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Wholesale Energy Markets in 2015

Report

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Overview:

This report assesses some key indicators that we use to monitor the wholesale energy markets in Great Britain (GB). It gives an overview of conditions in the gas and electricity wholesale markets, and how these compare to previous trends and other similar markets.

Through this report we want to provide independent and reliable information on the wholesale markets in GB. This promotes transparency, improves understanding and shows consumers, market participants and other interested parties how we monitor the markets.

We have been providing information and assistance to the Competition and Markets Authority (CMA) throughout its investigation (including sharing the analysis in this report), and we consider that our analysis supports the CMAs findings. We will continue to support the CMA in the next stage of its investigation.

Context

Market monitoring is a crucial part of our role as the regulator of the gas and electricity markets in GB. It helps us keep abreast of developments, informs how we develop new policy, and helps us to assess the impact of existing regulations.

We are looking to foster understanding, trust and confidence among stakeholders by publishing more information about the markets we regulate. This report is part of a wider package of monitoring publications, including an annual report looking at recent developments in the retail markets; a report detailing trends in liquidity in the wholesale electricity market; and a new suite of energy markets indicators, which we will publish regularly on a dedicated section of our website. We have also begun the regular publication of key indicators tracking the customer service performance of individual suppliers.

These – and other – regular publications will help to build a picture of how the market is functioning and to identify any specific issues. They will also help to track the contribution of the retail and wholesale markets – including the way in which we regulate them – in achieving the outcomes for consumers set out in our strategy: lower bills, improved reliability, better quality of service, benefits for society as a whole and reduced environmental damage.[1] We are keen to hear stakeholders' feedback on these publications to inform future monitoring outputs.

Associated documents

Website Indicators: https://www.ofgem.gov.uk/market-monitoring

Retail Energy Markets in 2015: https://www.ofgem.gov.uk/publications-and-updates/retail-energy-markets-2015

Wholesale power market liquidity: Annual report 2015 https://www.ofgem.gov.uk/publications-and-updates/wholesale-power-market-liquidity-annual-report-2015

Electricity security of supply 2015: https://www.ofgem.gov.uk/sites/default/files/docs/2015/07/electricitysecurityofsupplyreport_final_0.pdf

[1] 'Our Strategy', Dec 2014

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Executive Summary

Introduction

This is our assessment of the wholesale energy markets in GB, which we monitor using a set of indicators. The wholesale markets are where retail suppliers purchase the energy they need from producers, generators and importers. The report gives a general overview of conditions in the gas and electricity wholesale markets, and how these compare to previous trends and other similar markets.

Through this report we aim to provide independent and reliable information about the wholesale markets in GB. This promotes transparency, improves understanding and shows consumers, market participants and other interested parties how we monitor the markets. We intend to publish this report annually.

We are also launching a set of wholesale market indicators on our website. These indicators are a selection of those covered in this report and we will update them regularly.

We are keen to talk to industry stakeholders and interested parties to understand what they think about the data used in this in this report, the indicators we have published on our website, and more about how the wholesale markets are working for them.

On 26 June 2014, we published our decision to refer the energy market to the CMA for investigation. This investigation is ongoing and we have already shared the information in this report with the CMA. The CMA published its summary of provisional findings and notice of possible remedies on 7 July 2015, and we are considering its report carefully. We will continue to support the CMA's investigation as it works towards its final report, currently scheduled for the end of 2015.

Our wholesale markets framework

There are many indicators that can be analysed when monitoring the wholesale markets. We have developed a framework of what we consider to be the key features of a well-functioning wholesale market:

- **Security of supply** – critical for consumers, the economy and wider society
- **Access and liquidity** – makes it easy for market participants to trade and facilitates competition
- **Competition** – drives innovation and puts downward pressure on prices to ensure they are as low as possible
- **Investment and sustainability** – ensures there are adequate, clean supplies of energy for current and future consumers

Trends in energy prices

Wholesale costs are currently the single large component of final consumer bills, accounting for around half of an annual bill. So, understanding what drives changes in wholesale prices is crucial to protect the interests of present and future consumers, which is one of our core aims. Over much of the past decade both gas and power prices have generally risen. But in the last two years, this trend has changed and prices have fallen.

In the gas market, a key driver of the long-term increase in prices since the mid-2000s has been GB's move away from self-sufficiency in gas supplies. GB is now reliant on imports for around half of its gas supplies. This has put GB in direct competition with other countries in what is an increasingly globalised market. What companies in GB pay for gas supplies therefore depends heavily on what companies in other countries are willing to pay and the cost of transporting gas to GB. As many long-term contracts for gas in Europe and Asia are still indexed to the price of oil, rising oil prices over the last decade have fed through into global gas prices.

Since the end of 2013, GB gas prices have fallen. On one hand, this has been because of global factors, such as the loosening of the global supply and demand for gas, and significant declines in the price of oil. On the other hand, falling prices have also been driven by more local factors such as milder winter weather which has reduced demand.

Gas is one of the key fuel sources used to generate electricity in GB, so power prices often reflect changes in the price of gas. As gas prices have risen over the past ten years or so, power prices have also risen. Rising carbon costs have also pushed power prices up, particularly after the Carbon Price Floor (CPF) was introduced in GB. The recent decline in power prices since the end of 2013 has been primarily driven by falling gas prices.

Gas

For **security of supply**, existing gas supply capacity is expected to be capable of meeting demand well into the future. The diverse nature of GB supplies means that GB is resilient to all but the most extreme circumstances. From day to day, the market generally promotes efficient balancing, even though within-day demand is becoming more variable.

On market **access and liquidity**, our indicators suggest that the GB wholesale gas market remains a mature, liquid market with high levels of churn, narrow bid-offer spreads and more active participants. There is a diverse range of products and platforms available for those looking to trade gas in GB. Historically, the majority of trading has been conducted "over-the-counter" through brokers, but in recent years gas trading has shifted towards exchange platforms.

When assessed using a range of standard **competition** metrics, the GB market appears to be competitive and outperforms virtually all relevant European and US benchmarks. The evidence shows low levels of concentration, robust market entry and exit, and low levels of vertical integration.

On **investment and sustainability**, market signals have incentivised significant investment in new import infrastructure in the past decade. Investment in storage has been more muted, but this reflects the current market signals and the declining summer/winter spread. Uncertainty over Government policy and unintended consequences of regulatory interventions can negatively impact investments. On issues of governance and regulatory burden, there have been some encouraging trends, with the number of code modifications falling over time. However, the complexity of many of the new changes continues to pose a challenge. Finally, from a sustainability perspective, demand has fallen in recent years. There are many likely causes of this, one of which is better energy efficiency.

Electricity

For **security of supply**, total generation capacity has been steady over recent years. Retired or mothballed coal, oil and older gas-fired capacity has been replaced by renewables, interconnectors and new gas-fired capacity. The fast pace of conventional generation closures and the intermittent nature of much of the new capacity have meant tightening capacity margins in the near-term. Although generation has been more intermittent, market participants have maintained their ability to balance. To meet the challenges of a changing system and encourage efficient investment in new capacity, the government's Electricity Market Reform (EMR) and our Electricity Balancing Significant Code Review (EBSCR) both introduced a number of changes. Given the risks to security of electricity supply, in 2013 Ofgem approved the Supplemental Balancing Reserve (SBR) and Demand Side Balancing Reserve (DSBR) as extra tools that National Grid could use to help balance the system if the margins tighten.

On **access and liquidity**, when assessed across a number of metrics the GB market appears relatively illiquid compared to some international power markets. There are signs that liquidity is improving since our 'Secure and Promote' reforms were implemented, but it is too soon to draw robust conclusions. Liquidity in the market tends to be clustered in near-term markets and baseload contracts. The majority of trading is conducted through brokered over-the-counter trading.

When assessed using a range of standard **competition** metrics, the GB wholesale electricity market appears reasonably competitive, and compares well with other European markets. The market has seen both entry and exit by generators and suppliers in recent years. Our analysis suggests there is limited scope for generators to exert market power in the GB market, although there does appear to be greater scope for this at a sub-national level because of transmission constraints. We continue to monitor compliance with the Competition Act, REMIT and the Transmission Constraint Licence Condition (TCLC) to ensure parties are not abusing any dominant position.

On **investment and sustainability**, market signals have not encouraged enough investment to halt the trend of tightening margins in recent years. A range of measures have been introduced to resolve this, including EMR and our EBSCR reforms. We, along with National Grid are carefully monitoring the impact of these reforms and capacity margins ahead of Capacity Market (CM) payments in 2018/19. On governance and regulatory burden, there have been some encouraging trends,

with the number of code modifications falling over time. However, the complexity of many of the new changes being introduced continues to pose a challenge. Finally, on the issue of environmental sustainability, output from renewables continues to grow. This has contributed to GB's emissions intensity (the amount of emissions per unit of electricity generated) falling to its lowest recorded level in 2014. Prior to this, the impact of renewables on emissions intensity had been blunted. This is because favourable coal prices relative to gas had been incentivising higher levels of output from coal-fired power stations.

1. Introduction

Chapter Summary

This chapter summarises the scope and purpose of this report. Our framework for monitoring and assessing the wholesale markets is also summarised here. We have structured the report based on this framework. This chapter also provides some background on the role that the wholesale markets play in the energy supply chain and the arrangements that govern how they function.

What is the scope and purpose of this report?

1.1. Monitoring forms a crucial part of our role as the regulator of the gas and electricity markets in GB. We constantly monitor key market trends, such as prices and security of supply, in order to understand the impacts on consumers. We also monitor market participants' compliance with obligations. As well as giving us an up-to-date awareness of market developments, our monitoring informs how we develop new policy, and allows us to assess the impact of policy changes that have already been implemented. These various monitoring activities are essential to ensuring the markets are working for consumers.

1.2. This report is our assessment of a range of key indicators that we monitor on the wholesale energy markets in GB.[2] The wholesale markets are where retail suppliers purchase the energy they need from producers, generators and importers. The report gives a general overview of conditions in the gas and electricity wholesale markets, and how these compare to previous trends and other similar markets. This report does not evaluate policies in the energy market. It is an evidence-based view of how the markets have been performing given the current arrangements.

1.3. Through this report we aim to provide independent and reliable information on the wholesale markets in GB. This promotes transparency, improves understanding and shows consumers, market participants and other interested parties how we monitor the markets. We intend to publish this report annually.

1.4. We are also launching a set of wholesale market indicators on our website to further promote transparency and understanding. These indicators are a selection of those covered in this report and will be updated regularly. We have also published a

[2] This report also contains the necessary analysis to support our work related to new European requirements for considering any potential amendments to GB's bidding zones configuration within the electricity wholesale market. The CACM European network code establishes a detailed process for all EU Member States to consider their bidding zone configuration (ie, maintaining, splitting or merging of price zones). An important element to this, led by ACER and supported by NRAs, is the triennial Market Report which will assess the market efficiency of existing arrangements.

separate report and accompanying set of indicators for the website on the retail markets.

Next steps

1.5. We are keen to engage with industry stakeholders and interested parties to get their views on the data used in this in this report, the indicators we have published on our website, and to understand more about how the wholesale markets are working for them. You can email us at wholesalemarketindicators@ofgem.gov.uk.

CMA investigation

1.6. On 26 June 2014, we published our decision to refer the energy market to the CMA for investigation.[3] This investigation is ongoing and we have already shared the information in this report with the CMA.

1.7. The CMA published its summary of provisional findings on 7 July 2015. In its report, the CMA provisionally found that its analysis has not provided evidence of adverse effects on competition in the wholesale gas and electricity markets. However, the CMA did provisionally find that some aspects of the wholesale electricity market rules and regulations do constitute adverse effects on competition. These include the absence of locational pricing for losses and the allocation mechanisms for awarding Contracts for Difference (CfDs). The CMA also found evidence of adverse effects on competition when looking at the governance and regulatory framework in the gas and power markets more broadly. It identified a lack of robustness and transparency in regulatory decision-making and concerns with the certain aspects of the industry code governance process.

1.8. Alongside its provisional findings the CMA published its notice of possible remedies. The notice set out possible actions which the CMA might take in order to remedy, mitigate or prevent the issues it identified in its provisional findings.

1.9. We welcome the CMA's provisional findings and notice of remedies and will continue to support the CMA's investigation as it works towards its final report, currently scheduled for the end of 2015. We will work with it, to develop and implement its final remedies, where they fall within our jurisdiction, to deliver a more competitive market for consumers.

Our wholesale markets framework

1.10. There are many indicators that can be analysed when monitoring the wholesale markets. We have developed a structured, clear approach to assessing the

[3] https://www.gov.uk/cma-cases/energy-market-investigation

markets. This should make it easier to explain the results of our monitoring to stakeholders and consumers.

1.11. Our framework shows what we consider to be the key features of a well-functioning wholesale market. This framework has indicators that can be assessed in order to provide a comprehensive view of the how the wholesale markets are functioning. We have sought to ensure that this framework is simple and manageable, but also open to adaptation and change over time. This report is structured based on our framework.

1.12. We have started with summarising the purpose of the market in a single sentence. This is then underpinned by the four key features that we consider the market should have if it is to achieve the objective. Finally, our framework ends with a range of indicators that can be assessed using quantitative or qualitative analysis and evidence to see if each of these features is present.

1.13. In developing this framework, we have sought to be consistent between gas and electricity where possible. The framework is not intended to provide a perfect representation of how a well-functioning wholesale market is structured or operates. Neither does it try to weigh or prioritise different elements of the market. In flagging up the range of indicators that we should be looking at, our framework can help highlight possible trade-offs. However, it does not say how those trade-offs should be managed, or set any kind of target for the indicators identified.

1.14. A well-functioning wholesale market should benefit consumers by making the wholesale price as low as possible, given the underlying factors driving the costs of supplying gas and electricity in GB. It should provide the incentives and the investment framework to reduce environmental damage and ensure secure supplies. The market should facilitate innovation and improvements to the quality of service received by those who rely on the market. Further, we believe that a well-functioning wholesale market creates benefits to wider society, notably through providing stable and improved economic performance.

1.15. In light of this we consider the overarching objective of gas and electricity wholesale markets is: **to provide a dynamic and sustainable mechanism in which informed participants can confidently and efficiently buy and sell the energy they need at a price that reflects economic costs**.

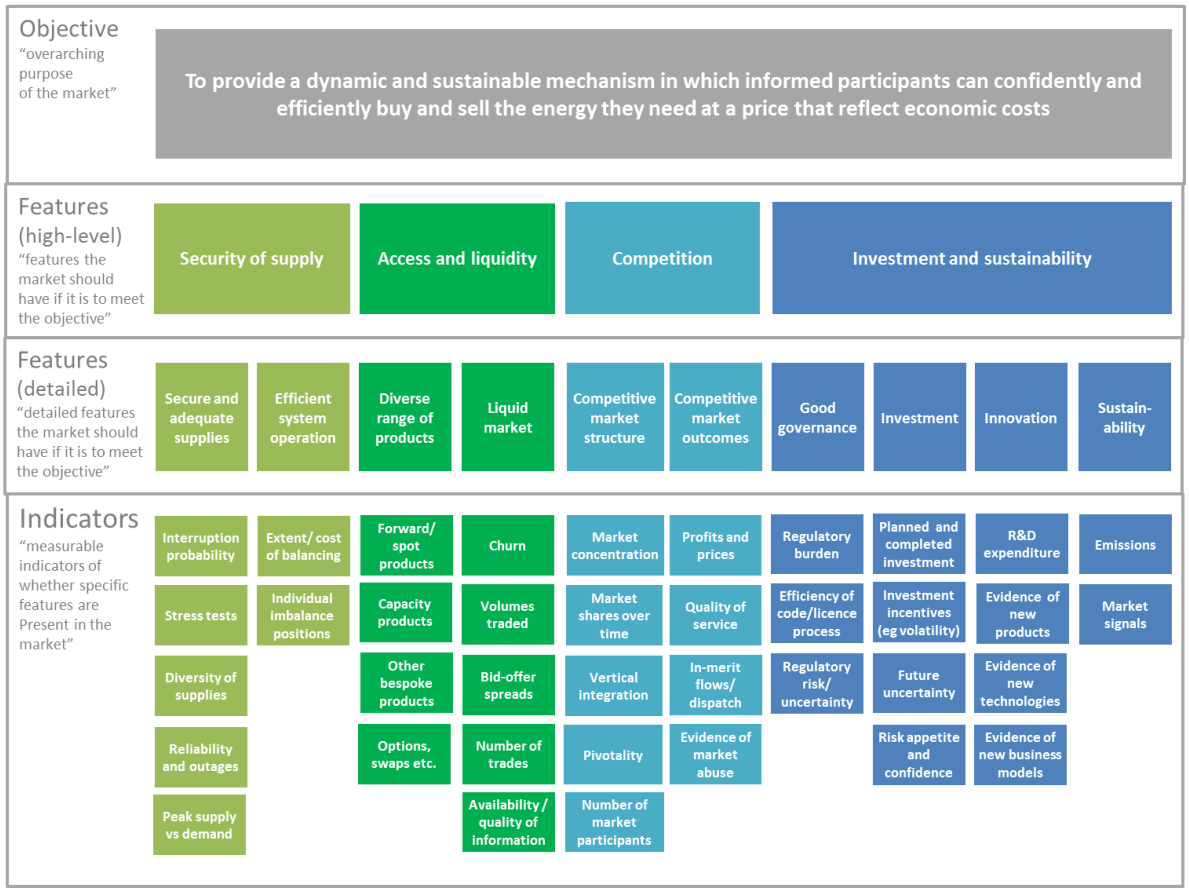
1.16. In order to achieve this objective, we consider that there are four high-level features that the wholesale gas and electricity markets should have:

- **Security of supply** – critical for consumers, the economy and wider society
- **Access and liquidity** – makes it easy for market participants to trade and facilitates competition
- **Competition** – drives innovation and puts downward pressure on prices to ensure they are as low as possible

- **Investment and sustainability** – ensures there are adequate, clean supplies of energy for current and future consumers

1.17. The indicators that we monitor cover all four of the key features. When assessed together, these indicators provide a broad view of how the market is functioning. The framework and many of the key indicators we assess are summarised in Figure 1 below. The framework is explained in greater detail in Appendix 1.

