission has stated it wishes to see but, it is my contention that (a few) gas hubs in western Continental Europe will provide a true reference point in a market priced environment.

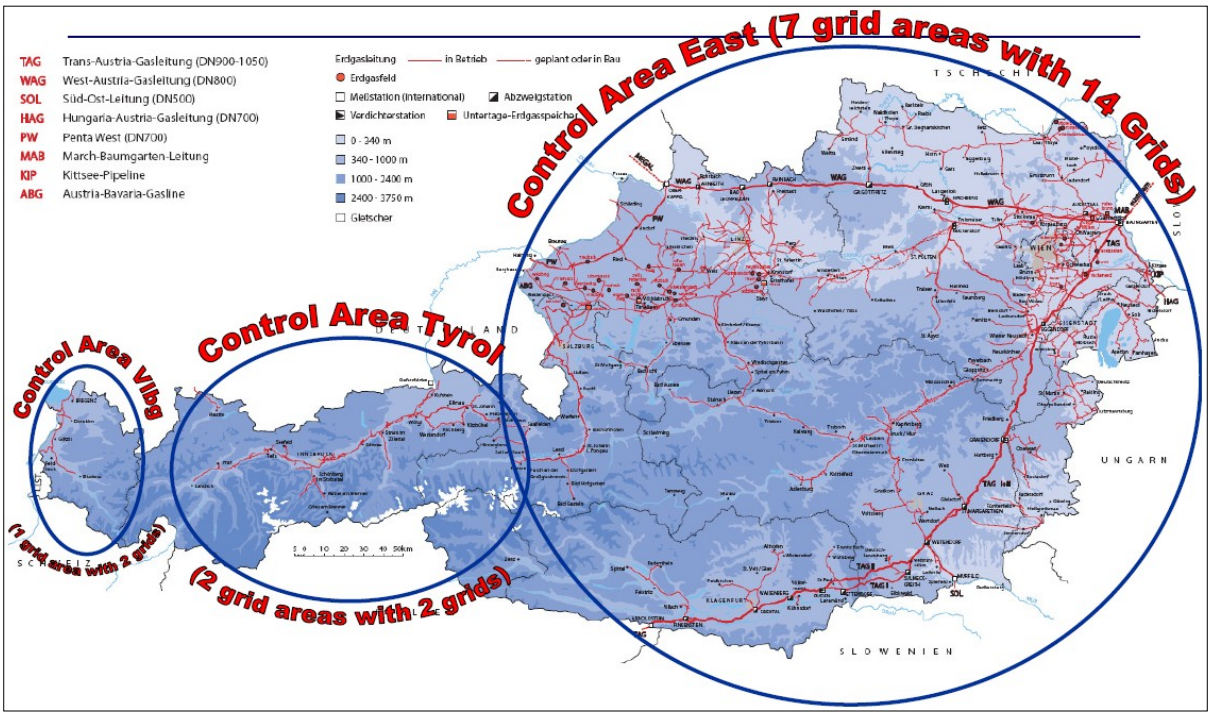
Appendices

A. Map of the Austrian high pressure/transit pipelines



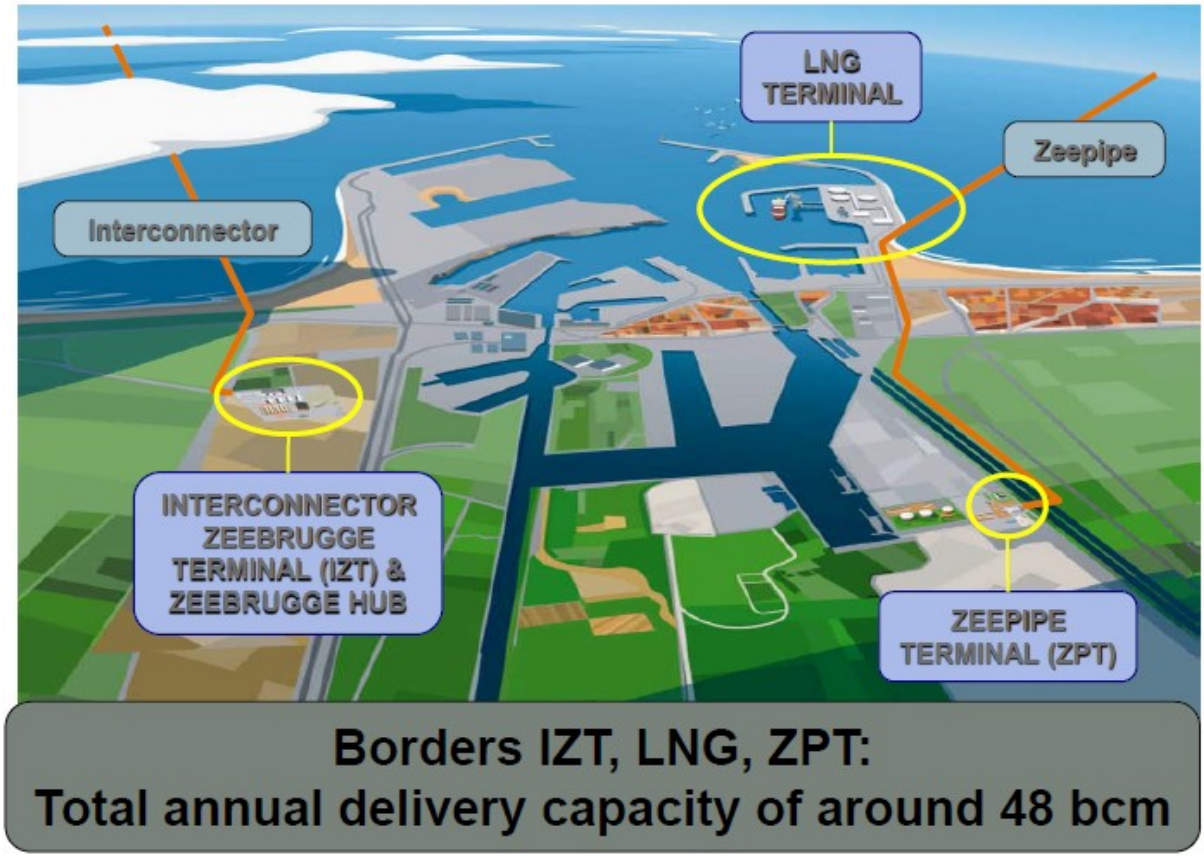
Source: E-Control

B. Map of the Austrian gas grids, divided into 3 Control Areas



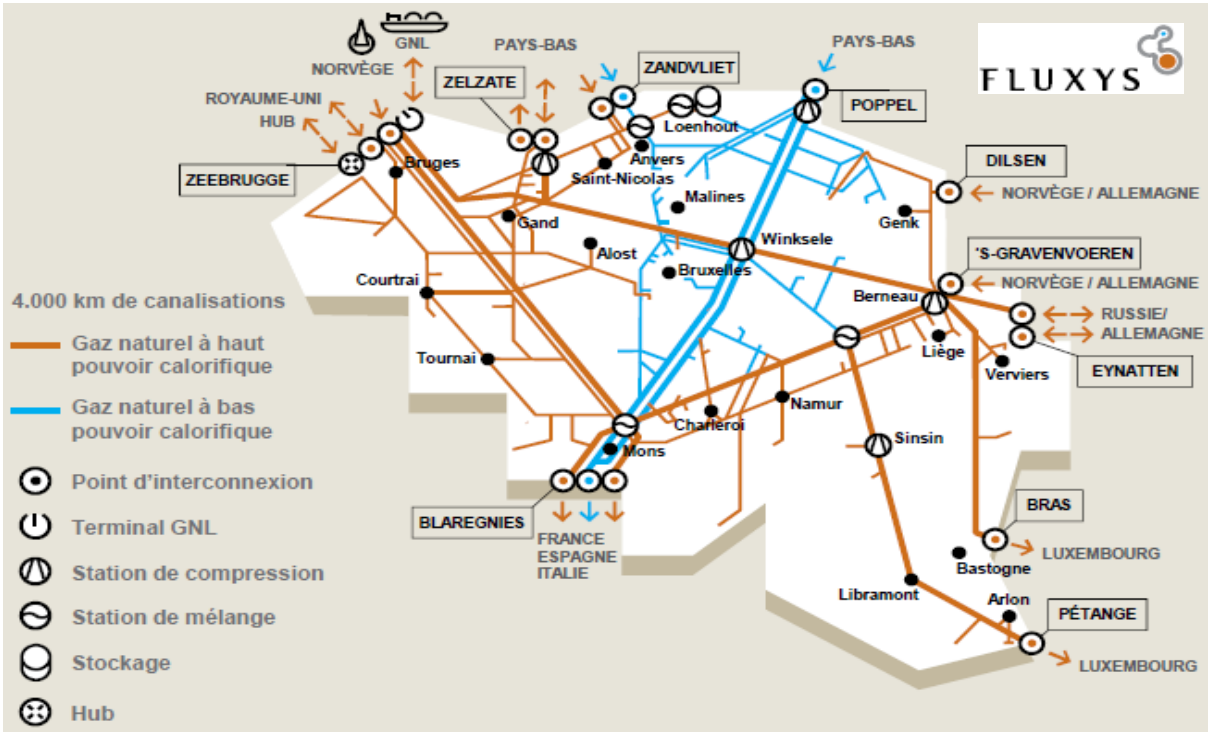
Source: E-Control

C. Diagram of the Zeebrugge Hub



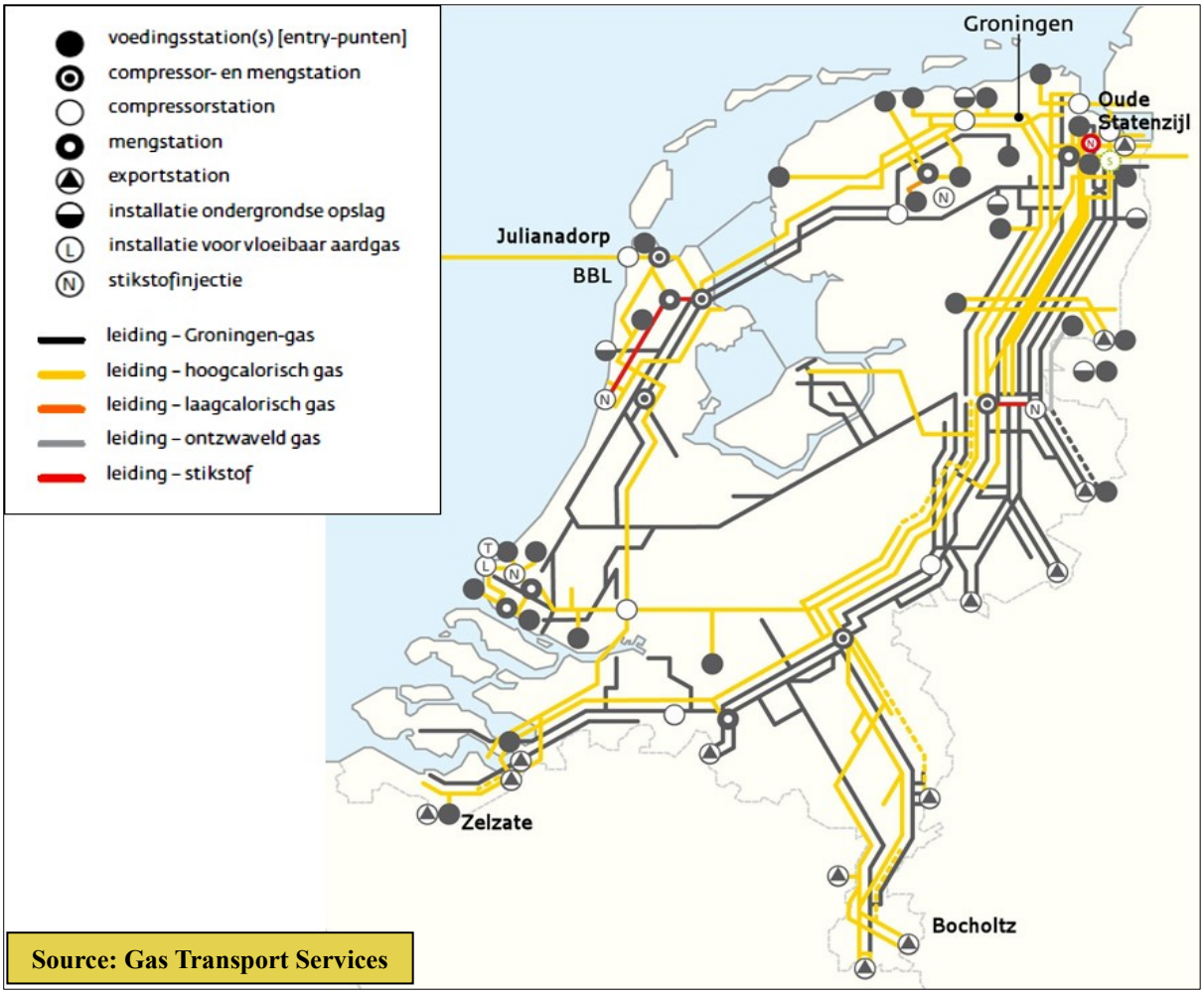
Source: Huberator

D. Map of the Belgian gas grid



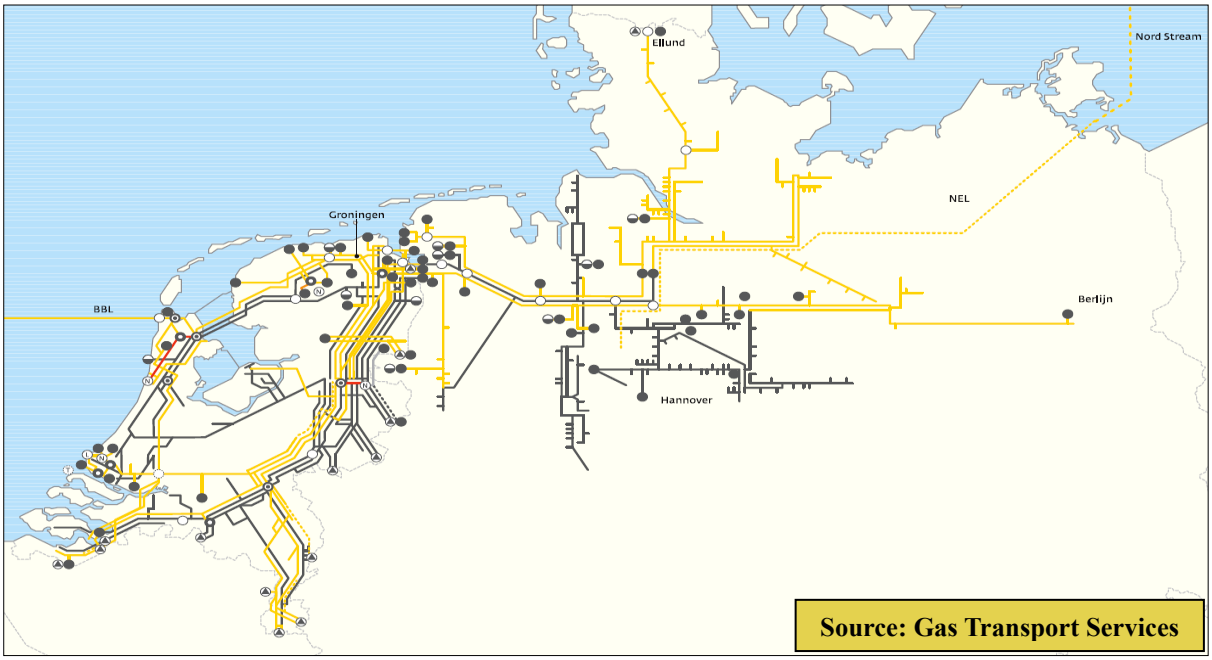
Source: Fluxys

E. Map of the Dutch gas grid



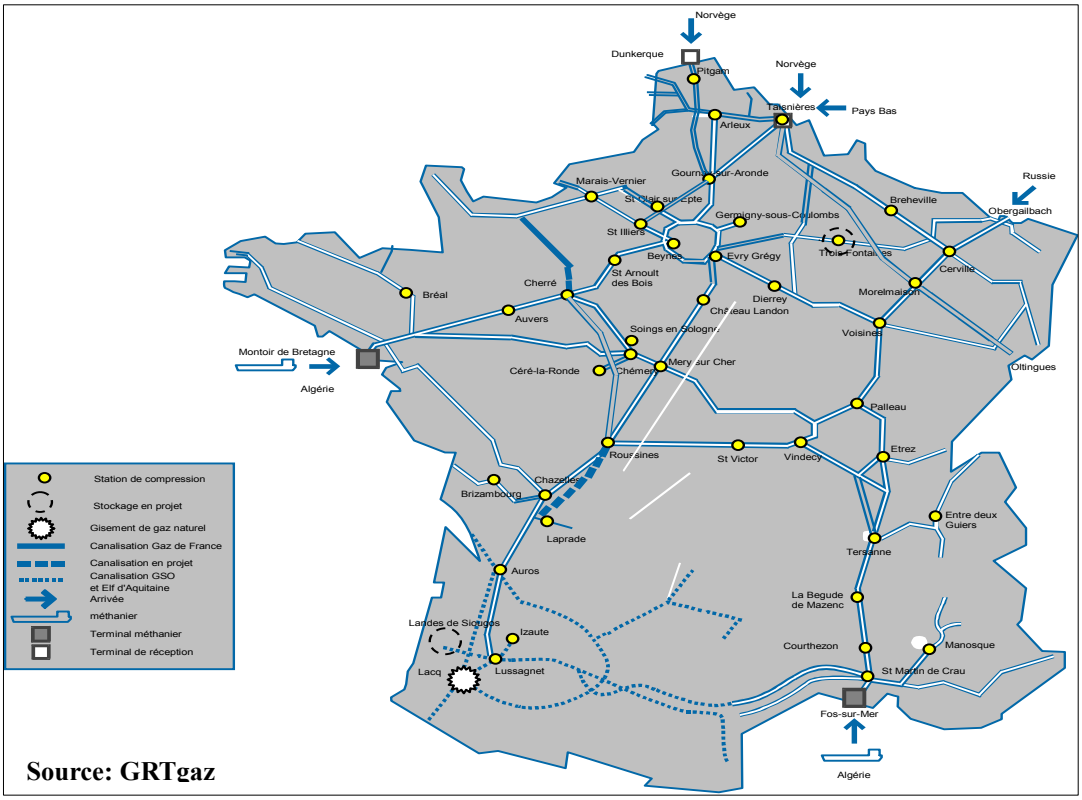
Source: Gas Transport Services

F. Map of the Gasunie GTS and GUD networks