Figure 1: Wholesale markets indicators framework



1.18. Our framework is based on the assumption that a well-functioning wholesale market is an integral part of ensuring the energy market works for consumers. The table below indicates where we believe the features of our framework play a role in Ofgem's key consumer outcomes. These are in our strategy statement.[4]

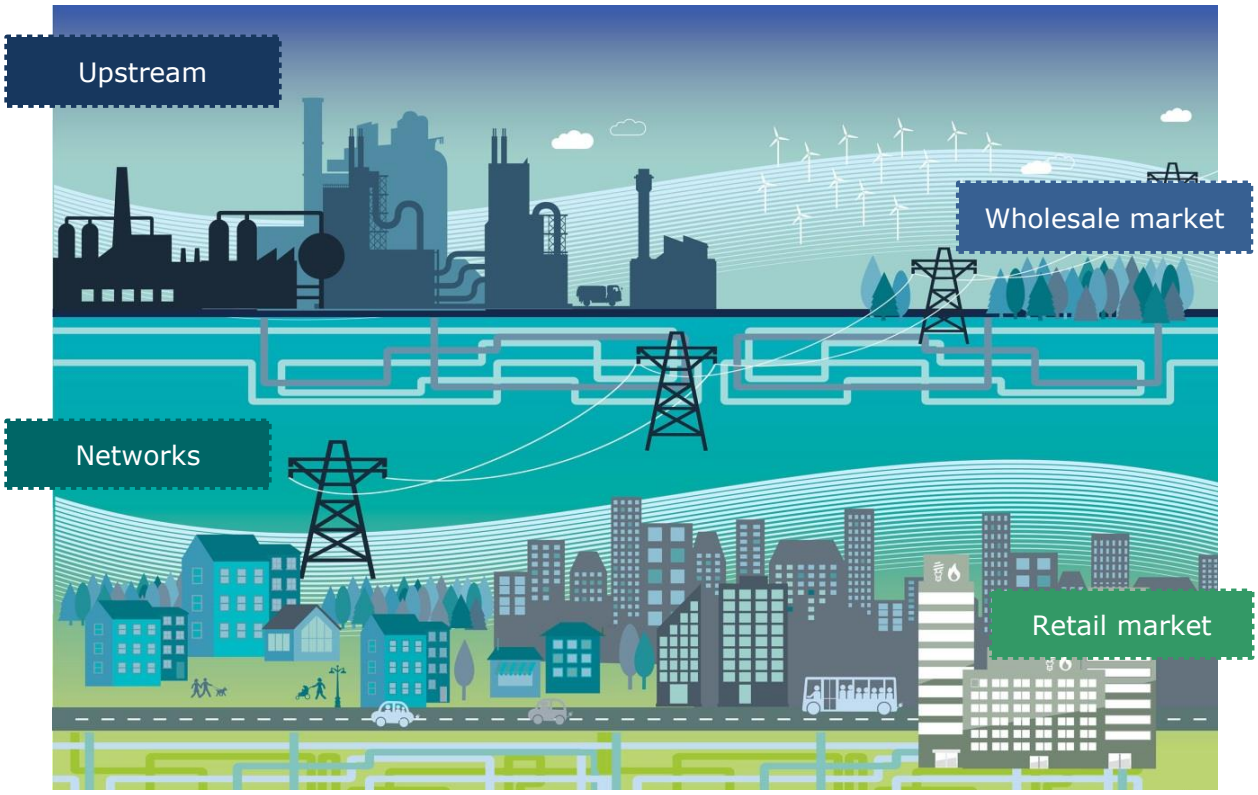
[4] https://www.ofgem.gov.uk/publications-and-updates/ofgem-our-strategy

Wholesale market framework features:	Ofgem consumer outcomes				
	Lower bills	Reduced environmental damage	Improved reliability	Better quality of service	Benefits to society
Security of supply			✓		✓
Access and liquidity	✓				
Competition	✓			✓	✓
Investment and sustainability	✓	✓	✓	✓	✓

What are the wholesale markets?

1.19. The vast majority of the gas and electricity that is consumed in GB must pass through a number of stages in the energy supply chain before it reaches the consumer's plug or meter. Figure 2 below is a brief summary of these various stages in the energy supply chain.

Figure 2: The energy supply chain



	Upstream	Wholesale market	Networks	Retail market
Gas	The gas supply chain begins when gas is extracted. This gas is then brought to GB by pipelines or on LNG tankers.	Once gas has reached GB it enters the wholesale market. Upstream producers and importers compete to sell their gas on to retail suppliers.	Various gas market participants pay gas pipeline operators to transport their gas through the pipes in the network.	The gas supply chain ends with the retail market. Here suppliers compete to sell gas on to end consumers.
Power	The power supply chain begins with the fuels that generate most of our power (coal, gas, uranium). We also import power from neighbouring countries.	Once power has been generated or imported into GB it enters the wholesale market. Generators and power importers compete to sell their power on to retail suppliers.	Various power market participants pay power grid operators to transmit their power through the wires in the network.	The power supply chain ends with the retail market. Suppliers compete to sell power on to end consumers.

1.20. The wholesale markets are where gas and power are bought and sold by several different types of participants. Companies that produce or import energy (eg electricity generators and gas producers) sell their energy in the wholesale markets. Companies that consume energy (eg large industrial companies) or have customers that consume energy (eg retail suppliers) buy the energy they need in the wholesale markets. There are also some companies whose primary focus is trading (eg banks and trading houses). They use the wholesale markets to optimise assets, provide liquidity, manage risk and speculate on market movements.

How do the wholesale markets work?

1.21. In 1980s and 1990s the gas and power industries were privatised. As a result, the wholesale markets for gas and power were established and this opened much of the sector up to competition. The process of privatisation has played an important role in formulating the arrangements that exist today, and is described in more detail in Appendix 2.

1.22. The wholesale market arrangements in GB are founded on open, non-discriminatory third-party access to the transmission and distribution networks. This allows market participants to transport their gas and power throughout GB according to terms that are fair and transparent. Market participants must pay transmission and distribution charges to network companies in exchange for these transportation services.

1.23. The wholesale markets are based on the principle of market participants balancing their own physical and traded positions. This is the combination of what

they physically flow in and out of the networks and what they contract to buy and sell. The market is therefore the primary mechanism by which the gas and power networks are balanced.

1.24. The system operator (SO) carries out a residual role in which it resolves any imbalances and locational issues that remain after the market has run its course. While the SO's general purpose is the same in gas and power, there are differences in the way it carries out its role in the two markets. The SO in gas is National Grid Gas (NGG). The SO in electricity is National Grid Electricity Transmission (NGET).

1.25. Where market participants fail to balance they must pay imbalance (cash-out) charges. These imbalance charges incentivise balancing and help compensate the SO for any actions it takes to balance the system.

1.26. Table 4 in Appendix 2 explains in more detail how the gas and electricity wholesale markets arrangements work in GB.

The recent policy environment

Europe

1.27. The move towards greater physical connection and harmonisation of market rules across Europe continues to require changes to the wholesale markets, as well as other aspects of the arrangements such as system operation. These reforms are intended to encourage more effective cross-border competition, by ensuring electricity and gas flows to the markets where they are most valued. The process to develop these rules is set out in law and voted on by European Member States. The new European rules will take the form of European Regulations and a number of these have already come into force.

1.28. Another key change to the wholesale markets has been the introduction of REMIT. This is an EU regulation on energy market integrity and transparency that came into force on 28 December 2011. It provides a consistent EU-wide regulatory framework specific to wholesale energy markets for identifying and penalising market abuse. This helps consumers, industry and other participants feel confident that wholesale energy prices are open, fair and competitive: the foundations of an effectively functioning energy market.

Gas

1.29. The policy environment in gas has been relatively stable for quite some time, particularly when compared to the electricity market. A key recent change to the GB wholesale gas market arrangements has been the reforms introduced by our Gas Security of Supply Significant Code Review (Gas SCR).[5] The Gas SCR changes aim to

[5] https://www.ofgem.gov.uk/gas/wholesale-market/market-efficiency-review-and-reform/gas-

ensure that, in a national gas supply emergency, the market rules provide appropriate incentives on gas market participants to secure supplies and balance supply and demand. The Gas SCR also initiated the development of a centralised mechanism for paying large consumers if they are able to reduce their demand before an emergency. This is intended to avoid or minimise an emergency and protect consumers that incur high costs when interrupted.

Electricity

1.30. Recently the Government introduced the EMR[6], leading to a period of change in the wholesale electricity market. EMR is a programme of reforms aimed at ensuring security of electricity supply while helping the UK achieve its decarbonisation goals affordably. CfDs are a new financial support mechanism intended to lower the cost of funding low-carbon generation by providing certainty about the revenues generators can expect to receive for their output. The CPF increases the cost of operating carbon-intensive generation sources such as coal-fired generation. The Emissions Performance Standard (EPS) also effectively prohibits the construction of new generation sources that exceed a certain level of carbon-intensity. Lastly, a new CM has been introduced to provide direct availability payments to generators. This is intended to incentivise investment in new capacity.

1.31. Our EBSCR[7] is also bringing changes to the market. EBSCR allows prices in the wholesale market to better reflect the costs of balancing the system, and thereby improves the strength of the signal in the wholesale market for flexible generation and demand side response. Flexible generation is increasing in importance as more intermittent renewable generation comes online.

1.32. Our recent 'Secure and Promote'[8] interventions to improve liquidity are also expected to bring about changes in the wholesale electricity sector. These reforms will make it easier for smaller, non-vertically integrated suppliers to access the traded products they wish to buy and at a reliable price.

significant-code-review-scr

[6] https://www.ofgem.gov.uk/electricity/wholesale-market/market-efficiency-review-and-reform/electricity-market-reform

[7] https://www.ofgem.gov.uk/electricity/wholesale-market/market-efficiency-review-and-reform/electricity-balancing-significant-code-review

[8] https://www.ofgem.gov.uk/electricity/wholesale-market/liquidity

2. Trends in energy prices

Chapter Summary

Wholesale costs are currently the largest component of final consumer bills. So, understanding what drives changes in wholesale prices is crucial to protect the interests of present and future consumers. Over the past decade, both gas and power prices have generally risen as GB has moved away from self-sufficiency in gas supplies and must compete in a global marketplace. Over this period, gas-fired generation has been setting the power price, and as such wholesale electricity prices have followed the wholesale price of gas.

In the last two years, this trend has changed however and prices have fallen. This has been driven by a combination of the loosening of global gas markets, significant declines in the price of oil and local drivers such as mild weather, which has reduced demand.

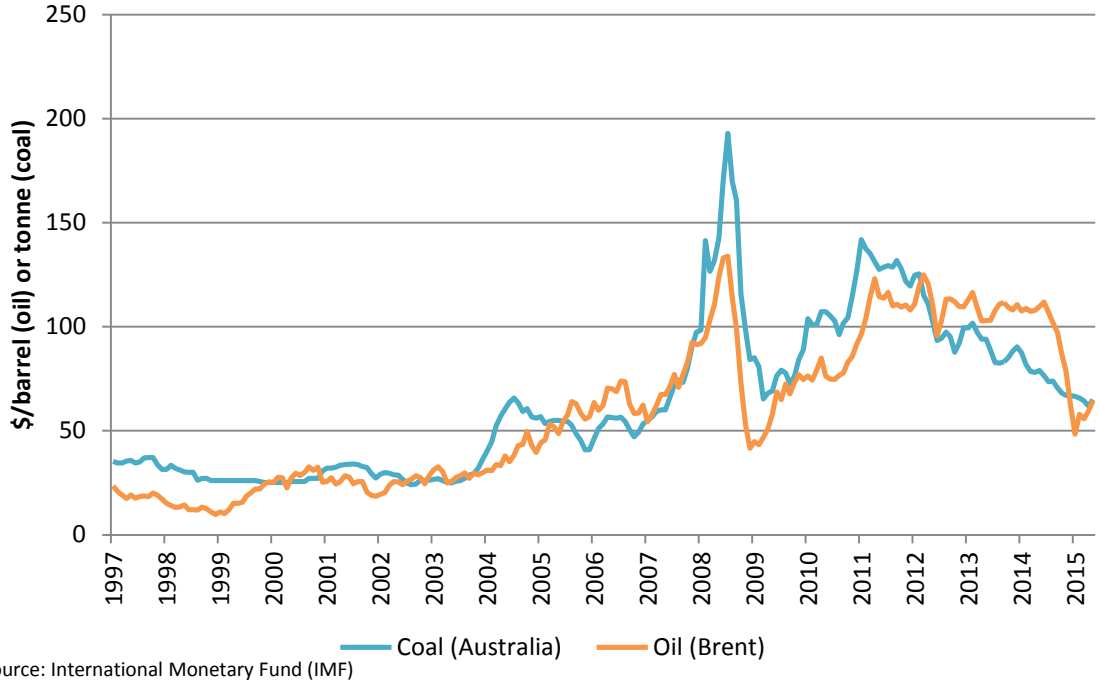
2.1. A crucial outcome of the gas and electricity wholesale markets is prices. Wholesale costs typically make up around half of the average domestic consumer's bill. Understanding how and why wholesale prices change over time is therefore very important to our aim of protecting the interests of present and future consumers.

2.2. In a competitive market wholesale prices are based on the cost of the marginal source of supply. This is the final source of gas or electricity supply needed to meet demand. What makes up the marginal source of supply will vary depending on what supplies are available, the costs of those supplies, and the level of demand.

Coal, oil and carbon prices

2.3. Wholesale gas and electricity prices are influenced by the prices of a number of other energy commodities. Of particular importance are coal and oil prices.

Figure 3: Monthly average coal and oil prices, 2000-2015



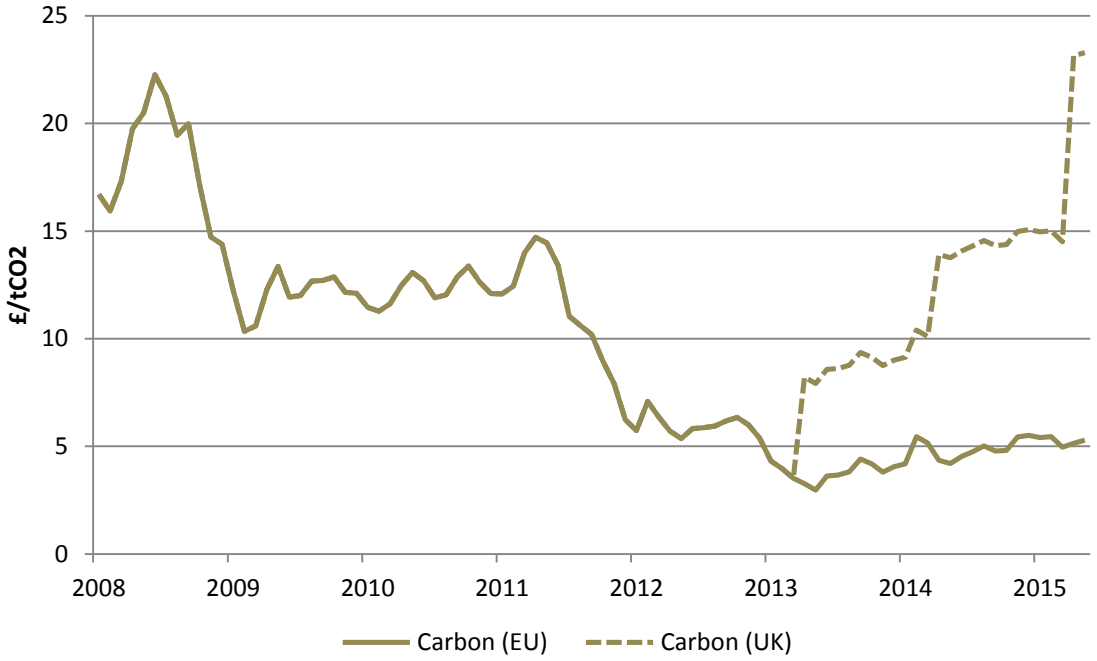
Source: International Monetary Fund (IMF)

2.4. Coal prices are important for the wholesale electricity market because a significant portion of GB's electricity is generated from coal. Oil prices are important for the wholesale gas market. A key reason for this is that historically a large number of long-term gas contracts in Europe and Asia have been indexed to the price of oil. This means oil prices affect gas prices in the global market for gas.

2.5. Electricity prices are also affected by the price attached to carbon. Fossil fuel power stations in the EU must hold allowances in order to emit CO_2. These allowances are traded through the EU Emissions Trading System (ETS) which was established in 2005 and provides a traded price for carbon.

2.6. The EU ETS price peaked in 2008 at around £22/tCO_2. Since then it has declined significantly due to an oversupply of allowances, and is now around £5/tCO_2. On 1 April 2013, GB introduced a CPF. This effectively sets a minimum price for carbon in GB by "topping up" the EU ETS carbon price. The main intent of the CPF is to send a strong, stable incentive to invest in low carbon generation. This is what is driving the divergence between the EU ETS carbon price and the effective GB price for carbon shown in Figure 4 below.

Figure 4: Monthly average carbon prices in Europe and the UK, 2008-2015



Source: Bloomberg, DECC, Bank of England

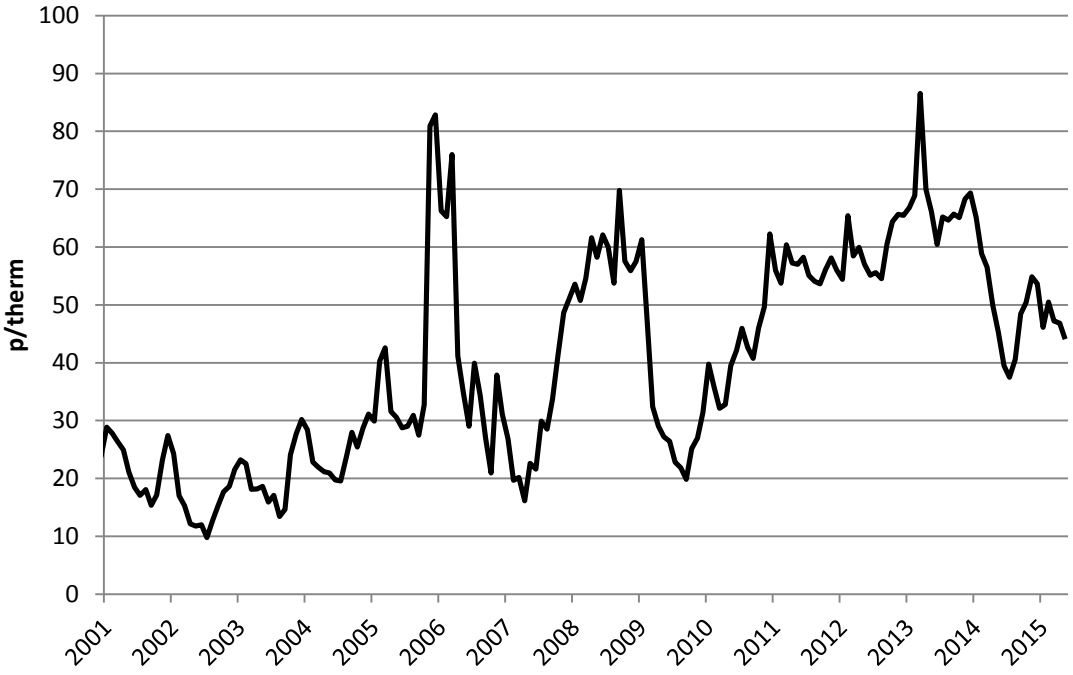
Wholesale gas prices

Long-term trends

2.7. Throughout much of the 1990s and early 2000s, GB met almost all of its gas demand from UK Continental Shelf (UKCS) production in the North Sea. Prices were therefore almost exclusively based on the cost of extracting and transporting this domestically-produced gas. UKCS production was solely supplied to the GB market with the remainder exported on to Ireland and Belgium. As a result, GB was not significantly exposed to global market pressures. GB wholesale gas prices at the National Balancing Point (NBP)[9] in the late 1990s and early 2000s were roughly 20p/therm (~£7/MWh).

[9] The National Balancing Point is a virtual point created by the market arrangements. It is where gas shippers nominate their trading activity to and is the notional point that National Grid balances the system against. Conceptually it can be thought of as representing "the GB gas network". All parties balance their inputs, outputs and trading at that point.

Figure 5: Monthly average wholesale gas prices (NBP Day-ahead), 2003-2015



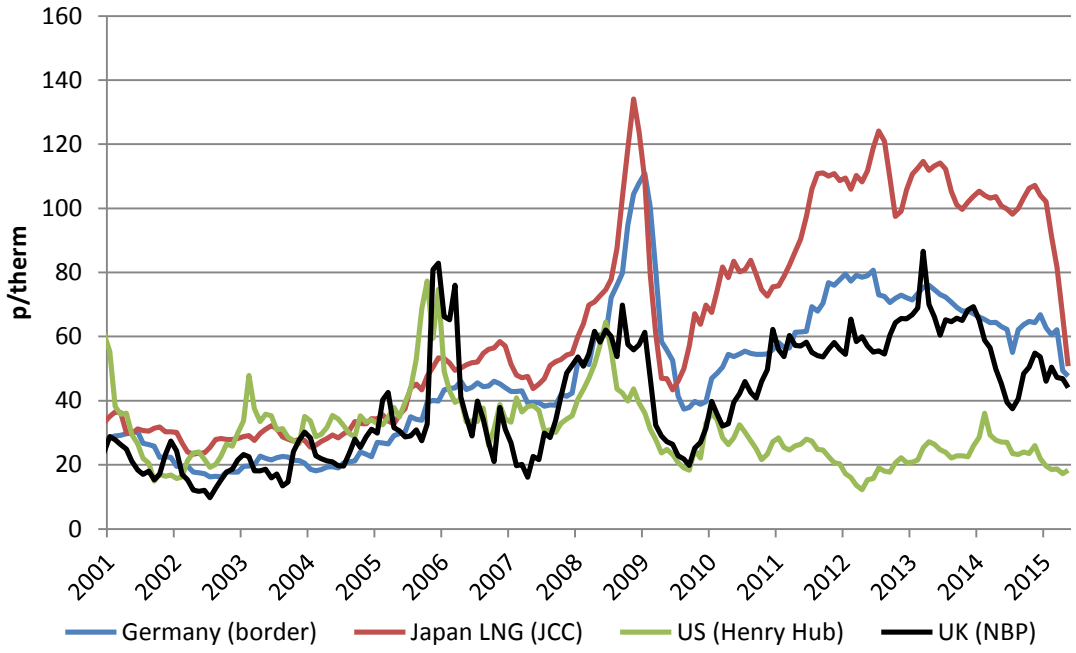
Source: ICIS

2.8. As the UKCS has matured, the cost of production has increased and production volumes have declined. As a result, GB has moved to being reliant on imports for around half of its gas supplies. These imports have come from Norway, Continental Europe and global liquefied natural gas (LNG) markets. In general, these imports have been more expensive than past UKCS production. As imported supplies have become the marginal source of supply, prices have had to rise to attract the supplies needed to meet demand. In the early 2000s wholesale gas prices began to rise and, despite significant variation from year to year, have roughly tripled to 60p/therm (~£20/MWh).

2.9. GB gas demand has fallen in recent years. Normally this would lead to a reduction in prices as more expensive supply sources are no longer needed to meet demand. However, because UKCS production has declined so rapidly, falling demand has not reduced our reliance on imports.

2.10. A key reason why imports have been more expensive than GB's domestic production is that they place companies in GB in direct competition with companies in around the world in what is an increasingly globalised market. What GB companies pay for imported supplies therefore heavily depends on what companies in other countries are willing to pay, and the effectiveness of the global market for gas. Gas prices in a number of key global markets are shown in Figure 6 below.

Figure 6: Monthly average global wholesale gas prices, 2000 - 2015[10]



Source: IMF, Bloomberg, ICIS, Bank of England

2.11. Figure 6 highlights a number of important trends. In the decade up to 2009 global gas prices generally moved together, and over that period the trend was broadly upwards. Since then, two key events have led to a big divergence in global gas prices. First, the 2011 Fukushima disaster led to an increase in Japanese demand for LNG as gas-fired power stations were needed to run when the Japanese nuclear fleet was shut down. This led to a substantial increase in the price Japan had to pay to secure these additional imports. Second, the shale gas boom in North America led to a decrease in US prices. A lack of capacity to export gas to other global markets has meant these declining prices have mostly been confined to the US. As this divergence between US and Asian prices has occurred, European prices have remained largely in the middle. Because GB is directly connected with other European countries, GB prices tend to move closely with prices in Continental Europe.

2.12. In recent years, the US has moved back towards self-sufficiency in gas supplies, so GB's main competitors for imports have been countries in Asia and

[10] In looking to show prices for LNG in Japan, there is no one agreed market price like the NBP price for GB. The prices agreed in long-term contracts are also usually confidential. As such a proxy called the JCC (Japan Crude Cocktail) is shown here. Japanese LNG contracts are generally indexed to the price of oil with a three month lag, and so the JCC is generally a good guide to movements in the Japanese price for gas. We also sense check this against recorded prices for delivered LNG. For example, the Japanese Ministry for Economy, Trade and Industry publishes some price information.

Europe. As can be seen in Figure 6, prices in these regions have been increasing and are considerably higher than a decade ago. As noted earlier, in Japan this has been partly a result of the Fukushima disaster. However, another factor driving this has been oil prices. Many companies in countries throughout Asia and Europe have tended to secure much of their gas through large, inflexible long-term gas supply contracts.[11] These contracts are often indexed to the price of oil. Given the rise in oil prices over much of the last decade (see Figure 3) gas delivered under these contracts has also increased in price. Rising prices in Europe and Asia have therefore meant prices in GB have also had to rise in order to compete and attract the imports needed to meet demand.

2.13. Finally, another reason why imports have often been more expensive than domestic production is transportation costs. Gas from Norway must be transported through longer pipeline networks to reach GB. The same can be said for gas from Continental Europe, which itself will have come from places as far afield as North Africa or Russia. LNG entails a supply chain spanning even greater distances. Most of our LNG is shipped from Qatar (see Figure 15). Transporting gas over greater distances generally entails a cost, which is reflected in the price paid.

Recent price movements

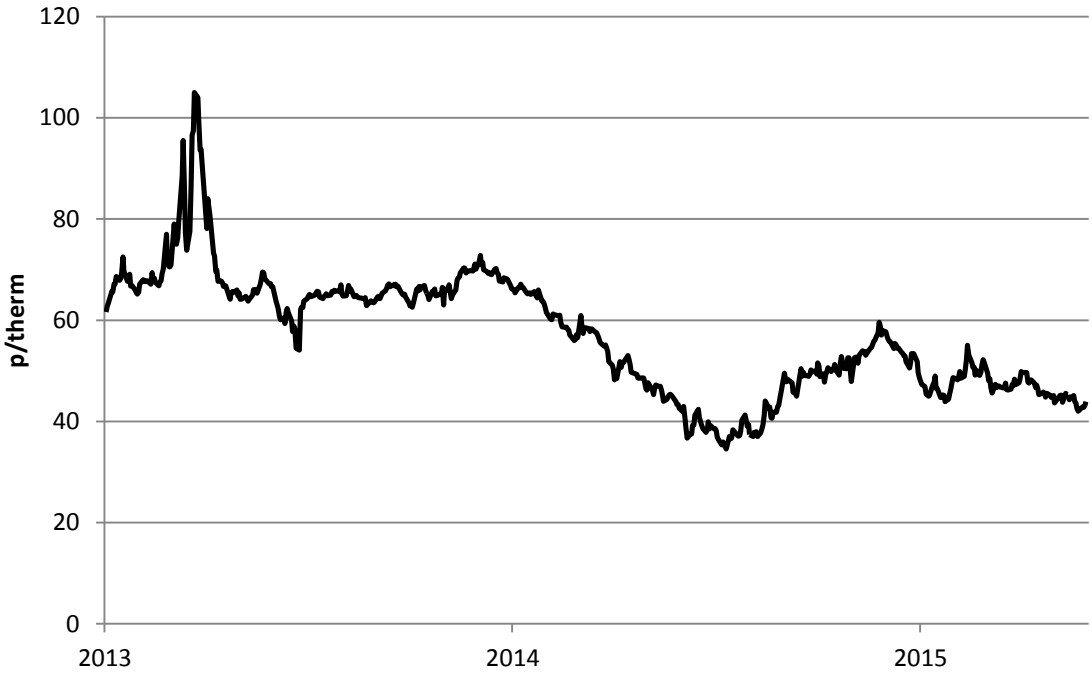
2.14. Wholesale gas prices in GB have fallen, since their highs in 2013. Prices in 2014 were on average down 26% on prices in 2013.

2.15. A key driver for the decline in 2014 has been the dramatic decline in oil prices. This has fed through into gas prices due to the oil-indexation of many long-term gas contracts. There have also been changes in the global supply and demand for gas. Gas demand from a number of key markets in Europe and Asia that traditionally compete with GB for gas imports was relatively weak, particularly for LNG. This has occurred as a number of new supply sources are coming online.

2.16. There has been more localised impacts such as weather. In GB there was a relatively cold winter in 2012/13, culminating in a price spike at the end of March. The winters in 2013/14 and 2014/15 were relatively mild. As demand and prices are generally higher during a cold winter, some of the year-on-year decline can be attributed to the weather. Furthermore, the mild 2013/14 winter meant gas storage was not heavily used. This led to a particularly loose supply picture during the summer of 2014 as gas demand from storage injections remained limited.

[11] These contracts also generally include a commitment to take a certain volume of gas or pay a penalty. This creates certainty that the gas will arrive, but also comes at a cost in terms of the price paid and the penalties incurred if demand falls.

Figure 7: Daily wholesale gas prices (NBP Day-ahead), 2013-2015



Source: ICIS

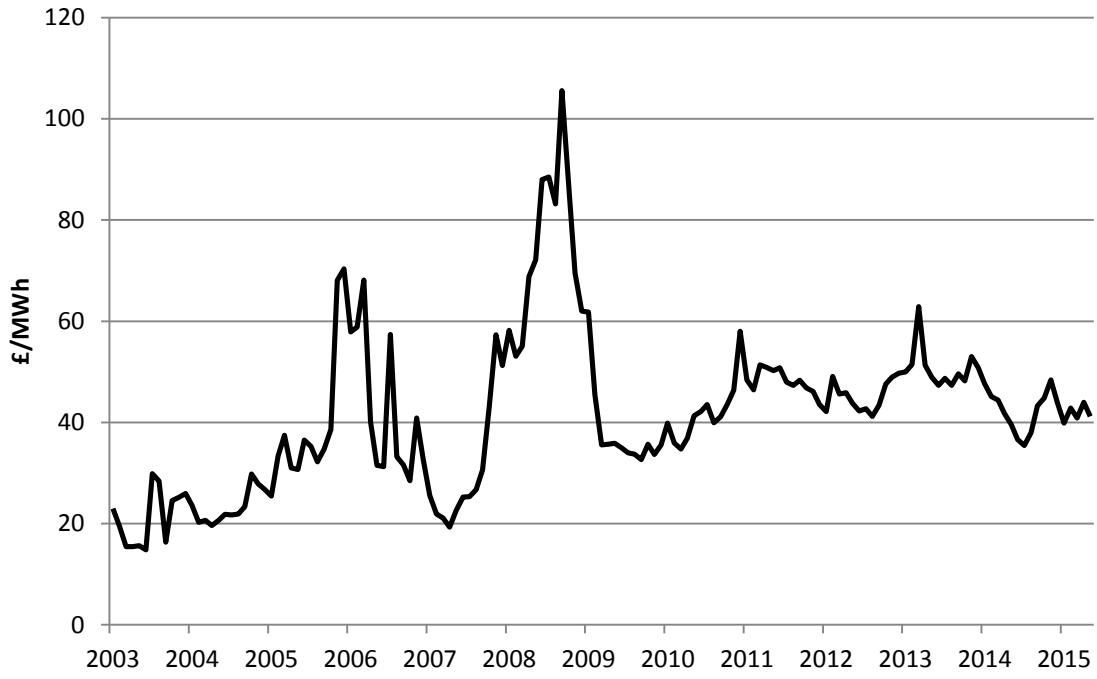
Wholesale electricity prices

2.17. Rising wholesale gas prices have been matched by rising wholesale electricity prices, as can be seen in Figure 8. Prices in the early 2000s were ~£20/MWh but have risen to ~£50/MWh in recent years.

2.18. Power prices in GB over the past decade have largely been driven by changes in the gas price. This is because gas-fired generation is often the marginal source of supply and hence sets the electricity price. As the price of gas rises, so does the cost of generating electricity using gas. This feeds through into the electricity price.

2.19. Over the same period coal prices have not seen the same gains, and in recent years they have actually fallen (see Figure 3). This has led to an increase in the proportion of electricity generated from coal when compared to gas. However, this has not led to a reduction in prices because some gas plant has generally still been needed to meet demand, and has therefore remained the marginal source of supply.

Figure 8: Monthly average wholesale power prices (baseload Day-ahead), 2003-2015



Source: ICIS

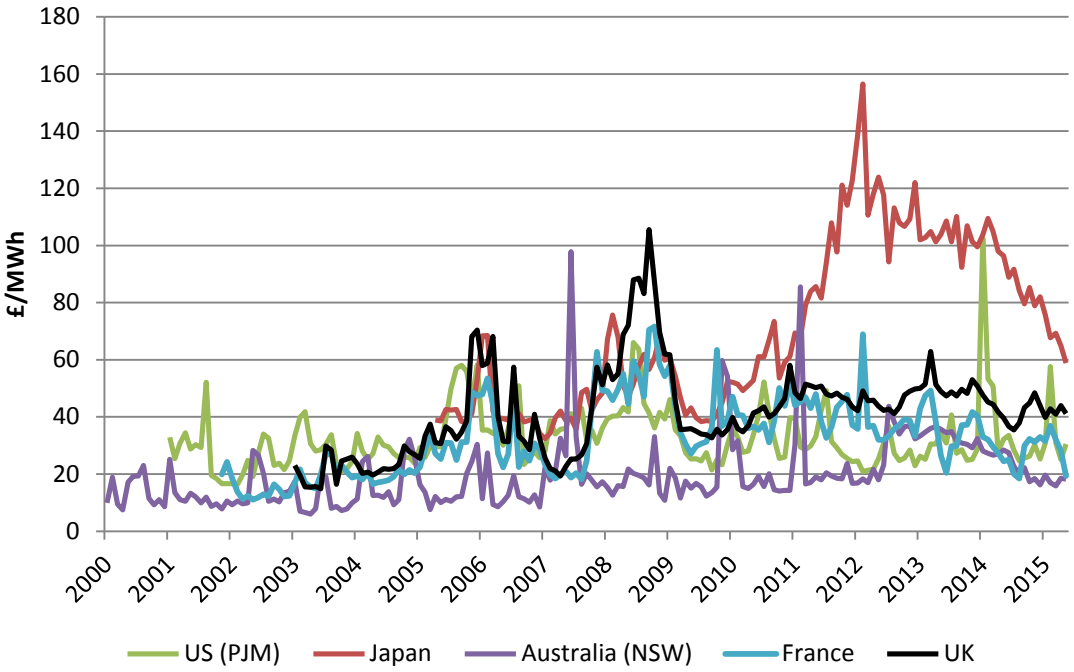
2.20. Power prices have also been influenced in recent years by changes in carbon prices (see Figure 4). Although not as important as the impact of changes in gas prices, carbon costs have still played their part in the long-term trend of increasing wholesale electricity prices.