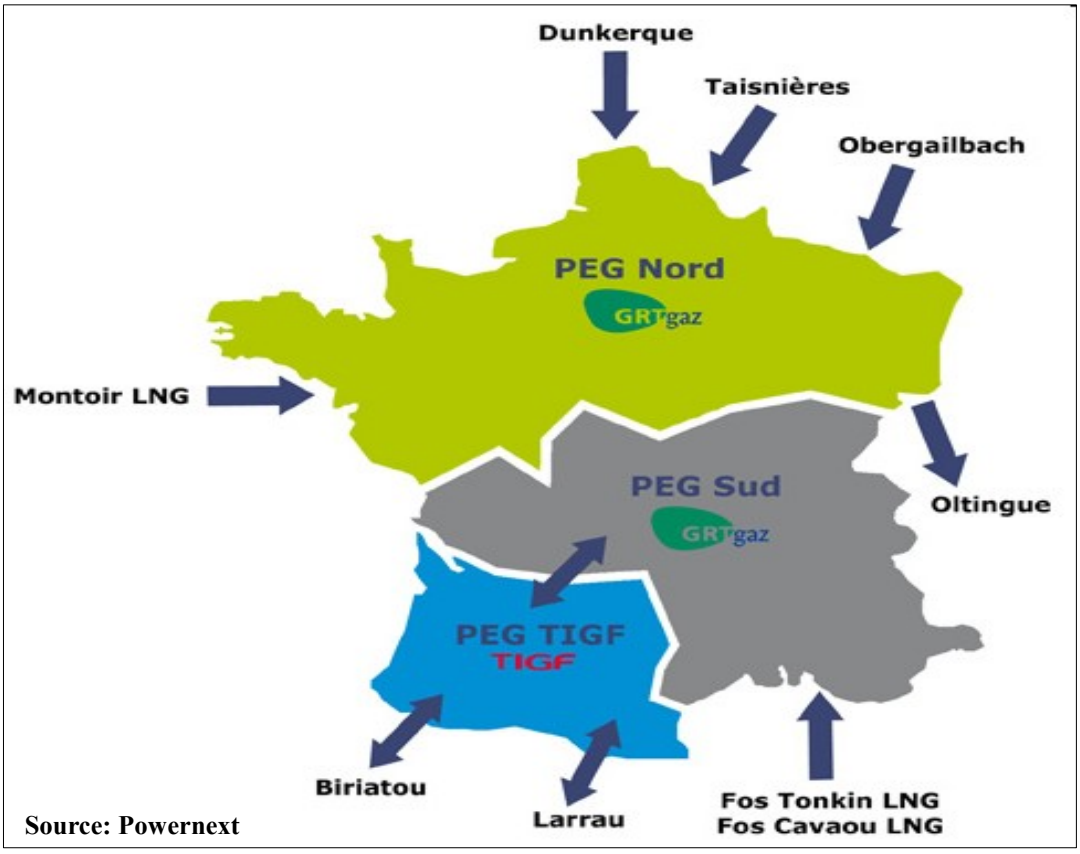
Source: Gas Transport Services

G. Map of the French gas grid



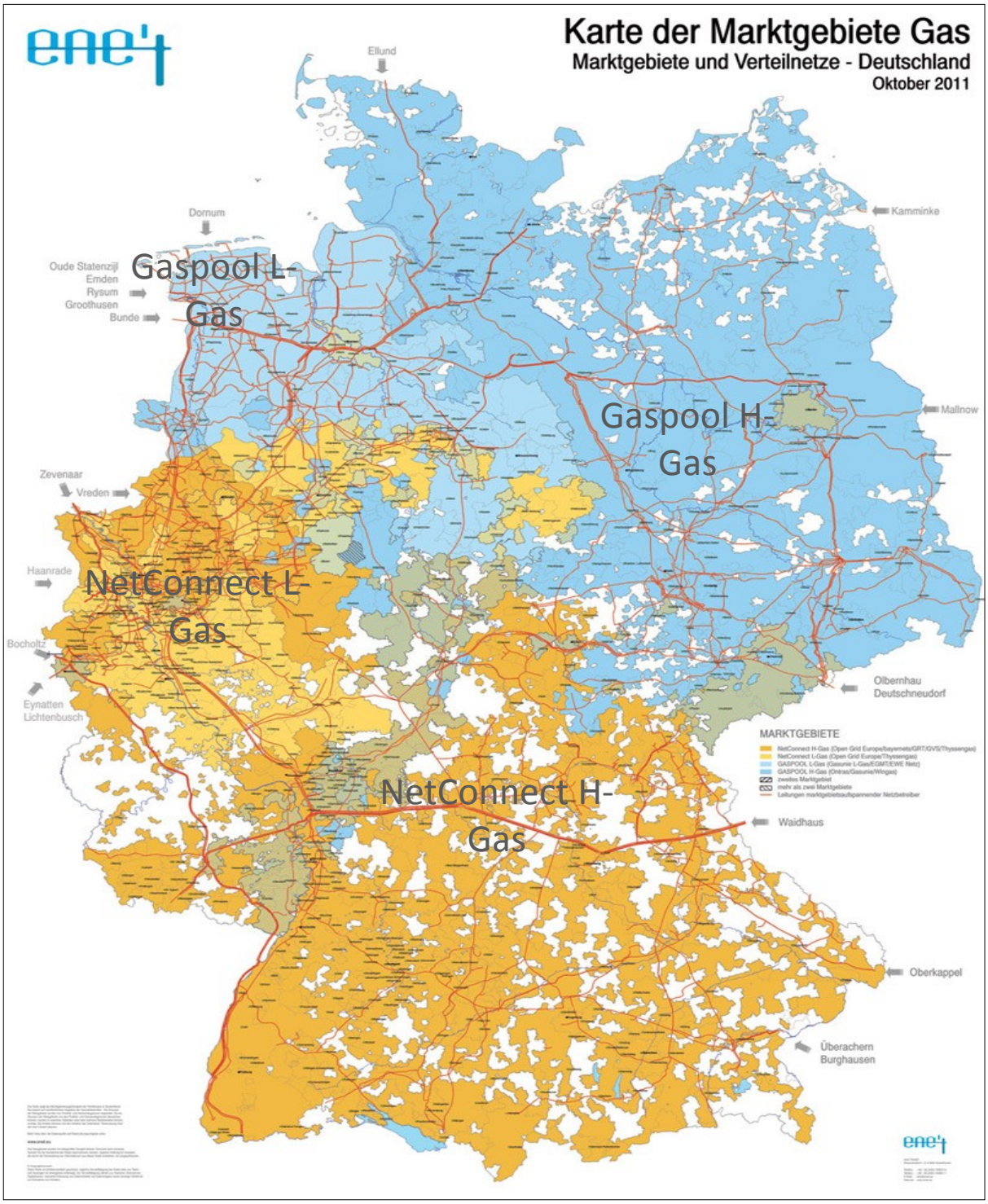
Source: GRTgaz

H. Map of the French PEGs



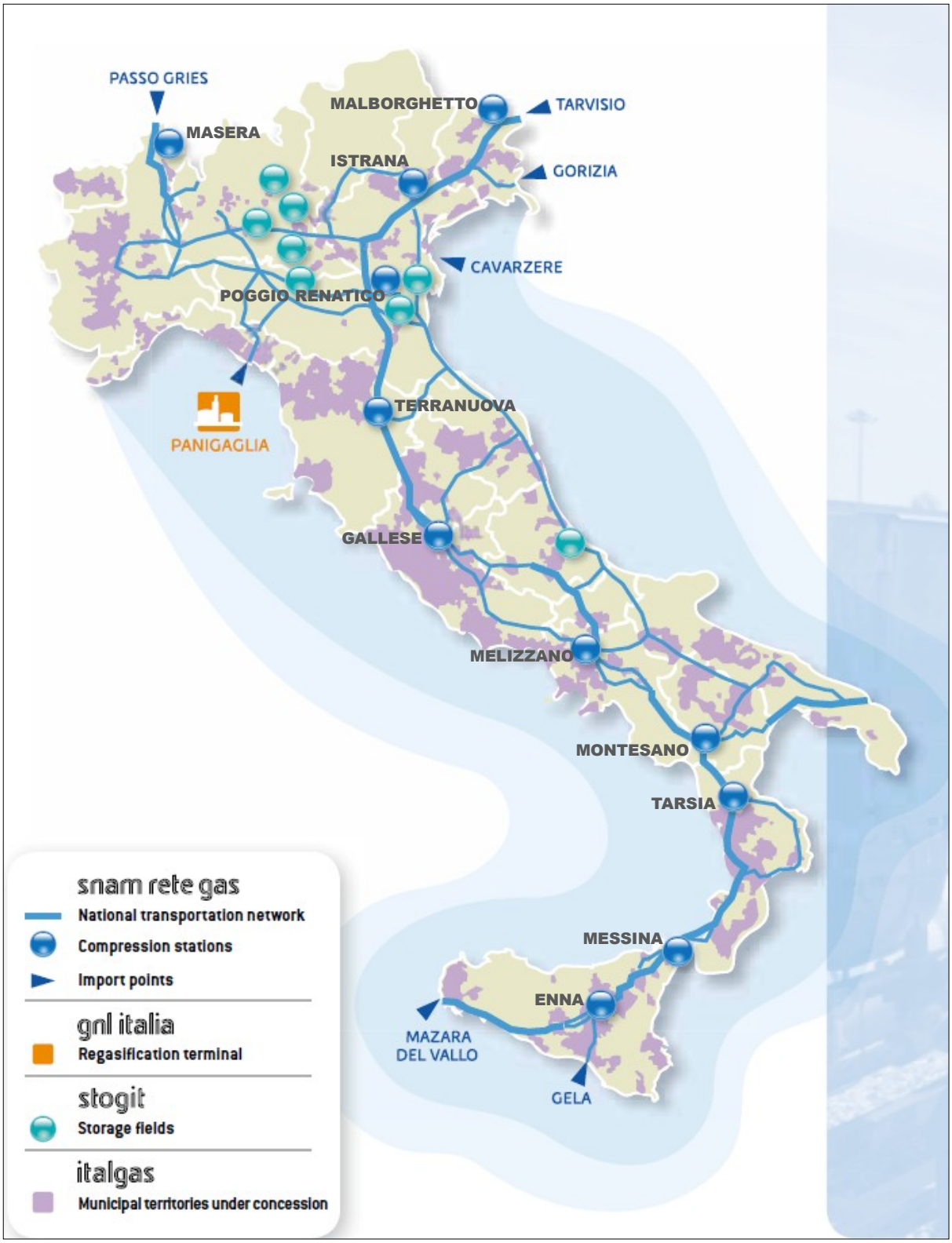
Source: Powernext

I. Map of the German Gaspool and NCG gas grids



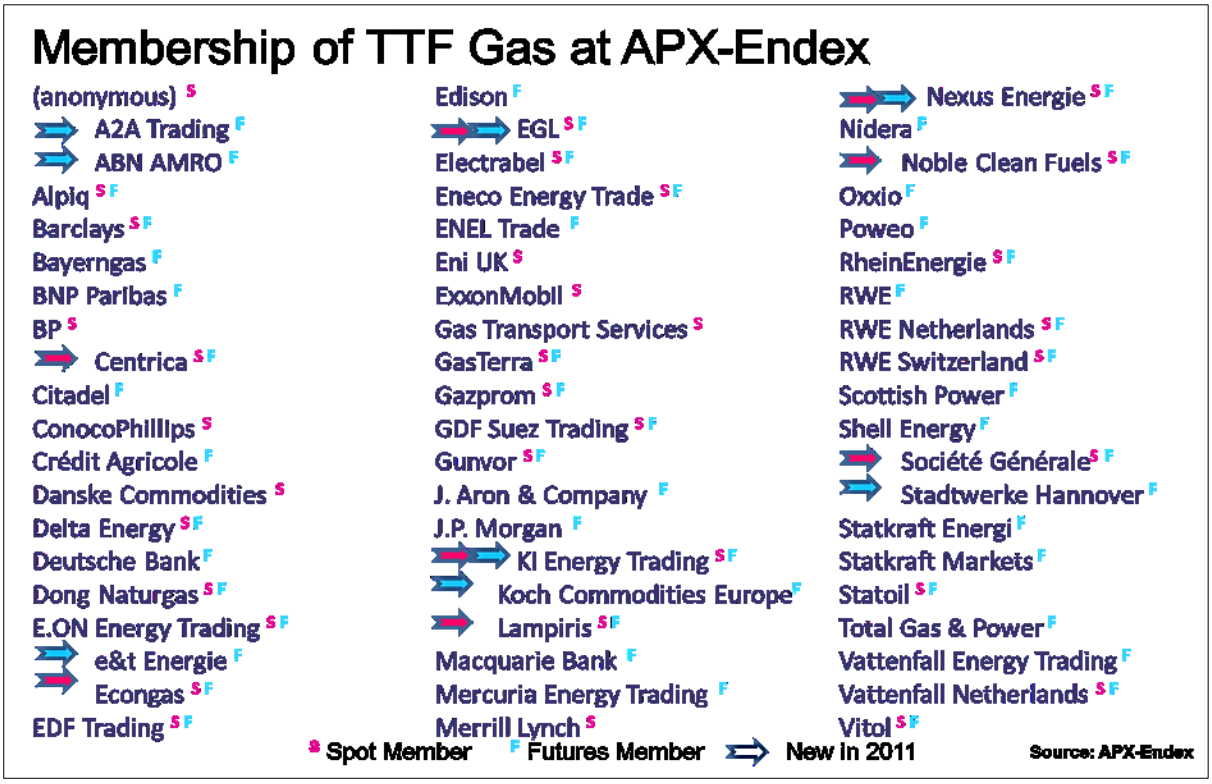
Source: ene't GmbH

J. Map of the Italian gas grid

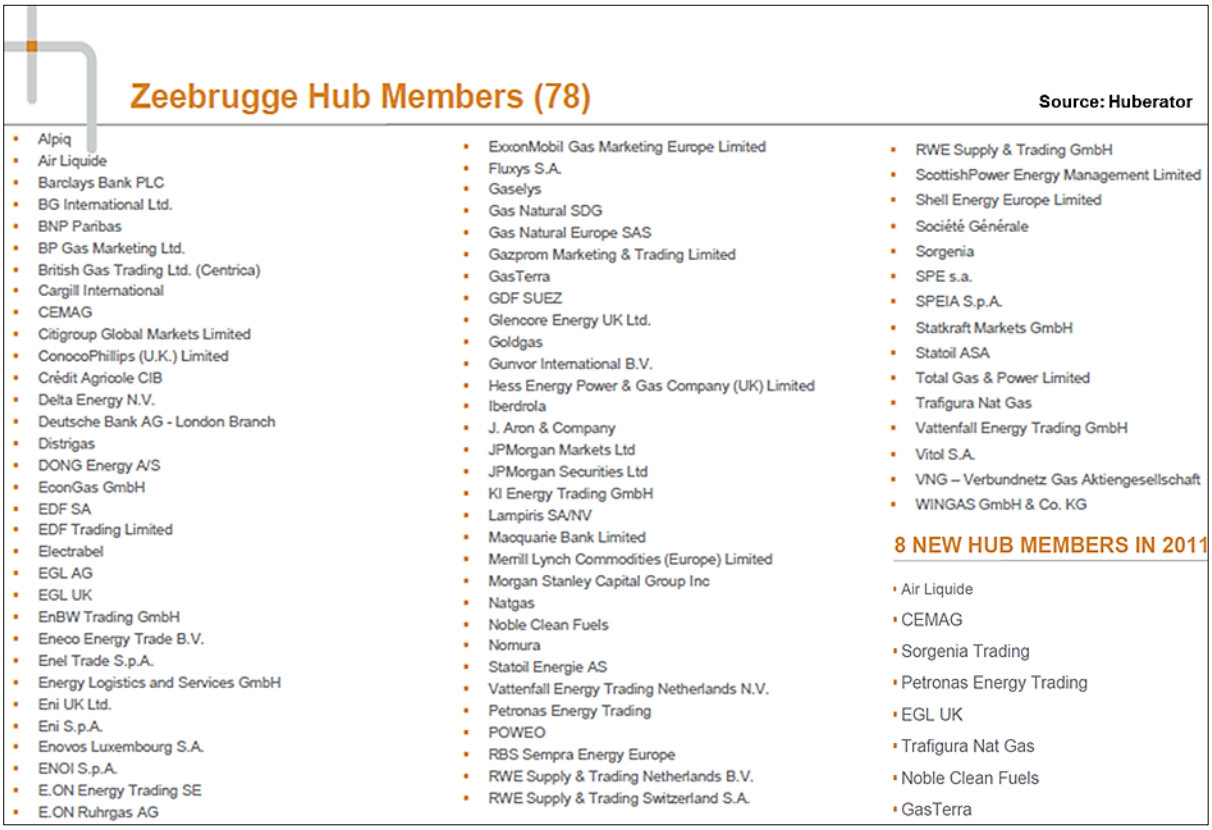


Source: SNAM Rete Gas, P. Heather

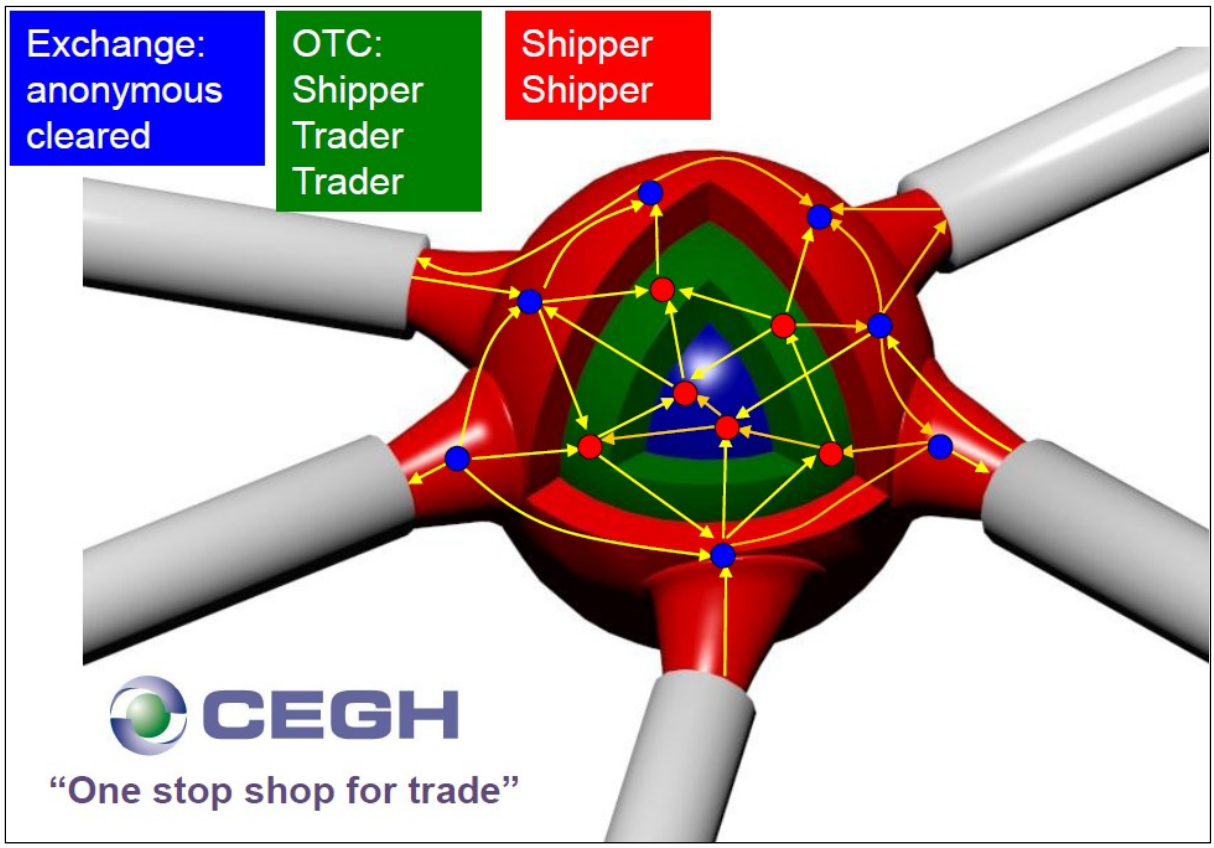
K. Memberships of TTF gas at APX-Endex at the end of 2011



L. Memberships of Zeebrugge Hub at the end of 2011



M. CEGH Exchange – the 3 'layers' of trading at Baumgarten



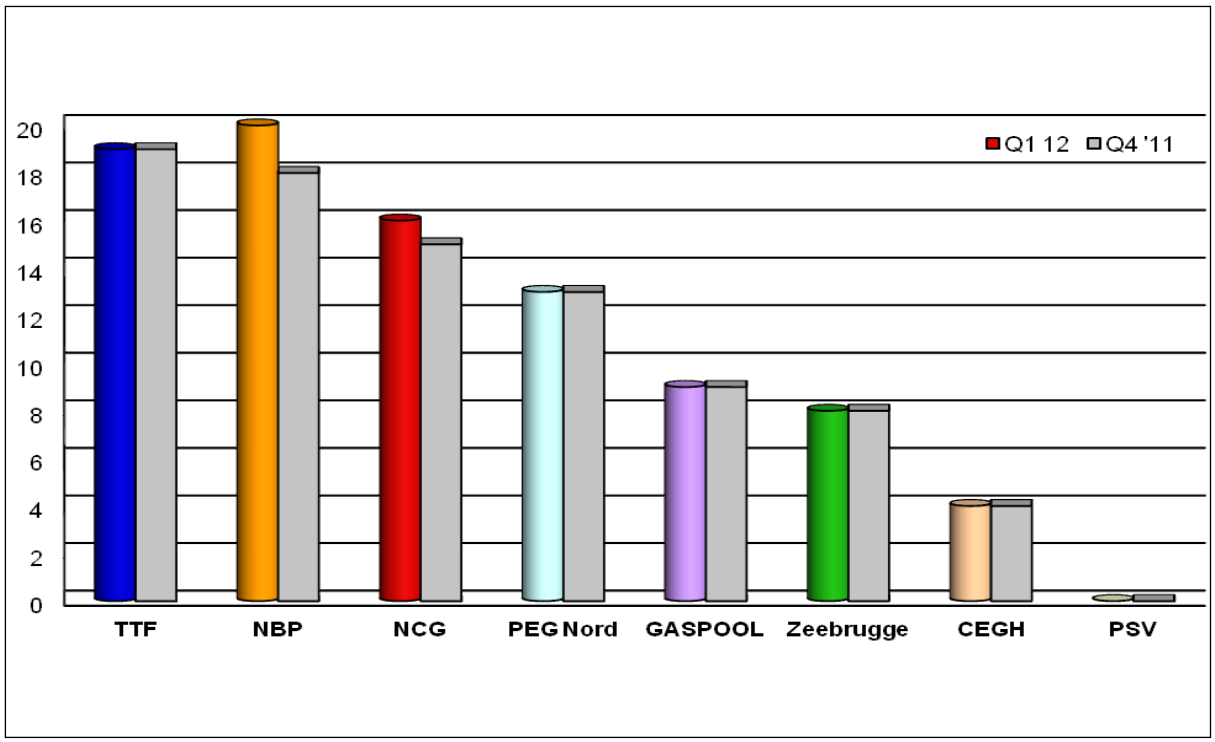
Source: CEGH Exchange

N. Calculation of the physical demand figures for Table 3