2.21. The growing penetration of renewable energy sources is also having an increasingly significant effect on wholesale electricity prices. Renewable energy sources, like wind in the case of GB, have very low marginal costs (zero fuel costs). They also receive subsidies when they generate. This means electricity generated from wind effectively displaces other power stations which have higher marginal costs. This has the effect of reducing the price of electricity in the wholesale market as the more expensive plant are no longer required to run when the wind is blowing. As renewables continue to contribute more to the generation mix, we expect that the impact this has on the wholesale price will increase. In Germany, where renewables already play a larger role in the generation mix than in GB, wholesale electricity prices are now highly correlated with the volume of wind and solar output.

2.22. Figure 9 shows wholesale electricity prices in a number of markets around the world. Electricity cannot currently be transmitted and traded globally, and so there is not a global market for power in the same was as there is for gas. This means there is limited scope for convergence between GB and markets in the US, Australia or Japan. Where GB is directly connected to other markets in Europe, such as France, there is greater scope for convergence as electricity can be transferred between markets. However, these transfers are limited by the amount of interconnection capacity linking the two markets.

2.23. Furthermore, it is also the case that there are very different policies in place in these different markets that can have a significant impact on prices. For example, carbon pricing is currently in place in GB but is not in the US or Japan, and was abandoned in Australia. Although other European countries are part of the EU ETS, they are not subject to the CPF that has been introduced in GB, and so their carbon prices have been lower than those in GB in recent years.

Figure 9: Monthly average global wholesale power prices, 2000-2015



Source: ICIS, JEPX, AEMO, PJM ISO, Bloomberg, Bank of England

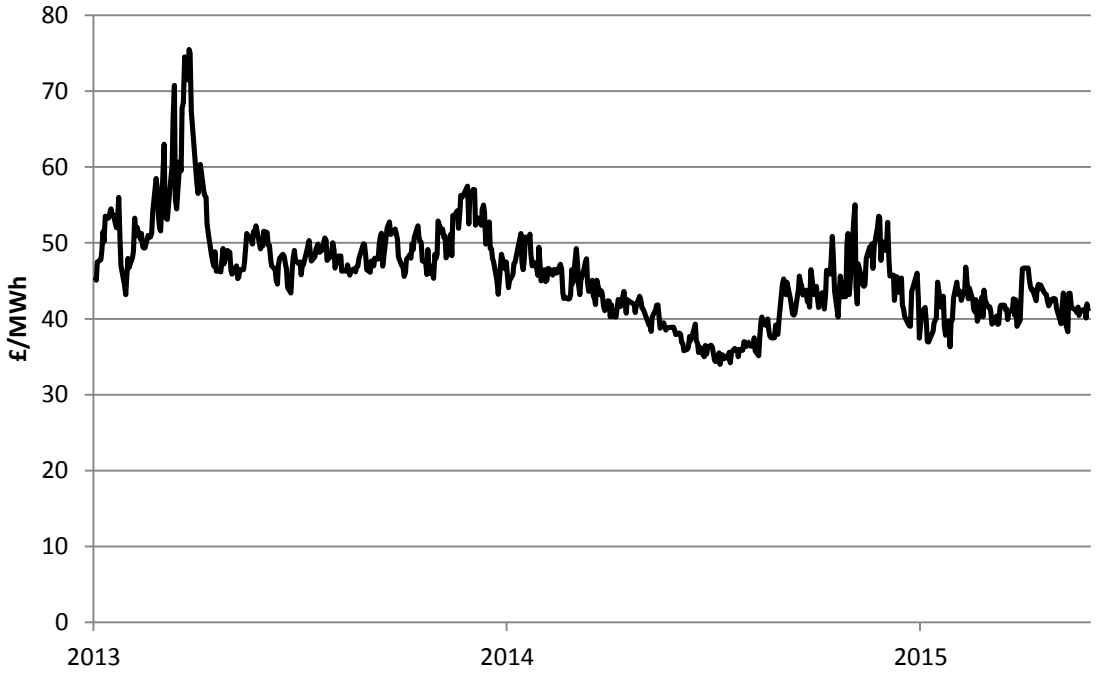
2.24. Bearing this in mind a number of markets around the world show similar power price trends to those observed in their respective gas markets. This is reflected in the substantial increase in Japanese power prices after 2011, and the decline in US power prices over that same period. This indicates that gas-fired generation is important to setting power prices in these markets. Australian prices have tended to be consistently below those in the other markets shown here. This is because Australia has historically generated the vast majority of its electricity from coal and has access to abundant domestic coal reserves. As GB is directly connected with its European neighbours, such as France, GB prices tend to move closely with prices in Europe. The recent divergence between GB and French prices is in part due to the GB-specific nature of the CPF. This divergence in prices has contributed to an increase in interconnector flows to GB in recent years.

Recent price movements

2.25. Over the past year wholesale power prices in GB have also fallen. This has been driven by falling gas prices reducing the fuel costs of gas-fired power stations.

However, the declines have not been to the same extent as in the gas market, with power prices in 2014 on average down 16% on prices in 2013. Wholesale power prices did increase again at the end of 2014 as demand rose during the winter, but have generally still remained below the levels reached in recent winters.

Figure 10: Daily wholesale power prices (baseload Day-ahead), 2013-2015



Source: ICIS

2.26. There are a number of reasons why wholesale power prices have not fallen as much as wholesale gas prices. First, carbon prices affect power prices, but not gas prices. The uplift created by the CPF was almost doubled in April 2014 from £4.94 to £9.55 per tonne of CO_2e. This provided an upward pressure on power prices that counteracted some of the impact of declining gas prices. Second, unplanned outages at a number of power stations in the run-up to the 2014/15 winter meant the supply outlook was not as comfortable in the power market as it was in the gas market. This was likely factored into power prices. Finally, fuel costs are only one component of the costs incurred by gas-fired power stations. Their other costs, such as network charges and operational and maintenance costs, did not change significantly over this period. This means any change in gas prices is unlikely to result in a one-for-one change in the overall marginal costs of generating electricity using gas.

3. Gas

Chapter Summary

For **security of supply**, existing gas supply capacity is expected to be capable of meeting demand well into the future. The diverse nature of GB supplies means that GB is resilient to all but the most extreme circumstances. From day to day, the market generally promotes efficient balancing, even though within-day demand is becoming more variable.

On market **access and liquidity**, our indicators suggest that the GB wholesale gas market remains a mature, liquid market with high levels of churn, narrow bid-offer spreads and a growing number of active participants. There is a diverse range of products and platforms available for those looking to trade gas in GB. Historically, the majority of trading has been conducted "over-the-counter" through brokers, but in recent years gas trading has shifted towards exchange platforms.

When assessed using a range of standard **competition** metrics, the GB market appears to be competitive and outperforms virtually all relevant European and US benchmarks. The evidence shows low levels of concentration, robust market entry and exit, and low levels of vertical integration.

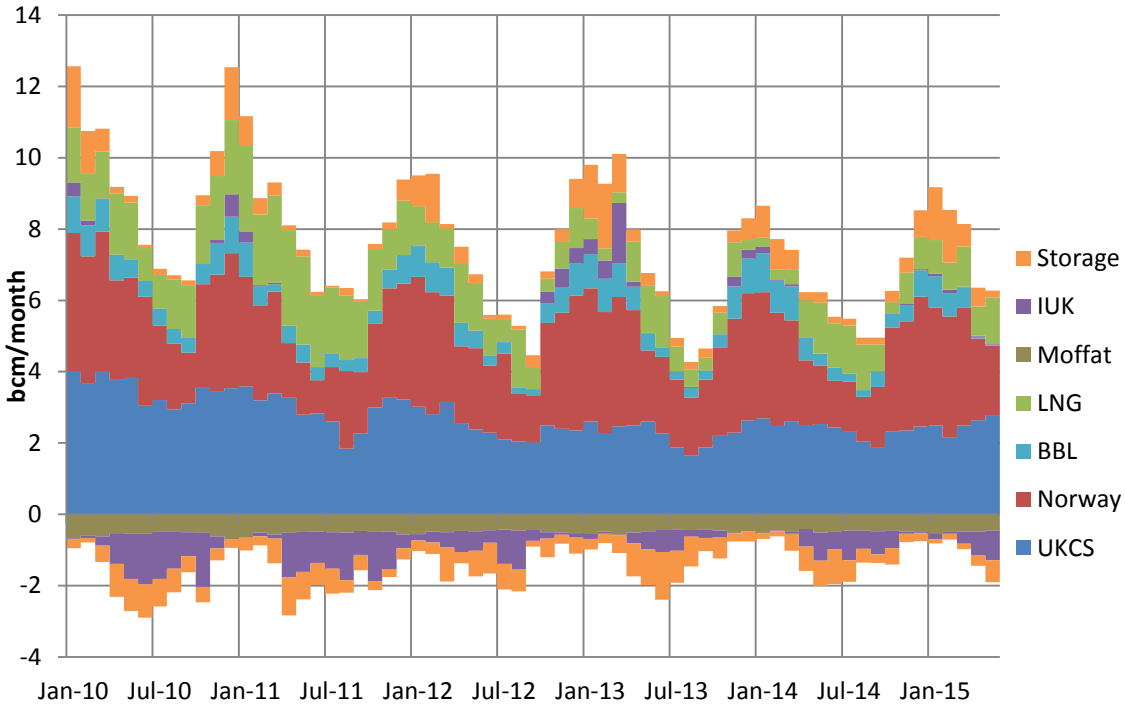
On **investment and sustainability**, market signals have incentivised significant investment in new import infrastructure in the past decade. Investment in storage has been more muted, but this appears to be in line with market signals and the declining summer-winter spreads. Uncertainty over Government policy and unintended consequences of regulatory interventions can negatively impact investment. On issues of governance and regulatory burden, there have been some encouraging trends, with the number of code modifications falling over time. However, the complexity of many of the new changes continues to pose a challenge. Lastly, from a sustainability perspective, demand has fallen in recent years. There are many likely causes of this, one of which is better energy efficiency.

Security of supply

3.1. Historically the vast majority of GB's gas supplies came from UKCS production in the North Sea. As domestic production has declined, GB have increasingly imported gas from a diverse range of sources. Figure 11 illustrates the make-up of our gas supplies over the last five years. The key trends are explained in

3.2. Table 1.

Figure 11: Detailed gas supply breakdown, Oct 2009 – Mar 2015[12]



Source: National Grid, Ofgem analysis

[12] The gas market operates according to "gas years" (eg 2009/10). These start in October. The winter season runs from October to March and the summer season runs from April to September. Positive values in the chart represent supplies to the GB system. This includes withdrawals from storage and imports via interconnectors. Negative values represent supplies from the GB system. This includes injections to storage and exports via interconnectors. For simplicity, gas entering at the St. Fergus terminal has been assumed to be from the UKCS for the Mobil subterminal and from Norway for the Shell and Total subterminals. This marginally overstates the amount of Norwegian gas.

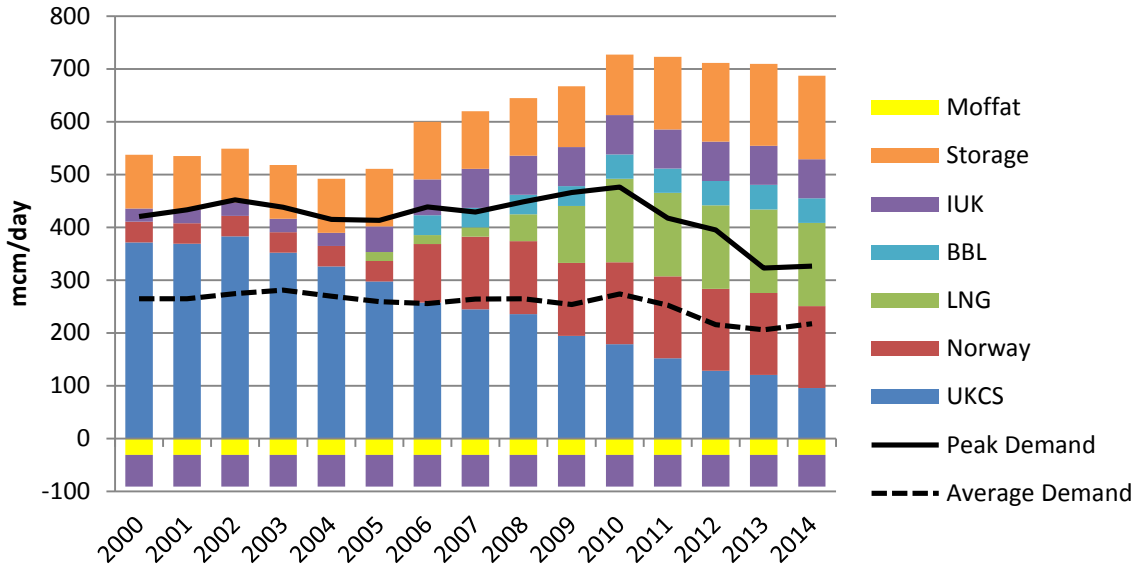
Table 1: Gas supply source summary

Supply:	Summary:
UKCS	GB's domestic gas production has continued to decline as the UKCS has matured and is now able to supply roughly half of annual GB demand.
Norway	The greatest volume of GB's imported gas comes from pipelines that connect GB to Norwegian production fields. Imports from Norway are greater in winter when demand is higher.
BBL	BBL is a physically one-way interconnector that allows GB to import gas from the Netherlands.[13] Flows have remained largely steady in recent years, with higher flows in the winter when demand is higher.
IUK	IUK is a two-way interconnector linking us to Belgium. GB tends to export to Belgium in the summer when GB wholesale prices are often lower. The reverse is generally the case in the winter. As domestic production has declined, GB's net exports via IUK have fallen.
LNG	GB's imports of LNG depend on the global market for LNG. Since 2011, global demand has risen faster than supply. As such LNG deliveries to GB have fallen.
Storage	Storage generally fills in the summer when prices and demand are low, and empties in the winter when the opposite is the case. Storage injections and withdrawals have varied depending on the extent of winter demand and the availability of alternative supplies. Even in the winter storage only makes up a small proportion of GB's total supplies.
Moffat	GB also exports gas to Ireland via the one-way Moffat interconnector. These exports have marginally declined over time.

3.3. In order for GB to have **secure supplies**, there needs to be enough supply capacity to meet demand. In the last decade, GB gas supply capacity has increased while demand has fallen. As such we consider that the likelihood of supply being unable to meet demand is low. This is the case when looking at both peak day demand in the winter, as well as total demand over the course of a year.

[13] BBL does also have a virtual reverse flow ability, which means in practice it should be able to behave as a two-way interconnector.

Figure 12: GB gas supply and interconnector capacity, 2000 - 2014[14]



Source: National Grid, GIE, ENTSOG

3.4. A range of studies conducted for our Gas SCR showed that GB's resilience is expected to remain well into the future. This is partly because GB's sources of supply are diverse. Our analysis suggests that only the combination of several simultaneous supply losses during a cold winter would truly test the market's ability to meet demand. The most recent example of a period where a range of events occurred together and tested the resilience of the system was in March 2013. Box 1 shows that while supplies were stressed during this period, GB was still some way from experiencing a supply emergency.

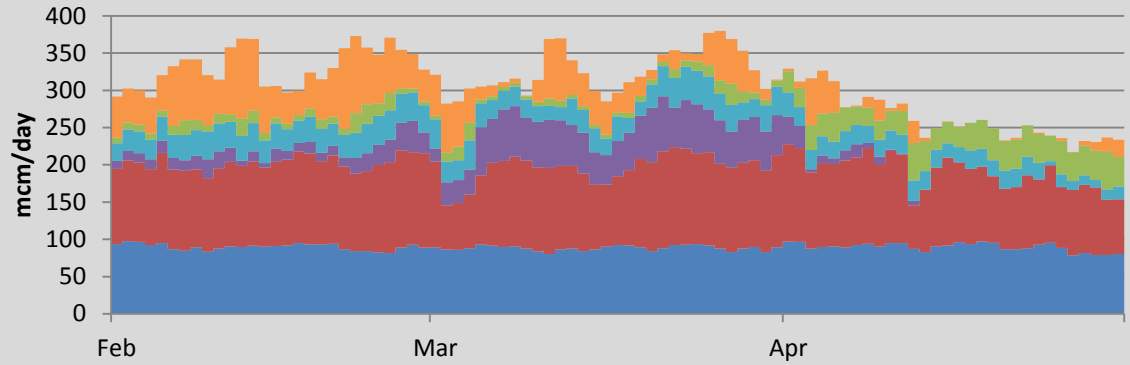
Box 1: Gas security of supply case study, March 2013

A useful case study of the impact of supply outages on the GB system is the cold period experienced in March and April 2013. The winter of 2012/13 was the coldest in the last 20 years, leading to above-average demand, particularly at the end of the winter. GB also experienced a number of supply difficulties, with low LNG deliveries due to a tight global market, and lower than expected UKCS production. The result was that by March 2013 gas storage stocks were heavily depleted and imports from the Continent were playing an important role in the supply mix. Storage had been filling up in the previous few months, in part due to record imports from IUK.

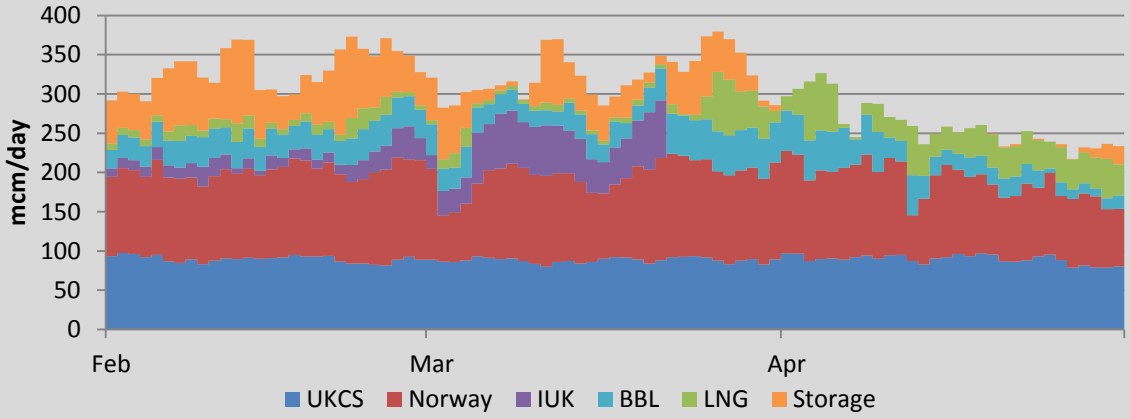
On March 22, IUK went offline due to an unexpected equipment failure, interrupting imports from Belgium. This caused within-day prices to spike to over £1.50/therm. Ultimately the outage lasted a few hours and the market responded well.

[14] Moffat capacity is assumed to be 31 mcm/day as this is the capacity of the pipeline connecting GB with Ireland and Northern Ireland.

Figure 13: 2012/2013 IUK stress test, actual (top) and counterfactual (bottom)



Source: National Grid, Ofgem analysis



Source: National Grid, Ofgem analysis

Our analysis indicates that even if the fault on March 22 had been more severe and IUK had remained offline for the rest of the winter GB still would have had access to sufficient supplies to meet demand. Where gas was previously imported to GB via IUK (see top chart), increased flows from storage,[15] BBL[16] and LNG[17] should have been able to replace this in the event that IUK remained offline (see bottom chart).

These results are possible even after making several conservative assumptions, such as assuming no increased LNG deliveries,[18] no increased flows from UKCS and Norway[19] and no reductions in demand due to demand-side response (DSR).[20]

[15] Any storage injections were set to zero and supplies from storage were increased until stocks emptied. More complex dynamic modelling of storage would be unlikely to materially alter the findings. There are some minor discrepancies in the shapes of total demand between the actual and counterfactual charts. This is due to the changes made to storage injections, but does not amount to a relaxing of the analysis.

[16] BBL imports were increased to maximum capacity as long as this was required.

[17] Flows from LNG terminals were increased until stocks were drawn down to an assumed operational lower limit of 10% fullness.

[18] This seems reasonable in the short-term given it usually takes a few weeks for LNG ships to reach GB. Over time additional LNG deliveries could have arrived.

[19] This was done because both are relatively inflexible and making alternative assumptions on what to increase them to is problematic. Even so, some increase in flows over the period after

3.5. A growing dependence on imports has changed the nature of the security of supply challenges that GB faces. As can be seen in the example in Box 1, GB increasingly relies on a smaller number of large pieces of import infrastructure (eg LNG terminals or interconnectors) and this increases the potential impact of a single piece of infrastructure failing. Import dependence has also made GB more sensitive to events that are much further afield. For instance, the 2011 Fukushima disaster led to an increase in Japanese demand for LNG, thus restricting the supplies available to GB.

3.6. To date the GB wholesale gas market has never experienced a national gas supply emergency in which consumers supplies had to be involuntarily curtailed. There have been instances of gas supply emergencies occurring in other well-developed markets though. For example, in February 2011 New Mexico, Arizona and Texas experienced severe cold weather that resulted in gas supply losses and record consumer demand. This ultimately led to some consumers being curtailed.[21]

3.7. In looking at GB security of supply, we also consider the role of **long-term contracts** for gas imports. Long-term contracts can be an important way of improving certainty that gas supplies will be available many years into the future. However there is also a trade-off here. Long-term contracts often entail paying a premium for the gas supplied, or sacrificing some degree of flexibility by being tied into purchasing a certain volume of gas many years into the future. Different companies in different countries choose to manage this trade-off in different ways by relying to a greater or lesser extent on long-term contracts. Overall long-term contracts are a less prevalent feature of the GB market than is the case elsewhere. GB contracts also tend to be priced based on the GB wholesale market price for gas, rather than indexed to oil.

3.8. Figure 14 shows a snapshot from 1 October 2014 of the amount of gas that GB gas shippers have procured through long-run gas import contracts. The data is for imports only so does not capture all long-run gas contracts (eg those for domestic production). Figure 14 shows that the annual import volume potentially covered by long-term contracts is currently just over 40 bcm. This equates to roughly half of total GB demand. Although this may seem to be a significant portion of GB's total supplies, these contracts can be divided into those that are firm and those that are interruptible. In general a firm contract means that the party supplying the gas is obliged to supply the firm volume and the party buying the gas is obliged to take that volume.[22] The volume of our long-term import contracts that are firm is 16 bcm. This equates to roughly one-fifth of total GB demand.

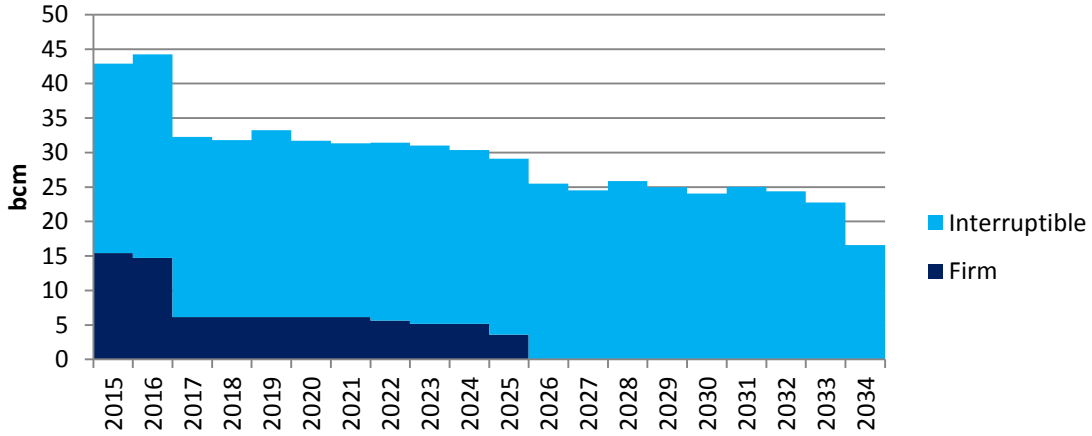
March 22 was probably still possible as these sources were not operating at capacity.

[20] Historically large consumers (eg industrial consumers and gas-fired power stations) have provided DSR at times of system stress when prices have spiked. A more severe outage on IUK would likely have resulted in higher prices, incentivising further DSR provision.

[21] Source: FERC, "Report on Southwest Cold Weather Event of February 1-5 2011".

[22] Importantly though, even firm contracts do not necessarily oblige the seller to physically

Figure 14: Long-term gas import contract volumes, by contract type, 2014

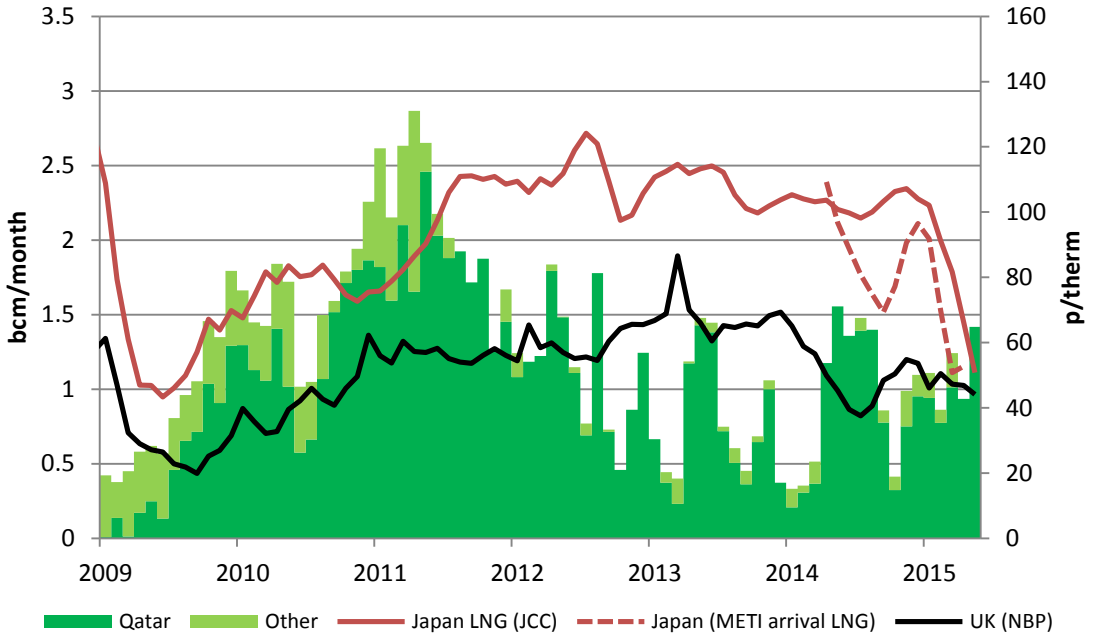


Source: Ofgem information request to shippers

3.9. Contracts that are not firm are generally called interruptible contracts. These contracts contain various clauses that mean the volume stipulated in the contract does not necessarily have to be supplied. For example, all LNG contracts in GB are essentially interruptible. Delivery is usually depending on the situation elsewhere in the global LNG market. Given higher prices in other key LNG destinations in recent years (notably Japan) imports due to these contracts have fallen. However, if increased security of supply risks in GB caused wholesale prices to rise relative to other global markets, these contracts suggest that LNG deliveries to GB should increase. In the last year, the global LNG market has loosened and Japanese LNG prices have fallen, leading to a pickup in LNG deliveries to GB (see Figure 15).

flow gas to GB. The seller may also be allowed to simply buy the gas in the GB market and pass it on to the relevant counterparty in the event that this is cheaper.

Figure 15: LNG flows in GB by origin and NBP vs Japanese price trends, 2009-2015[23]



Source: DECC Energy Trends, ICIS, Bloomberg, Japanese Ministry for Economy, Trade and Industry

3.10. As for **efficiently operating and balancing the system**, the variability of the within-day balance of supply and demand has been increasing in recent years. Despite this, National Grid Gas (NGG) continues to successfully execute its SO role of residual balancer. The gas market is balanced daily. During normal activity NGG generally takes actions to balance the system approximately two days in five, meaning the market balances itself without interventions by the SO on the majority of occasions.

Access and liquidity

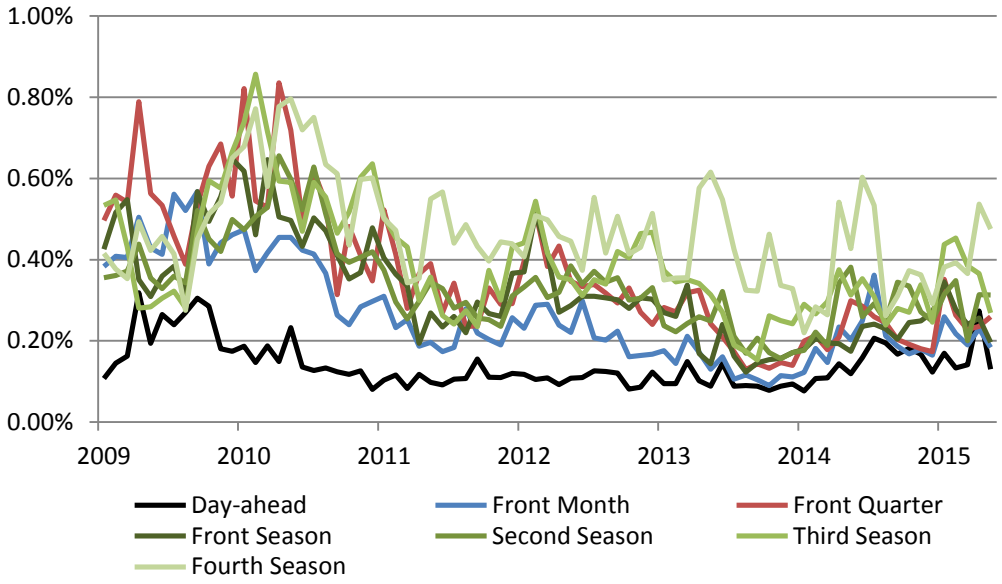
3.11. When assessing the ease with which market participants can buy and sell the gas they need we are generally talking about market liquidity. Historically the GB gas market has been the largest and most liquid in Europe.[24] **Bid-offer spreads** measure the difference between the best bid (to buy) and the best offer (to sell) in the market. In a liquid market with lots of trading parties, competition should cause

[23] It was noted in the footnote for Figure 6 that in looking to show prices for LNG in Japan, there is no one agreed market price like the NBP price for GB. The prices agreed in long-term contracts are also usually confidential. To more clearly highlight the recent price trends two prices are shown here. The solid red line is the JCC proxy price shown earlier in Figure 6. The dotted red line shows a recent series of prices for LNG cargoes published by the Japanese Ministry for Economy, Trade and Industry.

[24] Source: Patrick Heather (2012), "Continental European Gas Hubs: Are they fit for purpose?".

the difference between the bids and offers in the market to narrow. Tight spreads are therefore a useful indicator of liquidity. Bid-offer spreads for a range of gas contracts in GB continue to remain consistently low, as shown in Figure 16 below.

Figure 16: Bid-offer spreads for select traded products, 2009- 2015

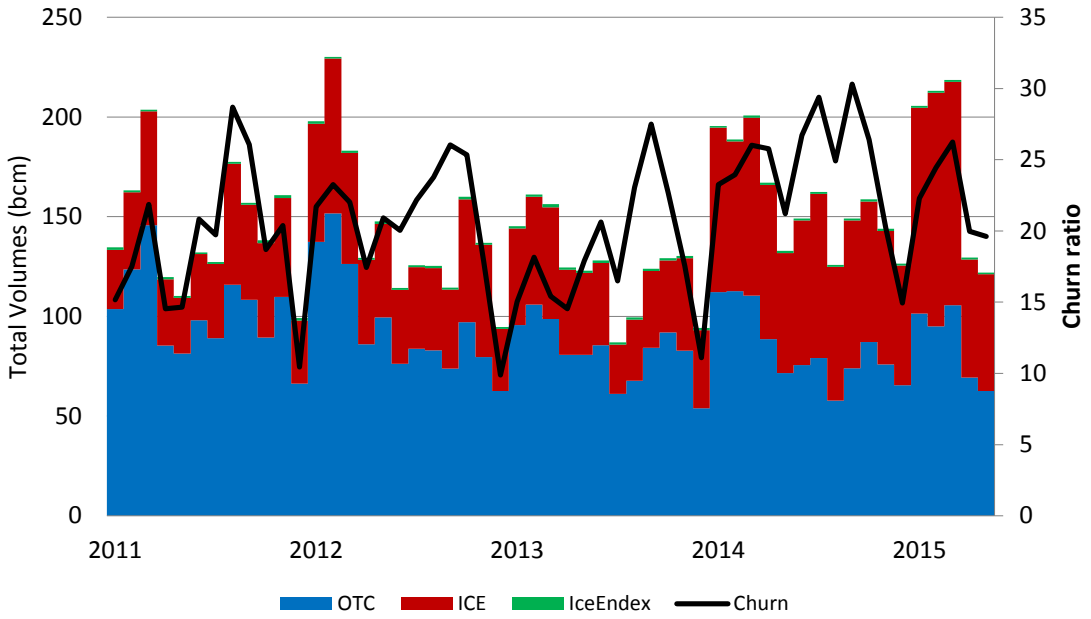


Source: ICIS, Ofgem analysis

3.12. Another key metric for assessing liquidity is the **churn ratio**.[25] This measures the number of times a unit of gas is traded before it is finally delivered. A higher churn indicates that it is easy for market participants to trade and that participants are often re-trading in order to optimise their positions before final delivery. Figure 17 suggests that GB continues to perform well on this indicator, with churn steadily increasing to an average of around 25 in 2014. A churn of 10 is generally seen as the minimum for a mature market.[26]

[25] Churn is the total volume of trading in the market (ie at the NBP) on all platforms (ie brokers and exchanges) divided by the volume actually delivered and consumed in the market area (ie in GB).
[26] Source: Patrick Heather (2012), "Continental European Gas Hubs: Are they fit for purpose?".