Country	Hub	Data source	Period	mcm	bcm	Conversion[1] TWh/1 bcm	TWh	Δ Q1-11/ Q1-12	TWh demand
Britain	NBP	NGG[2]	Q1-11	28,951.17	28.95	10.835	313.67		**313.67**
Britain	NBP	NGG[2]	Q1-12	27,247.80	27.25	10.835	295.25	0.94 actual	**295.25**
Holland	TTF	GTS	Q1-11	-	15.46	9.826	151.91		**151.91**
Holland	TTF	GTS	Q1-12	-	15.15	9.826	148.86	0.98 actual	**148.86**
Germany	NCG +GPL	CERA	Q1-11	-	29.80	10.763	320.74		**320.74**
Germany	NCG +GPL	estimated	Q1-12	-	-	10.763	-	0.96 applied	**307.91 est.**
France	PEGs	CRE[3]	Q1-11	-	-	10.763	194		**194**
France	PEGs	estimated	Q1-12	-	-	10.763	-	0.96 applied	**186.24 est.**

1: Calorific values: Energy Markets Intl Ltd, Conversion Chart, in btu/cf: UK: 1047; FR/DE: 1040; NL: 949 http://www.energymarketsinternational.eu/downloads/downloads.htm
2: NGG website; Data Items: NTS System Input Physical, Actual (Volume), D+1; 01/01/2011 – 31/03/2011 and 01/01/2011 – 31/03/2012: http://marketinformation.natgrid.co.uk/gas/DataItemExplorer.aspx
3: CRE: Electricity and gas market observatory Q1 2011, p.54:
http://www.cre.fr/media/fichiers/marches/electricity-and-gas-market-observatory-1st-2011-quarter

O. ICIS-Heren Tradability Index Q1-2012



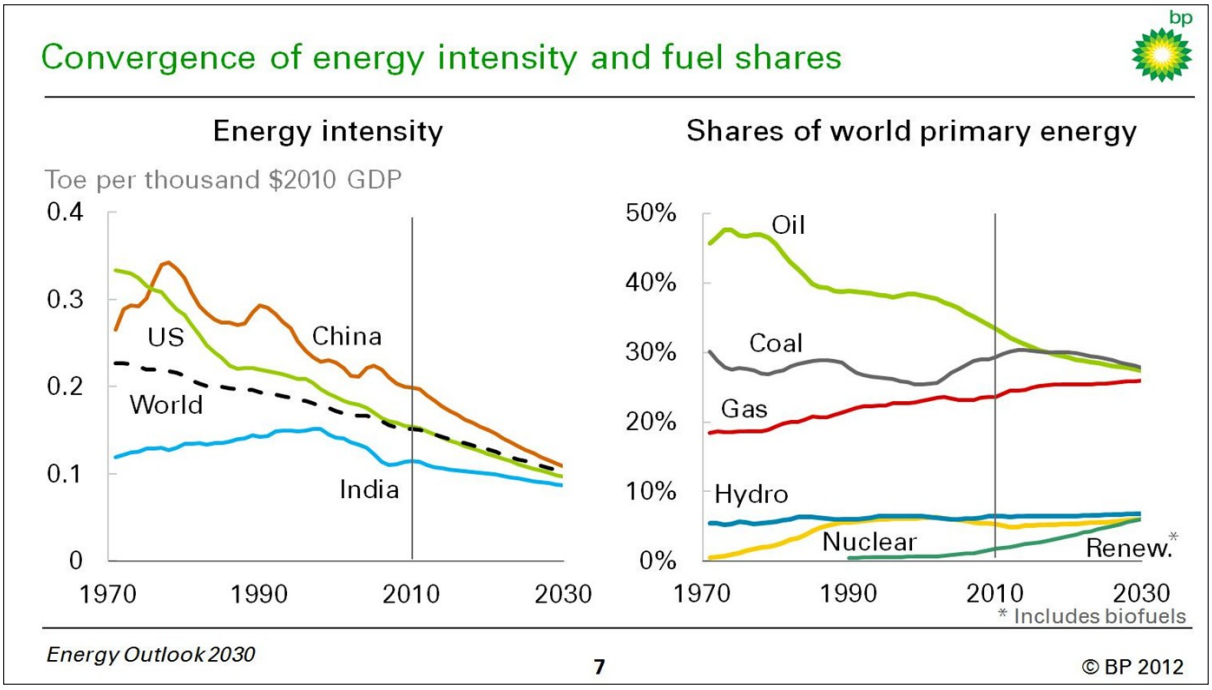
Source: ICIS-Heren

P. European shale gas technically recoverable resources

Country	Proved Natural Gas reserves (tcf)	Technically recoverable Shale Gas Resources (tcf)
POLAND	5.8	187
FRANCE	0.2	180
NORWAY	72	83
UKRAINE	39	42
SWEDEN	0	41
DENMARK	2.1	23
UK	9	20
NETHERLANDS	49	17
TURKEY	0.2	15
GERMANY	6.2	8
LITHUANIA	0	4
OTHERS	2.71	19
TOTALS	186.21	639