Figure 17: NBP trading volumes and churn, 2011- 2015[27]



Source: London Energy Brokers Association, ICE, ICE Endex, Bloomberg, National Grid

3.13. There is also a **diverse range of products and platforms** available for those looking to trade at the NBP. This includes a wide range of forward and spot contracts with significant trading volumes throughout.

3.14. Trading takes place on a range of platforms. The on-the-day commodity market (OCM) is operated by ICE Endex and has been used for short-term balancing since the market was first created. As trading has grown over time, bilateral over-the-counter (OTC) trading through brokers has tended to dominate, with the remainder taking place on the Intercontinental Exchange (ICE).[28] Recently there has been a significant shift of trading from OTC to ICE. This is discussed in Box 2.

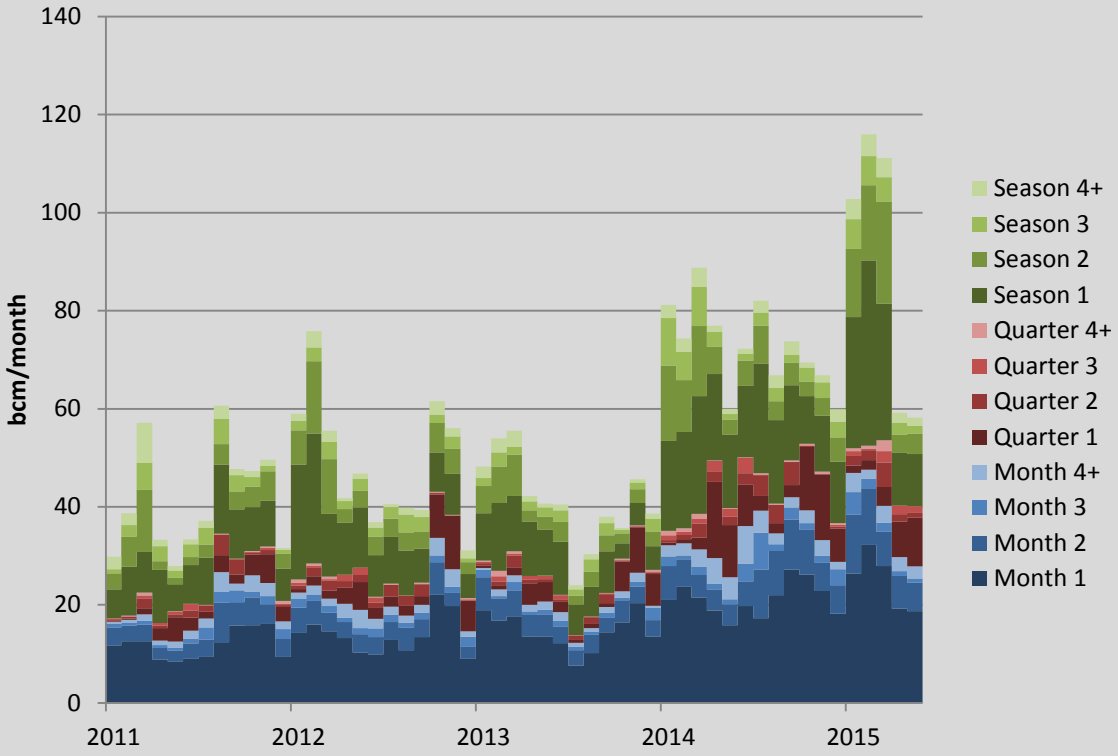
3.15. It is also notable that two new trading platforms entered the market in 2014.[29] Although they have yet to attract significant new trading volumes, this kind of market entry offers the prospect of greater choice and innovation.

[27] Churn is calculated as total traded volumes divided by total demand in the region served by the hub. This demand includes end user consumption, storage injections and interconnector exports. This approach is consistent with the approach taken by the European Commission and notable academic studies in this area. The chart shows that there is regular variation in the churn rate over the course of a year. This is essentially due to variations in the numerator (trading volumes) and denominator (demand) used in the churn calculation.
[28] ICE Futures is a regulated futures exchange where gas for delivery at NBP can be traded.
[29] The Chicago Mercantile Exchange (CME) and the European Energy Exchange (EEX).

Box 2: NBP exchange trading

Over the last few years there has been a big shift in trading volumes from OTC trading through brokers towards exchange trading on ICE. From 2011 to 2013, ICE volumes were approximately 30% of all trading. In 2014 this increased to almost 50% of all trading. Figure 18 below shows how much of the shift has taken place in both the front-month contract and in seasonal contracts.

Figure 18: Monthly ICE trading volumes by contract, 2011-2015[30]



Source: Bloomberg, ICE

3.16. Another notable development in gas trading in recent years has been the rapid rise of the Netherlands' Title Transfer Facility (TTF) hub. TTF now rivals the NBP on a number of key liquidity metrics indicating there are now two mature, liquid gas hubs in Europe. The growth of TTF likely reflects it serving as a better benchmark hub for Continental pricing than the NBP. This is almost certainly due to TTF being denominated in euro and having higher levels of interconnection with its continental neighbours. Some market commentators have suggested that there could become a

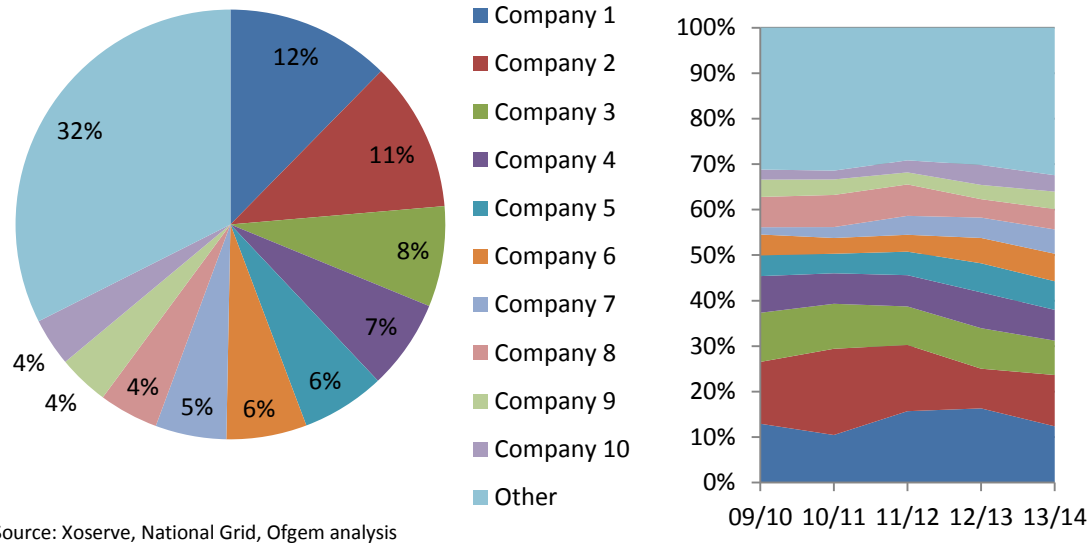
[30] Month 1 refers to gas for delivery in the next month. Month 2 refers to gas for delivery in the month after that, and so on. This chart does not include calendar year contracts. However, these are a tiny fraction of total ICE trading volumes.

point where TTF draws liquidity away from the NBP. However, we have seen no evidence of this and liquidity at both hubs appears to be increasing simultaneously.

Competition

3.17. A useful first step when looking at the effectiveness of competition is to consider **market concentration**. Measures of overall market concentration suggest that this market is not concentrated. For example, the Herfindahl–Hirschman Index[31] (HHI) for total upstream supplies is 603 for 2013/14, indicating low levels of concentration. This has also been falling over the last five years. Similarly low levels of concentration can also be found when looking at ownership of total supply capacity and flexible supply capacity. These low levels of concentration can be linked to the GB's diverse supply sources, which encourage a wider range of market participants.

Figure 19: Shares of gas supplies, 2013/14 (left) and 2009/10 – 2013/14 (right)[32]



Source: Xoserve, National Grid, Ofgem analysis

[31] This index measures concentration by summing the squares of the market share of each player. A HHI exceeding 1000 is regarded as concentrated and a HHI above 2000 is regarded as very concentrated. Source: CC/OFT merger guidelines.

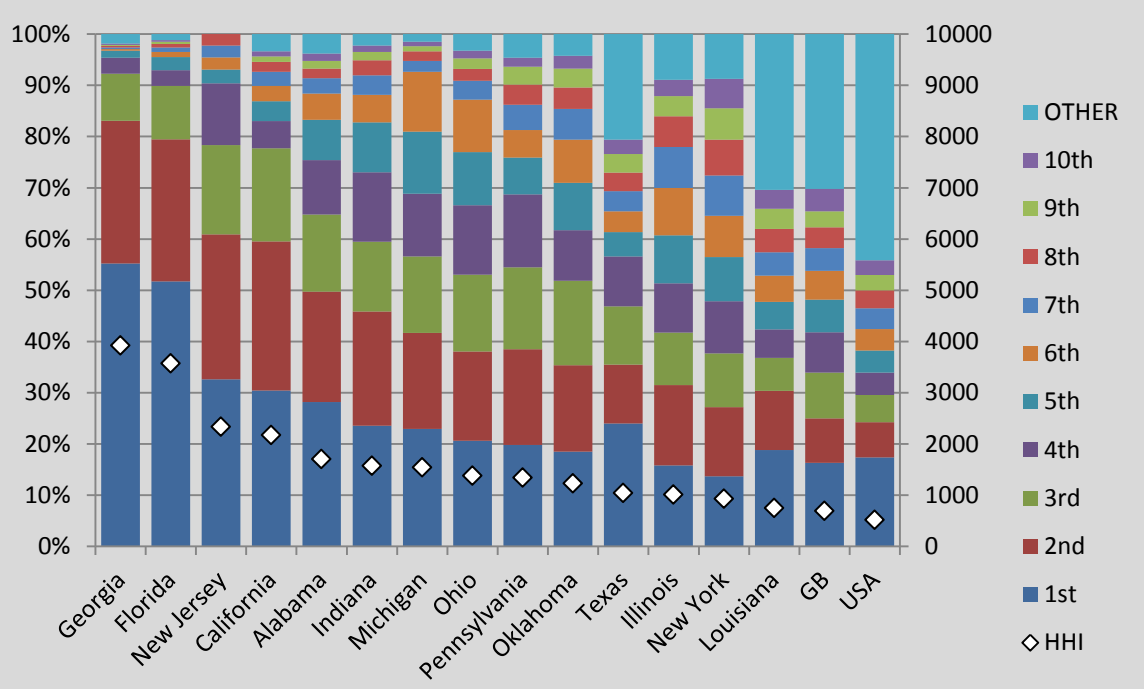
[32] Market shares are calculated based on physical entry allocations associated with shipper accounts. Assumptions have been made where a given company effectively controls multiple shipper accounts (eg through a subsidiary). Because these allocations data focus on which shippers are bringing gas onto the system, they will fail to account for arrangements that companies may have in place to ship gas on another company's behalf, and then transfer this at the NBP. Market shares are anonymised at the request of market participants, and do not represent the same companies as Figure 21.

3.18. To put this in an international perspective, GB has the lowest level of concentration in upstream supplies in Europe.[33] Box 3 also highlights how GB compares favourably with the US as well.

Box 3: Comparing gas supply concentration in GB with the US

The US has the largest, most mature gas market in the world. It therefore provides a useful benchmark against which concentration levels in GB can be measured. However, the US is a much bigger market than GB and is spread over a much larger area. Total gas consumption in the US is roughly the same as the whole of Europe. As such, individual US states potentially provide a better comparison with the GB market.[34] In particular, it is worth focusing on US states with consumption similar to most EU member states.[35]

Figure 20: HHIs and top 10 market shares of upstream supplies by US state, 2012[36]



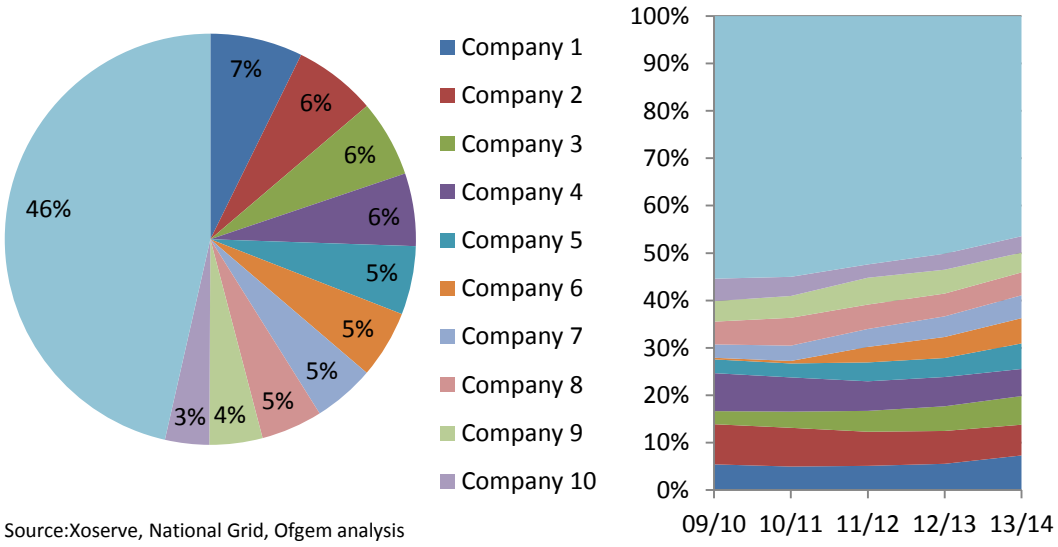
Source: Energy Information Administration Form EIA-176, Ofgem analysis

[33] Source: ACER, "ACER Market Monitoring Report 2014".
[34] In making a comparison between the UK and US states, we should be mindful that not all US states are likely to form suitable comparisons. For instance, Hawaii is a tiny island with a monopoly producer and supplier that has consumption that is a tiny fraction of GB's.
[35] Here this has been taken as an annual consumption of at least 15bcm. In general, smaller states have higher levels of concentration than larger ones.
[36] All countries/states are ordered left to right by their respective HHIs. The EIA data is such that some assumptions have been made about parent/subsidiary company relationships.

Figure 20 shows that the upstream gas supplies in the GB market are less concentrated than all comparable US states. Even when looking at the US as one homogenous entity, GB still compares relatively favourably. This indicates that the GB gas market has low levels of concentration by international standards.

3.19. Measuring concentration in the traded portion of the wholesale markets is challenging because most trading takes place in financial markets in which counterparties are either anonymised or kept confidential. One way of gaining some insights into who is trading in the gas market is to look at gas shippers' traded nominations at the NBP, as these nominations are made to National Grid. Although this is an imperfect reflection of total trading activity, it can still provide some useful insights.[37] When looking at gas trading from this perspective, we find that concentration is very low, with a HHI of 380 in 2013/14. This is consistent with the diverse range of participants that engage in trading, from upstream gas producers and importers to downstream retail suppliers, banks and trading houses. All of these different kinds of company are represented in Figure 21 below.

Figure 21: Approximate shares of traded activity, 2013/14 (left) and 2009/10–2013/14 (right)



Source:Xoserve, National Grid, Ofgem analysis

[37] This nomination data does not reflect all trading volumes and so may not be an accurate reflection of market shares or concentration. This is because not all trading that takes place for gas delivered at the NBP actually entails counterparties making the corresponding nominations to National Grid. This discrepancy can be seen when comparing trading volumes reported by the hub operator (ie National Grid) with those reported by exchanges and brokers. Market shares are anonymised at the request of market participants, and do not represent the same companies as Figure 19.

3.20. Another way of assessing the effectiveness of competition is to look at the scope for market power. **Pivotality** analysis does this by focusing on gas supply capacity and assessing whether a certain company's supply capacity is necessary to meet demand. Pivotality only looks at the *possibility* for market power. It does not account for the incentives on firms to exploit any dominant position, and is not an indicator of actual market abuse or anticompetitive behaviour. We conduct pivotality analysis using our internal pivotality model.[38]

3.21. Our analysis shows that in recent years there is only one company that could be considered pivotal in the wholesale gas market under normal market conditions. This company is pivotal to meeting a portion of GB demand over the course of a cold winter, but is not pivotal on any given day or week of such a winter.[39] In general, we find that there is a lower chance of pivotality occurring on any given day or week. This because in the short-term (ie over a few days or weeks) alternative supply sources such as gas storage can be utilised to make up any shortfall, but in the longer-term (ie over the course of a whole winter) these can be exhausted.

3.22. Beyond looking at concentration in the upstream segment of the market, it is also important to look at **vertical integration** (VI) across the entire market. This is because in certain circumstances VI can lead to some participants being able to foreclose the market.

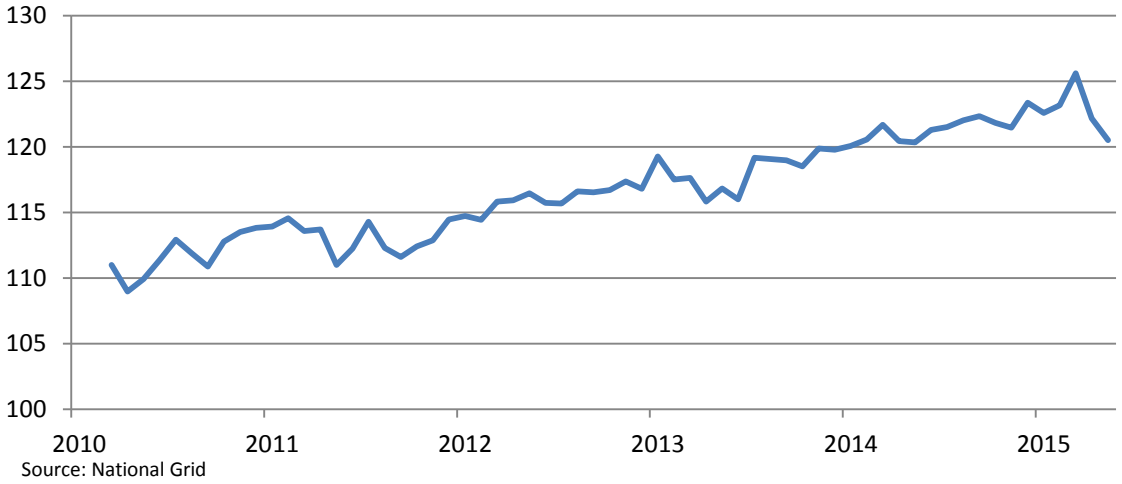
3.23. The gas supply and demand positions of the top fourteen gas companies suggest there are fairly low levels of VI in the gas market. In particular, the direct production assets of each of the six largest suppliers in the retail market are not able to cover their respective consumer demands.

3.24. **Entry and exit** has been positive throughout the market, with new gas importers entering from upstream and new smaller suppliers entering from the retail market. A number of financial institutions have reduced their gas and power trading in recent years, and some have exited the market entirely. There are many causes of this trend including tougher European financial regulations and falling market volatility. Nevertheless, the number of new entrants has outweighed those exiting and this is reflected in the growing number of active trading parties, shown below.

[38] A description of the model can be found in Appendix 4 of our consultation on a Minor Facilities Exemption for Phase 2 of the Stublach storage facility: https://www.ofgem.gov.uk/publications-and-updates/storengy-uk-ltds-application-minor-facilities-exemption-stublach-gas-storage-phase-2

[39] In a cold winter, demand is higher and so a given company's supply capacity is more likely to be needed.

Figure 22: Number of unique trading parties at the NBP, 2010-2015



Source: National Grid

Investment and sustainability

3.25. **Regulatory burden and the quality of institutional processes** play a key role in determining how the market changes over time, and provides an indication on the ease of market entry and investment. The length of the shipper licence has remained broadly stable since 2008[40], and the number of code modifications per year has fallen slightly since 2005.[41] The average number of days between a modification proposal being raised and submitted for decision has also remained largely stable.[42]

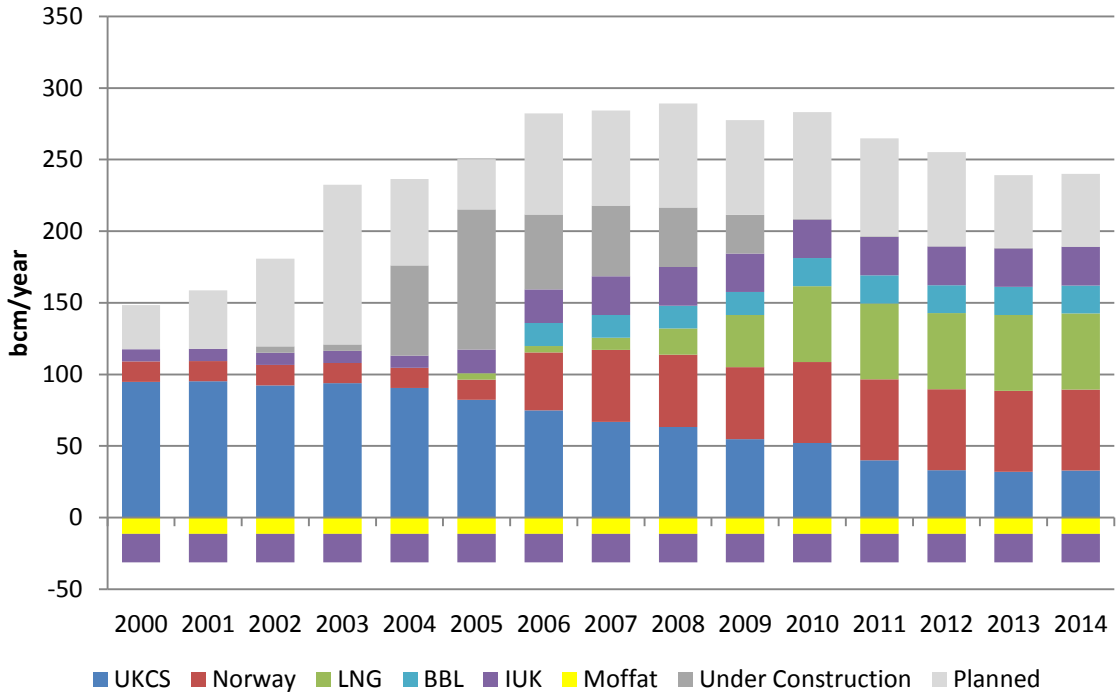
3.26. However, the need to implement a range of new policies means that it is important to not be complacent over the size and complexity of our regulatory arrangements. For example, the Uniform Network Code (UNC) is now over 1500 pages, which is more than three times the length of the equivalent Dutch Network Code. Unfortunately trends in this area are difficult to measure and so drawing clear conclusions remains a challenge. More detailed work on governance issues can be found in a working paper we submitted to the CMA.[43]

3.27. On **investment** the picture is much clearer. The last decade has seen the market bring forward significant investment in new import infrastructure to replace declining domestic production. This expansion has now plateaued, with existing infrastructure projected to be capable of meeting demand well into the future.

[40] Source: Ofgem Electronic Public Register https://epr.ofgem.gov.uk/Document.
[41] Source: UNC Modification History http://www.gasgovernance.co.uk/mods.
[42] Source: UNC Code Administration Code of Practice KPI Reports http://www.gasgovernance.co.uk/Performance/KPIs.
[43] https://www.ofgem.gov.uk/publications-and-updates/market-investigation-reference-code-governance-submission.

3.28. A number of gas storage projects have also come online in the last decade. As can be seen in Figure 24 these have resulted in an increase in total storage space of approximately 20%.[44] The more flexible nature of these new facilities has meant total storage deliverability[45] has seen larger gains of over 50%.

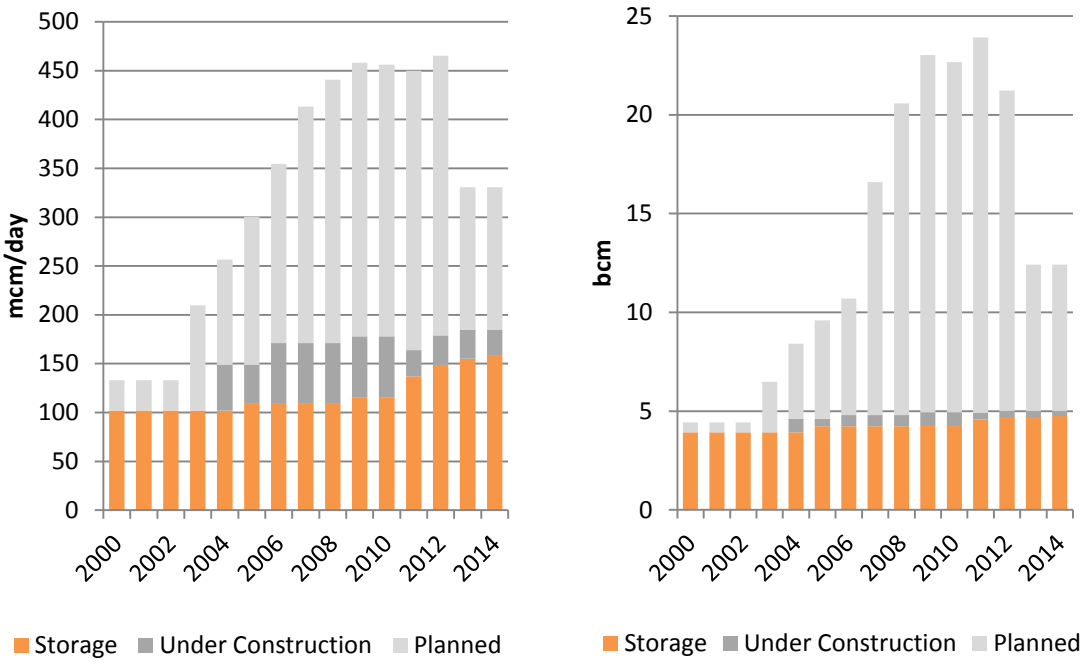
Figure 23: Investment in gas import infrastructure over time, 2000-2014



Source: National Grid Ten Year Statements, ENTSOG, trade press

[44] Storage space refers to the amount of gas that can be stored at any one time in a facility.
[45] Storage deliverability refers to the rate at which gas can be withdrawn from a facility.

Figure 24: Investment in gas storage infrastructure over time, 2000-2014, deliverability (left) and space (right)[46]



Source: National Grid Ten Year Statements, GIE, trade press

3.29. Notably the storage projects that have gone ahead are only a small fraction of the total that reached the planning stage. We see this as largely being due to changes in the market signals for further storage investment. Storage facilities create value by injecting gas when the price is low and withdrawing it when the price is high. The variability of prices is therefore crucial to their profitability. This applies to both the spread between summer and winter prices (summer-winter spreads), as well as shorter-term price volatility.

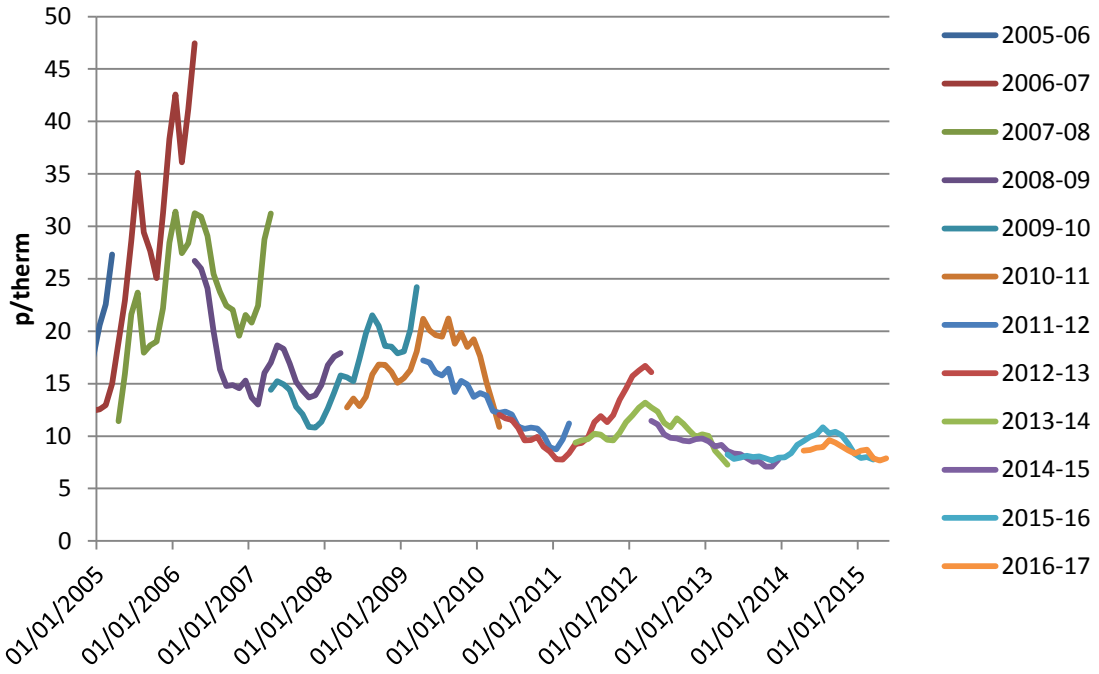
3.30. Figure 25 shows that summer winter spreads have fallen significantly over the past decade. Short-term price volatility has also declined over the same period (see Figure 39). It is likely that these trends are at least partly a result of the increase in import infrastructure highlighted earlier. Because much of this new import capacity is able to operate flexibly, it can often act as a substitute for storage by responding to variations in demand. This diversity of supply sources also promotes competition, driving down prices.

3.31. The trend of declining spreads shown in Figure 25 is also something we view as driving falling profits for storage operators. For instance, Centrica Storage, which

[46] Where information on the deliverability of a site was not available a simplistic assumption was made that this would at least the amount necessary to empty the site in a winter season.

operates the Rough storage facility, has seen operating profits fall from £240 million in 2007 to £29 million in 2014.[47] We consider that this is what has led many storage projects that had been in the planning stage to be cancelled or put on hold indefinitely (see the fall in planned projects after 2012 in Figure 24).[48]

Figure 25: NBP gas summer-winter spreads, 2005-2015[49]

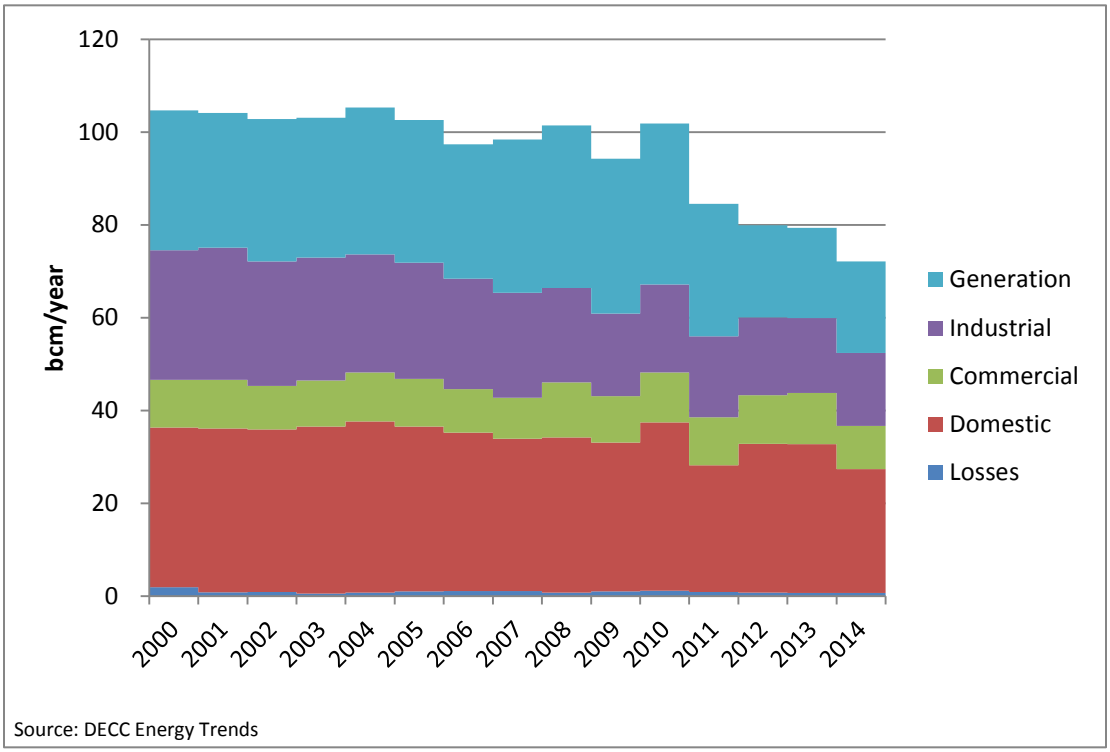


Source: ICIS, Ofgem analysis

3.32. On **environmental sustainability**, a key consideration in the wholesale gas market is trends in overall gas demand. Decarbonising the GB energy sector entails reducing our consumption of fossil fuels. In the long term this may include reducing consumption of natural gas. Figure 26 below shows how gas demand in recent years has fallen across the three main types of consumers. There are a number of different factors that can explain this fall and these are discussed in more detail in Table 2.

[47] Source: Centrica, "Centrica Annual Reports and Accounts", 2007-2014.
[48] In September 2013 DECC concluded that a subsidy for gas storage was not cost-effective. https://www.gov.uk/government/publications/gas-security-policy-assessment.
[49] Summer winter spreads are calculated as the difference between the price of the summer contract and the following Q1 contract.

Figure 26: Trends in annual gas demand, 2000-2014



Source: DECC Energy Trends

Table 2: Potential causes of falling gas demand for key consumer types

Consumer:	Summary of key gas demand trends:
Domestic & Commercial consumers	Gas demand from domestic and commercial consumers is generally driven by similar factors. Demand from these consumers has fallen since 2010. Key reasons for this are: • Gas demand from these consumers depends heavily on the weather. In particular, gas demand for heating is significantly higher in winter when it is colder. There have been a number of milder winters since 2010/11, so the weather is responsible for part of the decline. However, even after accounting for the weather gas demand from these consumers has still fallen.[50] • Part of the decline in demand is due to energy efficiency improvements or the adoption of other substitutes for gas (eg ground-source heat pumps). Since 2000, the uptake of A-rated boilers and home insulation are estimated to have resulted in 55 TWh and 18 TWh of energy savings per annum respectively.[51] • A portion of the decline in demand may be due to consumers changing their consumption habits, or responding to higher prices by consuming less. For example, consumers may try and keep their bills down by using their heating less often.

[50] Source: National Grid, "National Grid Winter Outlook 2014/15".
[51] Source: National Grid, "National Grid Future Energy Scenarios 2014".