Source: EIA

Q. Convergence of energy intensities and fuel shares to 2030



Source: BP Energy Outlook 2030

Glossary

Term	Definition	Comment
APX-Endex	[Formerly the Amsterdam Power Exchange]. APX-ENDEX is Europe's premier provider of power and gas exchanges, operating five markets in the Netherlands, the United Kingdom and Belgium. Specialises in spot and prompt UK, Dutch and Belgian power and gas contracts. Very important to UK power and gas communities as APX operates the within-day markets. **http://www.apxendex.com**	APX Gas UK developed the concept of a balancing market with the implementation of the OCM – the On-the-day Commodity Market – providing the within day trading tool for the UK gas industry. Additionally it provides a market for trading on the UK National Balancing Point (NBP) up to 7 days in advance of delivery. APX Gas NL offers an anonymous market place for integrated trading, clearing and notification of Within Day and Day Ahead gas contracts at the Title Transfer Facility (TTF). It self-clears all of its contracts.
BAFA	Bundesamt für Wirtschaft und Ausfuhrkontrolle Federal Office of Economics and Export Control, part of the Federal Ministry of Economics and Technology. It is entrusted with important administrative tasks of the Federal Government in the following sectors: foreign trade, promotion of economic development and, energy.	In the energy sector BAFA implements measures to promote a better use of renewable energies, the saving of energy, for the maintenance and extension of the power-heat-linkup and for German coal mining, and participates in crisis-contingency measures in the mineral oil sector. In the case of natural gas, BAFA is in charge for the licensing of import treaties with a period of delivery of 24 months as well as the collation and publication of different statistics (incl. border crossing prices). **http://www.bafa.de/bafa/en/index.html**
Balancing Mechanism Balancing zone	In a natural gas pipeline network or an electricity grid, the means of ensuring that demand does not outstrip supply, or vice versa. See also "Daily Balancing".	In the UK, the gas Balancing Zone is the whole gas grid (NTS) and it is balanced by the TSO (NGG); this is a safety requirement and part of its statutory obligations.
Baumgarten	One of the six delivery points tradable at the CEGH (see below), Baumgarten is situated in the east of Austria on its border with Slovakia. The import terminal itself is vast and is owned and operated by Gas Connect Austria.	The largest import location for gas into western Europe, with an annual capacity of 89bcm. Approximately one third of all Russian gas supplies to Western Europe come through Baumgarten for onward transportation to Germany, Italy, Slovenia and Hungary, as well as for supplying the national market.
BBL (Balgzand to Bacton Line)	A gas pipeline interconnector flowing gas from Julianadorp (near Balgzand) in Holland to Bacton in East Anglia, England. **http://www.bblcompany.com/en/**	A uni-directional flow 36-inch diameter pipeline with a rated capacity of 13.41bcma which increased in December 2010 to 16.24bcma. Started operation on 1st December 2006. A joint venture between Gasunie BBL BV (60%), E.ON Ruhrgas BBL BV (20%) and Fluxys BBL BV (20%).
BCM/bcm bcma bcm/mth	Billion cubic metres Billion cubic metres per annum Billion cubic metres per month	
Bid/Offer Spread	The difference between the bid/buy/buyer price in the trading quote and the ask/offer/seller price.	
BNetzA	Bundesnetzagentur. Federal Network Agency. The agency for Electricity, Gas, Telecommunications, Post and Railway is a separate higher federal authority within the scope of business of the German Federal Ministry of Economics and Technology.	The Energy Act assigned the task of regulating Germany's electricity and gas markets to the Federal Network Agency. The purpose of regulation is to establish fair and effective competition in the supply of electricity and gas. The responsibilities of the Federal Network Agency therefore include ensuring non-discriminatory third-party access to networks and policing the use-of-system charges levied by market players. **http://www.bundesnetzagentur.de/cln_1911/EN/Home/home_node.html**

Broker Commodity Broker	A broker is a party that mediates between a buyer and a seller. It can be a firm or an individual who executes orders to buy or sell commodity contracts on behalf of clients and charges them a commission. A broker who also acts as a seller or as a buyer becomes a principal party to the deal, as opposed to an 'agent' who acts on behalf of a principal.	Commodity contracts can include physical spot, prompt and forwards or futures, options, and similar financial derivatives. The main brokers of European gas are Icap, Prebon and Spectron.
BTU/Btu	A British Thermal Unit (BTU) is the amount of heat energy needed to raise the temperature of one pound of water by one degree F. This is the standard Imperial measurement used to state the amount of energy that a fuel has, as well as the amount of output of any heat generating device.	There are 100,000Btus to 1 Therm. There are approximately 1,055Btus to 1 Joule.
Calorific value (CV)	The CV refers to the amount of energy released when a known volume of fuel is completely combusted under specified conditions. By custom the basic calorific value for solid and liquid fuels is the gross calorific value at constant volume and for gaseous fuels it is the gross calorific value at constant pressure. The word 'gross' here signifies that the water formed and liberated during combustion is in the liquid phase. The CV of solid and liquid fuels is quoted in megajoules per kilogramme (MJ/kg). The CV of natural gas, which is dry, gross and measured at standard conditions of temperature and pressure, is usually quoted in megajoules per cubic metre (MJ/m^3).	Across Europe, each country has in the past developed its own standards so that they differ slightly from each other; also, in Holland, Belgium, northern France and northern Germany, there are supply grids for both high and low calorific gases (H-Cal and L-Cal). Nevertheless, the average CV in each country is as follows (MJ/m^3): Austria: 39.6; Belgium: 39.5; Denmark: 44; France & Luxemburg: 38; Germany: L-Cal: 35.17, H-Cal: 39.6 – 40.46; Italy: 38.1; Netherlands: 35.17; UK: 39. Typical CV figures of some fuels are: Wood: 16 Steam coal: 36 Methane (North Sea gas): 39 Petrol: 44.8-46.9 Propane: 94 Butane: 118
Capacity	A measure of the amount of gas that a pipeline is rated to transport. This will usually be quoted as a flow rate.	
Capacity Trading	The trading between gas shippers of 'space' within a pipeline system giving the purchaser the right to transport gas through that system.	In the UK, capacity is initially bought from National Grid Gas at one of the Entry Points to the NTS and can then be re-traded between shippers.
Cash Settlement	The financial settlement of futures contracts, at expiry, by reference to an Index (as opposed to actual physical delivery).	Although most commodity futures contracts are based on physical delivery, there are some (such as the ICE Brent contract) which allow for any open contracts at expiry to be settled financially.
CEGH (Central European Gas Hub)	The CEGH Central European Gas Hub AG (CEGH), located in Vienna, Austria, is the leading hub for trading gas flowing into western Europe from Russia through the Baumgarten import terminal (see entry above) and at 5 other physical locations in Austria. As from 1st January 2013, the CEGH will become a virtual trading point (VTP), making it possible to trade all gas in the Austrian eastern Market Area. **http://www.cegh.at/index.php?id=33**	It currently offers a range of traded markets: OTC; Exchange spot; Exchange futures. The Exchange contracts are provided in association with Wiener Boerse. It is possible to trade at: Baumgarten, Oberkappel, Ueberackern, Weitendorf, Murfeld and Mosonmagyaróvár. In 2011, CEGH achieved a total trading volume of approx. 40 billion cubic metres of natural gas, thus consolidating its position among the leading gas hubs in Continental Europe.

Churn Churn Ratio Re-trading Ratio Gross Market Churn	A measure of the number of times a 'parcel' of a commodity is traded and re-traded between its initial sale by the producer and final purchase by the consumer. The 'churn' is a good measure of a given market's liquidity and depth and, as a general indication, markets are deemed to have reached maturity when the churn is in excess of 10. Because European gas differs from most commodities in that it still has large volumes delivered under long term contracts, it is more difficult to measure the true level of churn.	Therefore, a 'simple' calculation would be to compare the total traded volume to the net delivered traded volume, giving what is termed a "net re-trading ratio"; and a more 'accurate' calculation, using the EU approach, of comparing the total traded volume to the net delivered total amount, represented by the hub area's physical demand, giving what is termed the "gross market churn". In the 1st Quarter of 2012, and using the "gross market churn" methodology, the British gas market churn was 21.35; The Dutch TTF gas market churn was 14.25; by comparison, other main North West European gas hubs are far behind: Germany (NCG + GPL): ~1.3; French PEGs: ~0.6.
Clearing	Strictly speaking, the processing of all purchase and sale contracts traded on a futures exchange.	Term used in the futures markets to describe the process of anonymously matching buyers and sellers who trade on the Exchange.
Clearing House	The body responsible for the clearing of futures contracts on Exchanges. As well as processing all of the trades, it financially guarantees their performance, through initial and variation margining.	The Clearing House deals only with the futures Exchange whose contracts it is clearing and never directly with the users of that Exchange. It is the central counterparty to every trade so as to provide anonymity.
Commercial	Gas customers whose establishments consist of services, retail precincts, manufacturing non-durable goods, dwellings not classified as residential, and farming (agriculture).	See "I+C (Industrial and Commercial)" below.
Control Area	The term used to define each of the 3 separate gas grids in Austria: Eastern, Tyrol and Voralberg.	The Eastern Control Area contains the transit pipelines, a high pressure transmission grid and a high and low pressure distribution grid. Tyrol and Voralberg Control Areas are not physically connected to the Eastern Area, nor to each other but have direct pipeline connections to Germany and so can be considered as separate distribution grids off the German NCG system.
CRE	La Commission de Régulation de l'Energie. **http://www.cre.fr/en**	Independent administrative body in charge of regulating the French electricity and gas markets.
Cubic Metre (m^3)	The *Systeme International* (SI) unit of measurement of the volume of a cube with edges measuring 1 metre in length. 1,000 litres = $1m^3$ (= 1cu m) 1m3 ~ 35.314 cu ft	Since the volume of a gas is inversely proportional to its pressure, and proportional to absolute temperature, when measuring gases it is important to determine these criteria. Therefore, for volumes of natural gas, see "Normal cubic metre" and "Standard cubic metre" below.
CREG	Commission de Régulation de l'Électricité et du Gaz. Federal regulator of the Belgian electricity and gas markets. **http://www.creg.be/fr/index.html**	The CREG is tasked with overseeing market transparency and competition, making sure that the market's activities are within the public's interest and the context of global energy policy, as well as addressing the specific interests of the consumer.
'D', 'D-1', 'D+1'	'D' stands for 'Day', the delivery day of gas. 'D-1' refers to the day before the day of delivery. 'D+1' refers to the day after the day of delivery. See "Gas Day".	Term used in the trading, nomination and balancing of gas to refer to gas delivered on a given day, and to (trans)actions to do with that gas effected either the day before or the day after delivery.
DA Day Ahead (Trading)	'DA' stands for 'Day Ahead' and refers to the trading of gas for 'tomorrow', the day after the trading day.	
Daily Balancing	A regime in which inputs to and outputs from a gas system must be balanced (within limits) during a gas day. The balancing regime in the Network Code	This is primarily a safety issue: NGG has to maintain safe pressures at all times in the NTS. Daily balancing has been in place in the UK since 1996, before which time there was a regime of

	puts the obligation on National Grid Gas to achieve physical balancing of the NTS within day.	monthly balancing. Other networks operate an hourly (such as Belgium) or a quasi real time (in the Netherlands) regime.
Deliverability	The rate at which gas can be supplied in a given period, for instance from storage or through a pipeline or distribution network in a single 24-hour period.	Usually expressed as a flow rate and dependent on factors such as the design and type of a storage facility and the capacity of the pipeline network.
Delivery Day	See "D" above.	
E-Control	Energy Control Austria is the energy regulator for Austria. It is a public authority whose tasks and duties are laid down in the "*E-Control Gesetz"* (E-Control Act).	The regulator has the job of strengthening competition and ensuring that this does not compromise security of supply and sustainability. To act even-handedly in the interests of all market participants, regulators must be politically and financially independent. **http://www.e-control.at/en/home_en**
EEX (European Energy Exchange)	The German energy exchange, providing market platforms for trading in power, natural gas, CO_2 emission allowances and coal.	EEX's main contracts are German Power and the NCG and Gaspool gas futures contracts. It self-clears all of its contracts. **http://www.eex.com**
EFET (European Federation of Energy Traders)	Founded in 1999, EFET is a group of more than 100 energy trading companies from 27 European countries dedicated to stimulate and promote energy trading throughout Europe. EFET concentrates its work on: Power, gas and emissions market design; Energy policy and regulation; Standard energy contracts; Electronic transaction data standards.	The EFET master contracts for wholesale OTC transactions in gas, power and related products have been a tremendous success right from the beginning. They are well-accepted by the market and used as a general reference point by traders conducting business with counterparties throughout Europe. **http://www.efet.org/**
EGIX	European Gas Index. The Index, launched on 27th January 2011, is based on a volume-weighted daily average price across all exchange transactions which are concluded on the EEX Derivatives Market for Natural Gas in the respective current front month contracts.	The EGIX is established for the GASPOOL and NCG market areas and for a virtual German market area. Marketed by the EEX (see above) as always reflecting "the current market price for natural gas deliveries in the respective front months" and "as a result, it is optimally suited to gradually replace and/or supplement gas supply contracts based on natural gas substitutes (such as oil or coal)".
End User	All final customers of natural gas. Includes: residential, commercial, light industrial, heavy industrial customers and direct connect users.	Can also include: CHP generation, petrochemical works, cement and glass manufacturers and CCGT electricity generation plants.
Entry Point	A point where transmission capacity can be contracted or traded in order to input natural gas into the national network.	
EU Natural Gas Directive	The European Parliament and Council Directive 98/30/EC concerning common rules for the internal market in natural gas. Its aim was to create a single Europe-wide gas market by reducing barriers to trade and encouraging new entrants into the market.	The full document can be accessed at: **http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=CELEX:31998L0030:EN:HTML**
€/MWh	Euro per MegaWatt hour	
Exchange	A place or forum where securities or commodities are bought, sold or traded in an open but regulated environment.	Can be actual or virtual, offering 'open outcry' pit trading or an 'electronic' trading platform. Offers standardised contracts (see "futures" below).
Exit point Off-take Point	A point where transmission capacity can be contracted or traded to withdraw natural gas from the national network.	
Flat Gas	Gas traded and delivered at a constant flow rate throughout the delivery period.	Trading term used in the British 'NBP'97' contract in which no interruption / volume tolerance is permitted.

Fluxys	Fluxys Belgium is the independent operator of both the natural gas transmission grid (TSO) and storage infrastructure in Belgium.	The company also operates the Zeebrugge LNG terminal. **http://www.fluxys.com/en/home.aspx**
Firm Gas	Gas sold on a continuous basis and generally on long term contracts	
Force Majeure (FM)	Force Majeure literally means "greater force". FM clauses in contracts excuse a party from liability if some unforeseen event beyond the control of that party prevents it from performing its obligations under the contract.	Typically, Force Majeure clauses cover natural disasters or other "Acts of God", war, or the failure of third parties--such as suppliers and subcontractors--to perform their obligations to the contracting party. It is important to remember that FM clauses are intended to excuse a party only if the failure to perform could not be avoided by the exercise of due care by that party.
Forwards	OTC contracts to trade a commodity for delivery in the future. A forwards contract is a bilateral contract, whether traded directly between two parties, or through the intermediary of a broker, or on an electronic trading platform.	The cash flow of trading forwards is very different to trading futures: forwards contracts are settled after the delivery of the traded commodity, when the buyer will pay the seller's invoice. However, there is full counterparty risk until the payment has been made.
Futures	Exchange contracts to trade a commodity for delivery in the future. A futures contract is a legally binding agreement between a seller and a buyer to deliver/take delivery on a specified future date a given quantity and quality of a commodity at a price level agreed today.	The cash flow of trading futures is very different to trading forwards: futures contracts are margined by the Exchange on behalf of the Clearing House in order to be able to financially guarantee the performance of the contracts: both buyer and seller in a given trade will deposit margin money on the day of trading (often in the order of ~10% of contract value, depending on market volatility) and will make further variation payments in the case of adverse market prices or increased volatility.
Gas Day	Refers to a 24 hour period other than a calendar day. The start time, when different to Midnight, will be chosen for operational reasons. In the UK and many other countries, the Gas Day runs from 06:00 (through to 05:59 on the next calendar day).	6am was chosen as it falls at the end of the low demand night period and before the beginning of the morning peak. It also means that it is relatively easy to balance the day's volumes (whether as shipper or as TSO) during the quiet nighttime period. However, other countries do operate different 'days', such as Austria which actually has three: starting at 8am for transit gas from Russia; at 6am for Austrian transmission; and midnight for Austrian distribution.
Gaspool (GPL)	One of the two Market Areas in Germany. Also, the designation of one of the natural gas futures contracts offered on the EEX electronic exchange.	Gaspool, based in Berlin, is jointly owned by 6 gas pipeline companies: DONG Energy Pipelines, GASCADE Gastransport (formerly Wingas), Gastransport Nord (formerly EWE Netz), Gasunie Deutschland Transport Services, Nowega (formerly Erdgas Münster) and ONTRAS – VNG Gastransport. **http://www.gaspool.de/gaspool_hub.html?L=1**
Gas Year	Refers to a twelve month period other than the calendar year. In the UK and many other countries, the Gas Year runs from 06:00 on 1st October (through to 05:59 on 30 September the following calendar year).	Historically, the Gas Year was used as the time frame for purchase contracts. October was chosen as the start of the high demand winter season and the end of the low demand summer season and off-shore maintenance. Take or Pay obligations in Long Term Contracts must be met by the end of a given Gas Year.
Gross Market Churn	See "Churn" above.	
GRTgaz	GRTgaz is the operator of the natural gas transmission system (TSO) previously owned by Gaz de France.	**http://www.grtgaz.com/en/home/**
GTS	Gas Transport Services B.V. (GTS) is the national transmission operator in the Netherlands.	It ensures sufficient transport capacity, balances the grid and creates/maintains connections to other grids. In addition GTS has the following tasks: quality

	GTS is responsible for the management, the operation and the development of the national transmission grid on an economic basis. **http://www.gastransportservices.nl/en/**	conversion; flexibility services; to monitor the reliability, quality and safety of the system; to take measures relating to security of supply; to provide other network operators with information in order to allow for safe and efficient transport; and to provide users with information that is necessary for efficient access.
GUD	Gasunie Deutschland. A subsidiary of the Dutch Gasunie.	One of the 6 TSOs/joint owners of the Gaspool market area in Germany.
Heren	See "ICIS-Heren" below.	
High Calorific High Cal H-cal	See "Calorific Value" above	
Hub	A geographical location where multiple participants trade services.	The UK gas hub is 'NBP'; the major US gas hub is 'Henry Hub'; in North West Europe, there are several gas hubs e.g. Zeebrugge (Belgium), TTF (Holland), NCG (Germany), PEGs (France), and others.
ICE (InterContinental Exchange)	InterContinental Exchange is the world's leading electronic marketplace for energy trading and price discovery. ICE Futures (formerly the International Petroleum Exchange – IPE) operates the leading electronic regulated futures and options exchange for global energy markets. ICE's robust trading platform offers participants access to a wide spectrum of energy futures products. Contracts include the Brent global crude benchmark contract, Gas Oil, Natural Gas, Electricity, and ECX carbon financial instruments.	The ICE natural gas futures contract is based on physical delivery of gas at the NBP and was launched in January 1997. It quickly gained acceptance by traders and the relative share of the NBP futures contract to the overall traded volumes of gas at the NBP has now reached in 2012 record levels of around 35%. The exchange publishes a Month Ahead index which is commonly used to settle financial swaps and in indexed physical contracts. It self clears all of its contracts. http://**www.theice.com**
ICIS-Heren	ICIS Heren is a specialist information provider for the gas, LNG, power, carbon and coal markets. Many of its prices and indices are referenced or used in gas contracts, deals and negotiations.	Heren provides extensive coverage of the most widely traded European gas markets, publishing daily, weekly, fortnightly and quarterly reports. **http://www.icis.com/StaticPages/ICISHerenproducts.htm**
I+C (Industrial and Commercial)	One of the three main categories of gas users - defined as 'medium load' customers.	See "Commercial" , "Industrial" and "Residential"
Industrial	Gas customers who are engaged primarily in a process which creates or changes raw unfinished materials into another form or product.	See "I+C (Industrial and Commercial)".
Initial margin	See "margin" below.	
Interruptible Capacity	The variable capacity of a pipeline system in excess of firm capacity.	Interruptible (as-available) capacity may vary from day to day depending on operating conditions, e.g., loads, pressures, ambient temperatures, and the availability of equipment, such as compressor units.
IUK Interconnector	A 40-inch diameter gas pipeline flowing gas to and from Zeebrugge in Belgium and Bacton in East Anglia, England. It has a rated capacity of 20Bcma in 'forward' flow (GB to B) and 25.5Bcma in 'reverse' flow' (B to GB). An additional capacity of up to 3Bcma in either direction can occasionally be made available on an interruptible basis.	It was commissioned in 1998. It is jointly owned by Caisse de dépôt et placement du Québec (23.5%), CDP Investissements (10%), ConocoPhillips (10%), Eni (16.41% - 5% directly and 11.41% through Distrigas), E.ON Ruhrgas (15.09%), Fluxys (15%), Gazprom (10%). **http://www.interconnector.com/**
Langeled	A natural gas pipeline constructed to carry gas from the Ormen Lange field in	Running for 1166 kilometres, Langeled ranks as the world's longest underwater gas pipeline. The northern

	the Norwegian Sea, via the Sleipner East field and processing hub, to the receiving terminal at Easington on the English east coast. It has a capacity of 69.4 Mscm/day or ~25bcma.	leg from Ormen Lange to Sleipner is of 42-inch diameter and the southern leg from Sleipner to Easington is a 44-inch pipe. **http://www.gassco.no/wps/wcm/connect/gassco-en/gassco/home/var-virksomhet/ror-og-plattformer/langeled**
LEBA	London Energy Brokers' Association. LEBA was formed in 2003 to represent the interests of London-based energy brokers and now comprises 10 members.	LEBA provides coverage for all key product groups in the energy sector: oil, gas, power, coal and emissions. One of the key outputs is the provision of power and carbon indices, which have become benchmarks. **http://www.leba.org.uk/**
Line Pack (or Linepack)	Refers to the amount of gas 'squeezed' in to the transmission network pipes at any given time. It therefore represents, in balancing terms, the operational flexibility within the network to run at lower or higher pressure, allowing the TSO to increase or lower the total volume of gas in the system.	Linepack can also be used to balance or move gas over the whole system, using a network of compressors and regulators. However its ability to do this is strictly limited by physical safety constraints and in Britain, this means that operational flexibility is limited to plus or minus 10 mcm/day at any given time.
Liquefied Natural Gas (LNG)	LNG is natural gas that has been converted to liquid form for ease of storage or transportation. It takes up about 1/600th the volume of natural gas in the gaseous state. It is odourless, colourless, non-toxic and non-corrosive. LNG is principally used to transport natural gas to distant markets, where it is regasified and distributed by pipeline.	The liquefaction process involves removal of certain components, such as dust, acid gases, helium, water, and heavy hydrocarbons, which could cause difficulty downstream. The natural gas is then condensed into a liquid at close to atmospheric pressure (maximum transport pressure set at around 25 kPa/3.6 psi) by cooling it to approximately −162 °C (−260 °F). LNG typically contains more than 90% methane.
LNG Terminal	A receiving terminal for LNG shipments comprising: landing jetty and equipment, storage tanks and regasification unit.	
LTC (Long Term Contract)	In Continental Europe, Long Term Contracts are traditionally the way in which large volumes of gas are sold by producers to the importing wholesalers.	These contracts have been for a duration of 20-30 years and the prices are determined by formulae containing rolling averages of crude oil or defined oil product prices.
Lots	Exchange futures contracts trade in 'lots' which are standardised 'packets' of the underlying commodity.	For example: 1 lot NBP = 1000th/d/m 1 lot Baseload power = 1 MWh/h/d 1 lot Brent = 1000bbls 1 lot Gasoil = 100mt
Low Calorific Low Cal L-cal	See "Calorific Value" above	
'M', 'M+1'	'M' stands for 'Month', the delivery month of gas. 'M+1' refers to the month after the month of delivery.	Term used in the trading and accounting of gas to refer to gas delivered in a given month, and to (trans)actions to do with that gas effected either during that month or in the month after delivery.
Margin Margining Initial margin Variation Margin	When trading Exchange futures contracts, margining is the process by which the Clearing House can financially guarantee the performance of those contracts. It does so by collecting an initial margin from each buyer and seller at the opening of each position. Open positions are 'marked to market' at the close of each day against the 'settlement price' to produce a daily profit and loss cash flow; Variation margin is called on a losing position but this will be returned on a profit position.	Margins are set by the clearing house and are determined by assessing historical and current volatility, market liquidity, the size of open positions and an assumption of maximum daily price move. Margins can be in the form of cash or collateral and will be kept by the clearing house until the position is closed out or expires. Different rates apply to outrights and spreads and most clearing houses operate on a netting basis: both intra and inter commodity. This will derive a net/net margin across all of a participant's positions. All margining is calculated each day until the position is closed out or expires.

Market Area (MA)	A gas balancing zone. A market area is a network, or an alliance of several networks or sub-networks connected by interconnection points, in which a transmission customer may use booked capacities at entry and exit points in a flexible manner.	For example, Britain has one MA, the NTS. Germany has two MAs, Gaspool and NCG. Austria is proposing to have three MAs from 1st January 2013, Eastern, Tyrol and Voralberg and possibly, later this decade, have one Regional MA, to include the existing grids of Slovakia, Czech Republic and Hungary.
Market Maker	On traded markets, especially on Exchange futures contracts, a trader who makes a bid/offer spread in order to attract other participants to trade.	Exchanges will often implement Market Maker schemes when introducing new contracts so as to encourage liquidity and therefore new participants to trade.
mcm	Millions of cubic metres.	
MMBtu	Millions of British Thermal Units.	
MWh	MegaWatt hour.	
National Grid (NG)	National Grid plc is an international electricity and gas company and one of the largest investor-owned energy companies in the world. NG owns and operates the National Transmission System (NTS) throughout Great Britain and one of the 4 distribution networks. NG also owns and operates an electricity transmission system in the Northeastern United States.	National Grid is the owner, operator and developer of the majority of Britain's gas transportation system, made up of over 80,000 miles of pipeline, both high pressure national and regional transmission systems, and lower pressure local distribution systems. NG's gas distribution network comprises five of the twelve LDZs, in the heart of England. The US network covers approximately 8,600 miles covering upstate New York, Massachusetts, Rhode Island, New Hampshire and Vermont.
National Grid Gas (NGG)	National Grid Gas (formerly Transco), a division of National Grid, is the GB gas Transmission System Operator (TSO). NGG also owns and operates four LNG storage facilities in the UK. **http://www.nationalgrid.com/uk/Gas/About/**	As TSO, it has a legal duty to balance the system within precise safely parameters as set out in the Unified Network Code. It performs this duty as Balancing Agent on behalf of the shipping community. Day to day operations include balancing supply and demand, maintaining satisfactory pressures and ensuring gas quality standards are met.
NBP (National Balancing Point)	The National Balancing Point (NBP) is a virtual point or location created by the Network Code in order to promote the balancing mechanism detailed in the Code. In effect, it is the whole NTS.	It is where shippers nominate their buys and sells and where National Grid Gas balances the system on a daily basis. The NBP also rapidly evolved as a trading point and is the UK gas hub. Also forms the basis of the ICE futures contract.
NBP'97	Common name denoting the "Short Term Flat NBP Trading Terms & Conditions - 1997", the standardised contract used in Britain for trading gas at the NBP. As well as standardised billing and payment terms, the contract has three very important features that enabled trading to develop successfully.	The three main features are: Participants are 'kept whole', volumes delivered are guaranteed and always equal to volumes traded; Quantities traded are 'flat', volumes traded are delivered at a constant flow rate throughout the delivery period; There is very limited 'Force Majeure': the only relief from the obligation to deliver or take gas from the NTS is an event beyond the control of the affected party to make a nomination.
NCG (NetConnect Germany)	One of the two Market Areas in Germany. Also, the designation of one of the natural gas futures contracts offered on the EEX electronic exchange.	NCG, based in Ratingen, is jointly owned by 6 gas pipeline companies: Bayernets, Fluxys TENP TSO, GRTgaz Deutschland, Open Grid Europe, Terranets bw (formerly GVS Netz) and Thyssengas. **http://www.net-connect-germany.de/cps/rde/xchg/ncg/hs.xsl/index.htm**
Network Code	The document that set out the rules and procedures for third party access to the British pipeline grid and introduced the regime of daily balancing. Its authority was enshrined in the Gas Act (1995). First came into effect in March 1996. Since revised, amended and updated and replaced in 2005 by the Uniform Network Code.	BG plc was obliged, under the conditions of the BG Licence (as determined by the Secretary of State pursuant to section 8(2) of the Gas Act 1995[2]), to prepare a code governing the conveyance and storage of gas.

Nominations	Nominations are used to notify the TSO of expected gas flows (and in Britain, to seal a trade under NBP'97 terms). The nominations procedure is usually conducted through a dedicated computer system for trade nominations.	
Normal Cubic Metre (Nm^3)	One of several measurements in use for quoting the volume of Natural Gas. Defined by the *Deutsches Institut für Normung* in DIN1343 as: The volume of gas measured at zero degrees Celsius, at an absolute pressure of 1.01325bar, at zero relative humidity and at sea level. $1Nm^3$ ~ 37.32614 cu ft	Note that there is no universal standard for the measuring of gas volumes. See also "Standard Cubic Metre" below. $1Nm^3$ = 1.05697 Scm / 1Scm = 0.9461 Nm^3. The volume of a gas is inversely proportional to its pressure, and proportional to absolute temperature. When measuring gases it is important to determine these criteria. Generally speaking, Continental Europe uses Nm^3 in its gas calculations, although each country's definition might be different to the one given here
NTS (National Transmission System)	The NTS is the high pressure part of National Grid's gas transmission system and comprises over 6,600km of high pressure pipeline operating at 45-85bar.	The NTS forms the 'backbone' of gas transportation in Great Britain and provides the 'virtual location' for NBP trading; all gas within the NTS is said to be 'at the NBP'. Gas travels through the network at an average speed of 25 miles/hour.
OCM (On-the-day Commodity Market)	Successor to the Flexibility Mechanism as set out in the Network Code to assist the TSO to balance the NTS daily. Introduced in 1999, it is a screen based trading system operated by APX-Endex.	Trades can be carried out from 12 noon on D-1 up to 15:35 on D by Shippers or the TSO; after that time, the TSO will always be on one side of every trade in its role as balancing agent. Trading ceases at 4am on D.
Off-take Point	See "Exit Point" above.	
OGE (Open Grid Europe)	One of the 6 joint owners of the NCG market area in Germany.	
OTC (Over-The-Counter)	The most common form of trading today, OTC contracts are bilateral, dealt direct or through brokers, by voice or electronic media. See "forwards" above.	The duration can be from spot and prompt to several years forward, in the form of physical or financial deals. Unlike Exchange trading, OTC trading carries counter-party credit and performance risk.
PEG (Point d'Echange de Gaz)	There are 3 French balancing zones known as Points d'Echange de Gaz and each is also a traded hub. PEG Nord and PEG Sud are operated by GRTGaz; PEG TIGF (southwest) is operated by Total.	Also, the designations of the natural gas spot contracts offered on the Powernext electronic exchange. Powernext also offer a PEG Nord futures contract.
Pence/therm	Units used for natural gas traded at the NBP (and also at the Zeebrugge hub).	
Pipeline Quality Gas	Refers to the specific quality of gas to be transported in a pipeline system, as determined by the system operator. Specifications vary between networks. In Great Britain, the specification of the gas that can be entered into the NTS is governed by the Gas Safety (Management) Regulations 1996 [GS(M)R 1996], the full version of which can be accessed at: **http://www.opsi.gov.uk/si/si1996/Uksi_19960551_en_5.htm#sdiv3**	Natural gas, as it exists underground, is not exactly the same as the natural gas that comes through the pipelines to homes and businesses. Natural gas transported through pipelines must meet defined purity specifications. The 3 main groups of parameters are: Energy content: Gross Calorific Value (GCV). Combustion properties: Wobbe Index, Soot Index, Incomplete Combustion Factor, Hydrogen. Additional components: Total Sulphur, Hydrogen Sulphide, Mercaptans (odourisers), Hydrocarbon and Water Dewpoints, Oxygen, CO2, Impurities, Temperature.
Powernext	Powernext is a regulated investment firm based in Paris and operating under the "multilateral trading facility" (MTF) status. Powernext currently operates an	Powernext offers spot contracts for each of the 3 PEGs as well as futures contracts for the PEG Nord. Since 2011 it has also provided an electronic Nord/Sud virtual spread spot contract backed physically by the

	electronic trading platform for spot and derivatives markets in the European energy sector.	TSO, GRTGaz. **http://www.powernext.com/**
PSV (Punto di Scambio Virtuale)	The Italian gas trading hub, a virtual point located between the national network Entry and Exit Points at which the subscriber can trade/sell gas injected into the national network.	The PSV System is the IT platform for trading and selling gas at the Virtual Trading Point and which enables transactions to be registered.
Regasification Terminal	Where LNG vessels are received and their shipment transferred to holding tanks before being reheated and reconverted into pipeline gas.	Usually connected to a storage and pipeline distribution network to distribute natural gas to local distribution companies. In some cases they may directly feed a power station or industrial plant.
Residential	One of the three main categories of gas users defined as 'small load' customers.	See also "I+C" and "Direct Connect".
Re-trading Ratio	See "Churn" above.	
Shipper Gas Shipper Shipper's Licence	Generally, a company transiting or wholesaling gas. In Britain, one of three categories of Licences set out in the Gas Act (1995), alongside Transporters (operators of the distribution pipelines) and Suppliers (selling gas to the end users). The Shippers are in effect the 'wholesalers' of gas, buying from producers and selling to the Suppliers.	Shipper's Licences are granted by OFGEM after due consideration and examination of a proposed licence holder's commercial intentions and financial standing. In extremis, the Licence can be withdrawn if the Shipper does not comply with the rules as laid down in the Gas Act, the Unified Network Code and in the OFGEM licence application.
South Stream	South Stream is a transnational gas pipeline project being developed for the purpose of diversifying the routes of natural gas supplies to European consumers: several routes are being considered to bring Russian gas across the Black Sea to Central and Southern Europe.	In January 2012 and pursuant to the assignment by Vladimir Putin, Prime Minister of the Russian Federation, a detailed action plan was approved to speed up South Stream and to launch the gas pipeline construction in December 2012 instead of 2013. The final investment decision on South Stream is due to be made in November 2012. **http://south-stream.info/?L=1**
Standard Cubic Metre (Scm)	One of several measurements in use for quoting the volume of Natural Gas. Defined by the *International Organization for Standardiszation* in ISO2533 as: The volume of gas measured at fifteen degrees Celsius, at an absolute pressure of 1.01325bar, at zero relative humidity and at sea level. 1Scm ~ 35.31445 cu ft	Note that there is no universal standard for the measuring of gas volumes. See also "Normal Cubic Metre" above. 1Scm = 0.9461 Nm^3 / 1Nm^3 = 1.05697 Scm. The volume of a gas is inversely proportional to its pressure, and proportional to absolute temperature. When measuring gases it is important to determine these criteria. National Grid tends to use Scm in its gas calculations.
Storage	Simply, a means of maintaining a reserve of natural gas to allow supply to match demand, either on a seasonal level or from day to day, to within day. Stored gas helps protect downstream markets, to balance the system and to prevent supply interruptions. The main types of gas storage are: depleted fields, salt caverns, LNG tankage, peak shaving and linepack.	The characteristics of the various types of gas storage are: Depleted fields: High working volume/high injection/ low withdrawal Salt caverns: Low working volume/quite high injection/very high withdrawal Peak Shaving: Low working volume/ low injection/very high withdrawal
Storage Injection	The injection rate is the volume of gas that can be put in to storage over a given period and is dependent on the physical attributes of each type of storage.	Geological storage is most flexible: it can cope with maximum injection rates from just 10% full to 80-90% full.
Swing	A provision common in Long Term Gas Contracts, under which a buyer has the option to vary his demand, in a specified band above or below average contract quantity.	This is an important feature of the 'old style' Long Term Contracts as it provides the buyer with flexibility at no extra cost.

TAG	Trans Austria Gasleitung. A natural gas pipeline system consisting of 3 lines and covering a length of about 380 km, from the Slovakian - Austrian border near Baumgarten to the Austrian - Italian border near Arnoldstein. **http://www.taggmbh.at**	Started in the 1970s, it is now owned by Cassa Depositi e Prestiti (CDP) (89%) and Gas Connect Austria GmbH (11%). The TAG Pipeline System is used for supplying domestic customers in Austria as well as for the transit of natural gas to Italy and, via the SOL Pipeline which connects to it at Weitendorf, to Slovenia also.
Take or Pay (TOP)	A provision common in Long Term Gas Contracts, under which a buyer agrees to purchase and take delivery of a set amount of gas in a given time period (usually a Gas Year), or pay for an equal or lesser quantity of gas regardless of whether delivery is taken.	
Therm	The Imperial unit of measurement for a quantity of gas.	1 Therm = 100,000 Btu 1 Therm = 29.3071 kWh
Third Party Access (TPA)	Open and non-discriminatory access to networks by those who do not own the physical network infrastructure. Fundamental in facilitating greater competition and making energy markets work effectively.	Under EU legislation, owners of interconnectors, storage facilities and LNG import terminals may apply for an exemption from the requirement to offer access to third parties. Exemption is intended to promote the development of such facilities in a competitive market (such as in GB) where it is not necessary for the facilities to be stringently regulated (for example, tariffs would not need to be agreed by the regulator).
Transitgas	A natural gas pipeline system in Switzerland consisting of 36" and 48" single and dual lines, and covering a total length of about 293km. **http://www.transitgas.ch/en/pipeline.aspx**	The pipeline crosses central Switzerland and the Alps from the Wallbach border point with Germany in the north to the Griepass border point with Italy in the south and is connected to the French network at Rodersdorf in the west. The primary capacity holders are Eni Gas Transport International AG and Swissgas AG.
Trayport®	Trayport® design and market systems that enable trading for cleared and OTC markets mostly in commodities. The three products are: GlobalVision Trading Gateway, GlobalVision Broker Trading System and GlobalVision Exchange Trading System.	Trayport® is the foremost supplier of electronic trading and order matching software for Brokers, Exchanges and Traders in the energy industry worldwide. In addition, Trayport supports the operations of all major utilities, investment banks, hedge funds and proprietary trading houses. **http://www.trayport.com/en/splash/**
TSO (Transmission System Operator)	The company(ies) responsible for a gas pipeline system and its safe operation. Some countries have one TSO, others have multiple TSOs. Detailed information on all of Europe's TSOs is available in the ENTSOG Gas Regional Investment Plans (GRIPs) at:	Some European TSOs are: Austria, BOG/OMV/TAG; Belgium, Fluxys; Britain, NGG/IUK; France, GRTgaz/TIGF; Germany, see footnotes 54&55; Holland, Gas Transport Services; Italy, Edison Stoccaggio/Snam Rete Gas. **http://www.entsog.eu/publications/grips.html**
TTF (Title Transfer Facility)	The Dutch gas trading hub, TTF, is a virtual market place where the Dutch TSO, Gas Trading Services (GTS), offers market participants the opportunity to transfer gas that is already present in the GTS system ('entry-paid gas') to another party. Can also be traded as futures contracts on APX-Endex and on ICE.	TTF can serve as a virtual entry point in the portfolio of a shipper or trader who buys gas on TTF, or as a virtual exit point in the portfolio of a shipper or trader who sells gas on TTF. GTS registers the title transfers of gas via TTF by means of a 'nomination'. This is an electronic message stating the volumes of gas transferred, and the purchasing and selling parties.
TWh TWh/mth	TeraWatt hour. TeraWatt hour per month.	
Variation Margin	See "margin" above.	
VTP (Virtual Trading Point)	The virtual location in a Market Area where quantities of gas may be traded after entry and before exit.	The Virtual Trading Point enables the purchase or sale of gas quantities without booked capacities, as well as the transfer of gas quantities between balancing groups. It is not allocated to a physical entry or exit point.

WD Within Day (Trading) Within Day Market	Within Day. Refers to gas that is for delivery on the Gas Day in question; WD Trading is the trading of gas during the Gas Day in question.	
Zeebrugge (ZEE)	A Belgian port and the generic term used for the market hub of the same name. The Zeebrugge Hub is a so-called physical hub, with natural gas made available from neighbouring countries, the nearby LNG terminal or the Belgian market. Connecting to a variety of pipeline gas and LNG sources, the Zeebrugge area has an overall throughput capacity of about 48Bcma.	The Zeebrugge area is considered to be one of the most important natural gas landing points in the EU27. The Interconnector Zeebrugge Terminal (IZT) connects the Belgian grid (operated by Fluxys) to the underwater Interconnector pipeline which runs to Bacton in England. Gassco's Zeepipe Terminal (ZPT) connects Norway's Troll and Sleipner offshore gas fields to the Fluxys grid via the underwater Zeepipe pipeline. The Zeebrugge LNG Terminal serves as a gateway to supply LNG into North West Europe.
ZTP	Zeebrugge Trading Point. The proposed (in spring 2012) new Belgian entry-exit transmission model and offering of title trading. For Press Release, see: **http://www.fluxys.com/en/newsandpress/2012/120206_press_apx.aspx**	Belgian TSO Fluxys and energy exchange APX-ENDEX announced in February 2012 their cooperation in developing the new Zeebrugge Trading Point which will be created when Fluxys switches to a new Entry/Exit model for its transmission grid by the end of 2012. APX-ENDEX will provide the exchange services for the new Zeebrugge Trading Point.

Bibliography

BP Energy Outlook 2030:
http://www.bp.com/sectiongenericarticle800.do?categoryId=9037134&contentId=7068677

BP Statistical Review of World Energy, June 2011:
http://www.bp.com/sectionbodycopy.do?categoryId=7500&contentId=7068481

European Union documents:
*Directive 2009/73/EC of the European Parliament and of the Council of 13 July 2009 concerning common rules for the internal market in natural gas and repealing Directive 2003/55/EC: **http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2009:211:0094:0136:EN:PDF**

***R**egulation (EU) no 1227/2011 of the European Parliament and of the Council of 25 October 2011 on wholesale **E**nergy **M**arket **I**ntegrity and **T**ransparency: **http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2011:326:0001:0016:en:PDF**

*Regulation (EC) No 715/2009 of the European Parliament and of the Council of 13 July 2009 on conditions for access to the natural gas transmission networks and repealing Regulation (EC) No 1775/2005": **http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2009:211:0036:0054:EN:PDF**

EIA (2011) "World Shale Gas Resources: An Initial Assessment of 14 Regions Outside the United States", April 5, 2011: http://www.eia.gov/analysis/studies/worldshalegas/

Foreest (2010): Floris van Foreest: "The Role of Natural Gas in the Dutch Energy Transition"; OIES Paper NG39; January 2010: **http://www.oxfordenergy.org/2010/01/the-role-of-natural-gas-in-the-dutch-energy-transition-towards-low-carbon-electricity-supply/**

Heather (2010): Patrick Heather: "The Evolution and Functioning of the Traded Gas Market in Britain": OIES NG44, August 2010: **http://www.oxfordenergy.org/2010/08/the-evolution-and-functioning-of-the-traded-gas-market-in-britain/**

Honoré (2010): Anouk Honoré: "European Natural Gas Demand, Supply & Pricing: cycles, seasons and the impact of LNG price arbitrage", Oxford University Press, December 2010: **http://www.oxfordenergy.org/shop/european-natural-gas-demand-supply-pricing-cycles-seasons-and-the-impact-of-lng-price-arbitrage/**

Stern (2007): Jonathan Stern: "Is There a Rationale for the Continuing Link to Oil Product Prices in Continental European Long Term Gas Contracts?": OIES Paper NG19; April 2007: **http://www.oxfordenergy.org/?s=NG19**

Stern/Rogers (2011): Jonathan Stern/Howard Rogers: "The Transition to Hub-Based Gas Pricing in Continental Europe"; OIES Paper NG49; March 2011: **http://www.oxfordenergy.org/2011/03/the-transition-to-hub-based-gas-pricing-in-continental-europe/**