Industrial consumers	Another significant component of gas demand is consumption by larger industrial consumers. Demand from these consumers has been steadily declining for over a decade. Key reasons for this are: • Part of the decline in demand may be attributed to economic conditions. The 2008/9 recession and the period of depressed growth that followed may have caused some businesses to downsize or close, thus reducing demand for gas. • As with smaller consumers, it is possible that a portion of the decline is due to companies responding to higher prices by reducing their consumption. Some large energy-intensive consumers can be very sensitive to the price of gas if it is a significant part of their costs. In certain circumstances, this may even entail businesses reducing or closing their GB operations altogether and moving abroad where prices may be lower. • It is possible that some of the decline is due to improvements in the efficiency of industrial processes. These mean that the same amount of heat or end-product can be produced with less gas.
Gas-fired power stations	A final important component of gas demand is that from gas-fired power stations for electricity generation. Gas demand from the power sector has also fallen in recent years. This is despite total gas-fired generation capacity increasing. Key reasons for this are: • Output from new renewable capacity and interconnector imports has increased, displacing gas-fired generation. • Newer, more efficient gas-fired power stations have also been built. These can produce the same amount of electricity with less gas. This lowers gas demand as older less efficient plant are displaced. • In recent years some gas generation has also been displaced by coal generation. This is because of more favourable economics for coal generation relative to gas. Unlike the previous two reasons mentioned, this represents a negative trend from a sustainability perspective as it should raise emissions from the GB power sector, rather than decreasing them.

4. Electricity

Chapter Summary

With respect to **security of supply**, total generation capacity has been steady over recent years. Retired or mothballed coal, oil and older gas-fired capacity have been replaced by renewables, interconnectors and new gas-fired capacity. The fast pace of closures and the intermittent nature of much of the new capacity have meant tightening capacity margins in the near-term. Despite more intermittent generation, market participants have maintained their ability to balance.

On **access and liquidity**, the GB market appears relatively illiquid compared to some international power markets. There are signs, however, that liquidity is improving since our 'Secure and Promote' reforms were implemented, but it is too soon to draw robust conclusions.

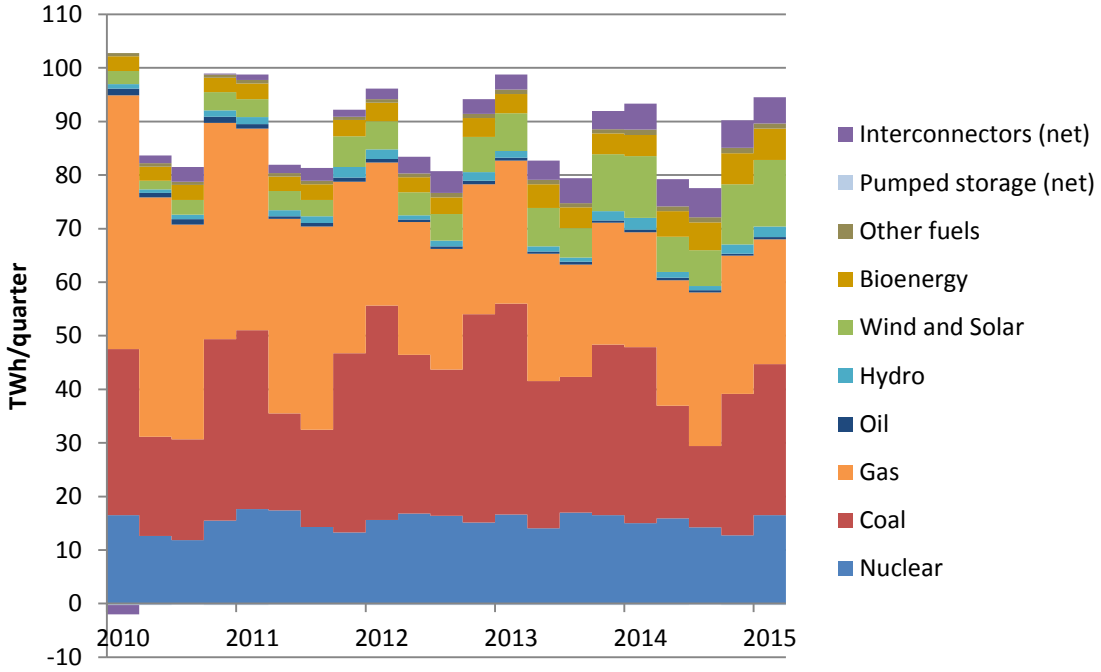
When assessed using a range of standard **competition** metrics, the GB wholesale electricity market appears reasonably competitive, and compares well with other European markets. Our analysis suggests there is limited scope for generators to exert market power in the GB market.

On **investment and sustainability**, market signals have not encouraged enough investment to halt the trend of tightening margins in recent years. With regards governance and regulatory burden, there have been some encouraging trends, with the number of code modifications falling over time. However, the complexity of many of the changes being introduced continues to pose a challenge. Finally, output from renewables continues to grow. This has contributed to GB's emissions intensity (the amount of emissions per unit of electricity generated) falling to its lowest recorded level in 2014.

Security of supply

4.1. The GB power system is undergoing a period of significant change. Figure 27 illustrates the various sources that have supplied our power since 2009.

Figure 27: Detailed electricity supply breakdown, 2009 to 2015[52]



Source: DECC Energy Trends

[52] Data marked as "(net)" is underpinned by both positive (generation) and negative (demand) values. For instance, interconnectors can both import and export. Similarly, pumped storage can both demand power for pumping and generates power when releasing water through its turbines. As the chart depicts monthly datapoints, the netting for these fuel types mean the full extent of generation and demand from these sources is underestimated.

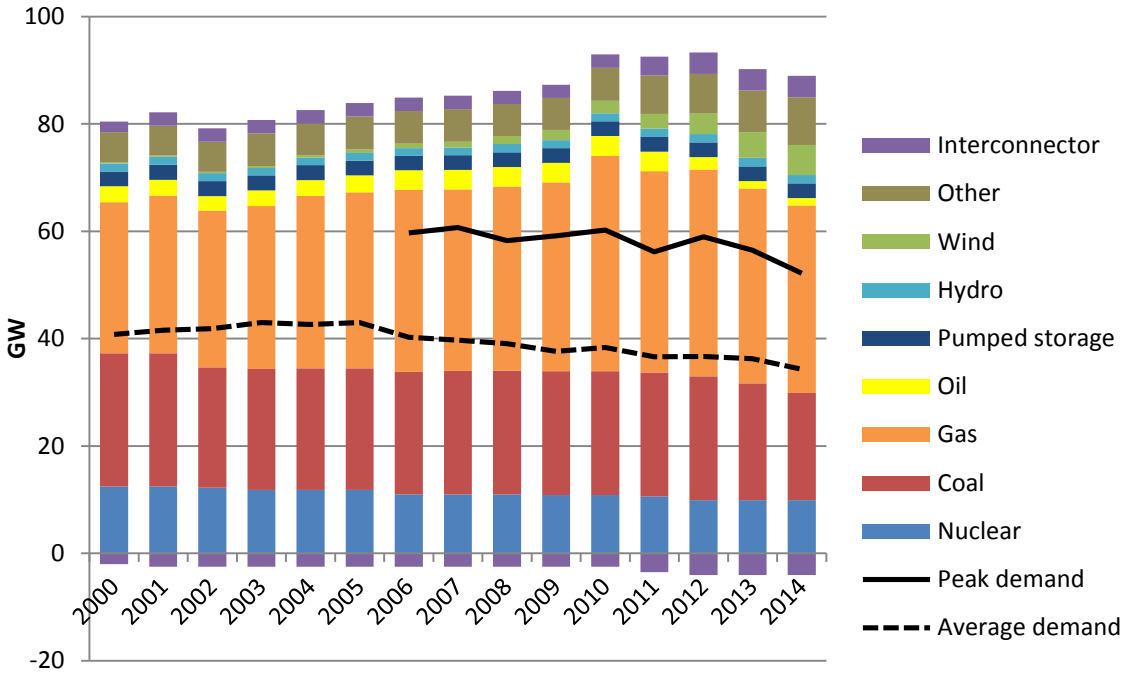
Table 3: Electricity supply source summary

Supply:	Summary:
Nuclear	Nuclear has remained stable source of baseload output. Nuclear output has declined slightly due to a number of power stations reaching the end of their lifetimes. For the power stations that are still operational, load factors have been high and a number of them have had their lifetimes extended.
Coal	Coal capacity has declined as a number of plants have closed in recent years. However, coal output has still remained high despite this due to favourable generation costs relative to gas. Coal generation is generally high in winter, and then declines in summer as gas plant economics tend to be more favourable in summer so making coal plant generation too expensive to be needed.
Gas	The amount of gas-fired generation capacity has increased in recent years. However, higher wholesale gas prices have led to a decline in gas generation output, particularly from older less efficient plants.
Oil	There is no longer any large scale oil-fired capacity in GB. Oil plant has high running costs and only operates during peak periods. As such, overall output has been negligible. In addition oil plants have been captured by the Large Combustion Plant Directive which place strict limits on emissions and effectively rules out oil plant generation.
Interconnector	Interconnector imports have risen in recent years. This is for a number of reasons. New connections to the Netherlands and Ireland have come online increasing import capacity. Furthermore, the price differential between GB and Continental markets has widened (see Figure 9) incentivising higher flows. The implementation of the European Target Model has also caused interconnectors to be operated more efficiently.
Hydro	Hydro output has been stable and remains a relatively minor source of generation.
Wind	Wind output has grown significantly as new onshore and offshore capacity has connected to the grid.
Bioenergy	Bioenergy output has increased as microgeneration and biomass generation have both grown.
Pumped Storage	The role of pumped storage in providing power quickly and meeting peak demand has remained largely unchanged.
Other	Another source of generation output has been from distributed generation that is not connected to the National Transmission System, for example small-scale solar, where installed capacity continues to grow.

4.2. The supply and demand of electricity to and from the grid must be matched on a second-by-second basis. To achieve **secure supplies** there is a long-term need to ensure sufficient generation capacity and a short-term need to ensure efficient operation of the system. It is important that the market functions efficiently in order to meet these requirements in an economic manner.

4.3. Although the total capacity of the system has stayed largely constant in recent years, there has been a reduction in the total 'de-rated' capacity (ie installed capacity is not always available, because, for example, of unforeseen outages (or breakdowns) or scheduled maintenance; hence installed capacity is de-rated to take account of the probable availability of different generation technologies). This has been driven by a change in the generation capacity mix, with less conventional generation and more intermittent generation in the system.[53] The mix has become more diversified, with some coal and oil exiting the market and being replaced by gas, renewables, and interconnectors (see Figure 28).

Figure 28: GB generation and interconnector capacity (non-de-rated) and peak and average demand (2000-2014)



Source: DECC DUKES, National Grid

4.4. As our electricity security of supply report showed[54], capacity margins have fallen in recent years and are expected to be tighter in winter 2015/16.[55] However,

[53] By conventional generation we generally mean coal, oil or gas-fired generation. These have traditionally been the main sources of power in GB. These are generally large-scale power stations that are able to flexibly vary their output in response to changes in demand. Intermittent generation refers to newer renewable sources that have started to enter the generation mix, such as wind, wave, tidal and solar. These are generally small-scale installations and their output is determined by intermittent factors, such as the wind or sunshine. As such they cannot flexibly vary their output.

[54] https://www.ofgem.gov.uk/sites/default/files/docs/2015/07/electricitysecurityofsupplyreport_final_0.pdf

National Grid has procured additional balancing services that it can use to help it balance the system if margins tighten. These services will effectively ensure that the risks reduce to meet the Government's reliability standard. Uncertainty around the outlook further out has increased, particularly for winter 2016/17. Margins could tighten if further power stations close or mothball, however, we have identified a significant potential for the market to respond positively and reduce the risks to security of supply. This trend of tightening margins highlights an important trade-off between security and affordability, as during tighter periods, prices generally spike. However, investing in new generation capacity to alleviate tightening margins entails upfront costs. These costs are ultimately borne by the consumer through higher bills. An efficient market should provide the right incentives to balance this trade-off between security, sustainability and affordability.

4.5. EMR established a new Government Reliability Standard for security of supply.[56] A range of policy changes are also being introduced as part of EMR and by our EBSCR reforms. Many of these are aimed at encouraging new investment where this is needed to ensure we have secure, sustainable and affordable supplies in the future. These policy changes are discussed in detail later in this chapter. Before these various changes can take effect, National Grid's New Balancing Services[57] have been introduced as a transitional measure. These provide the SO with additional tools to balance the system in light of tightening margins.

4.6. In a market with increasing amounts of intermittent generation, the challenges of **efficiently operating and balancing the system** have become more complex. In order to operate the system efficiently, it is important that there are appropriate incentives on market participants to balance their positions when it is efficient for them to do so. This ensures the role of the SO is minimised where appropriate. A key factor for encouraging efficient balancing is ensuring parties face cash-out prices that provide the right economic incentives. Our EBSCR reforms seek to do this by sharpening the cash-out prices that parties face on any imbalance.

4.7. In general energy prices, including cash-out prices, are positive so that generators are paid for the power they produce. Recently, there have been a number of instances of supply and demand conditions leading to negative prices for electricity. This is a product of the increasing amount of inflexible and intermittent generation on the system, and the subsidies that some renewable generators receive

[55] The tightening has largely been a result of plant closures, notably coal and oil plant due to the LCPD, and a lack of investment in the near-term to replace these losses. This is taking place against the backdrop of demand having fallen in recent years.
[56] This is currently set at three hours' Loss of Load Expectation (LOLE). The loss of load expectation (LOLE) represents the number of hours per year in which demand is expected to exceed supply during normal system operation. Importantly, a LOLE of three hours does not mean that customers will be disconnected or experience blackouts for three hours per year. In circumstances when demand exceeds supply, the SO can call upon a range of tools to mitigate this, such as using the New Balancing Services, for winter 2015/16, or voltage reductions, calling upon generators to increase output or calling upon demand side response.
[57] Demand Side Balancing Reserve (DSBR) and Supplementary Balancing Reserve (SBR).

when they are running. These instances tend to occur when demand is low and when it is particularly windy. Generators selling their power at a negative price are effectively paying to generate. In these situations it is generally more economic for a generator to pay to keep generating than it is for them to incur the costs of shutting down and restarting their plant again when prices recover. One such example of negative prices was on August 10 2014. This is explored in Box 4.[58]

Box 4: Case study of negative cash-out prices in August 2014

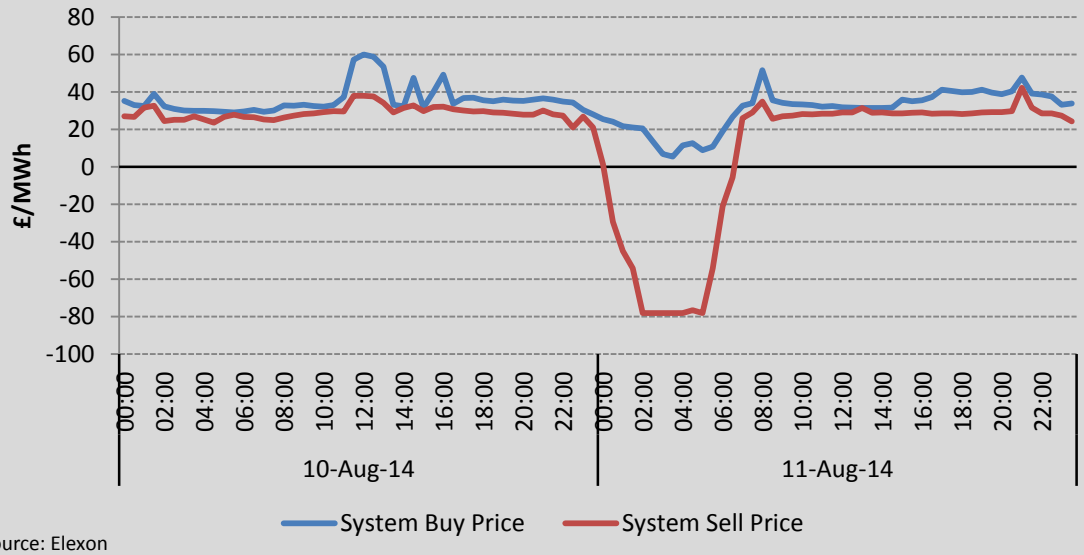
On August 10 2014, high winds from the tail end of hurricane Bertha hit GB. This resulted in very high levels of wind output at a time of low summer demand, particularly in the early morning. This combination of high wind output and low demand posed a number of challenges to the balance and stability of the system. To deal with these challenges, the SO took a number of actions, both before and during August 10. First, some wind capacity was instructed not to run to avoid a situation of there being an excess of generation in GB relative to demand. Second, additional Scottish wind capacity was instructed not to run to maintain balance throughout the network. This is because there are constraints on the amount of electricity that can be transmitted from Scotland to England & Wales. Third, a number of other actions had to be taken, such as limiting flows on the interconnectors and ensuring certain conventional power stations were available to provide power at short notice. This was because there are potential system stability problems with having too large a proportion of wind generation on the system at any one time.

The market is designed so that the balancing actions taken by the SO set cash-out prices. These are the prices market participants face when they fail to balance. When a generator has under-produced, it must buy extra power at the System Buy Price in order to make up the shortfall. When it has over-produced, a generator must sell its excess power at the System Sell Price in order to get rid of the surplus. In general the cash-out prices that market participants face are worse than what could be achieved in the market, thus incentivising parties to balance.

On August 10, system conditions meant that cash-out prices should have been providing a strong signal to parties not to over-produce power. Figure 29 shows how the System Sell Price during this period was pushed down as low as -£78/MWh. This meant that any party that generated more than they were contracted to would incur significant costs. In this respect, the market arrangements functioned as expected. Nevertheless, situations such as these are challenging for both market participants and the SO. As the amount of inflexible and intermittent capacity on the system grows, situations of negative prices will likely become more frequent.

[58] See National Grid's "Summer Outlook Report 2015" for a more detailed summary.

Figure 29: Cash-out prices, 10-11 August 2014



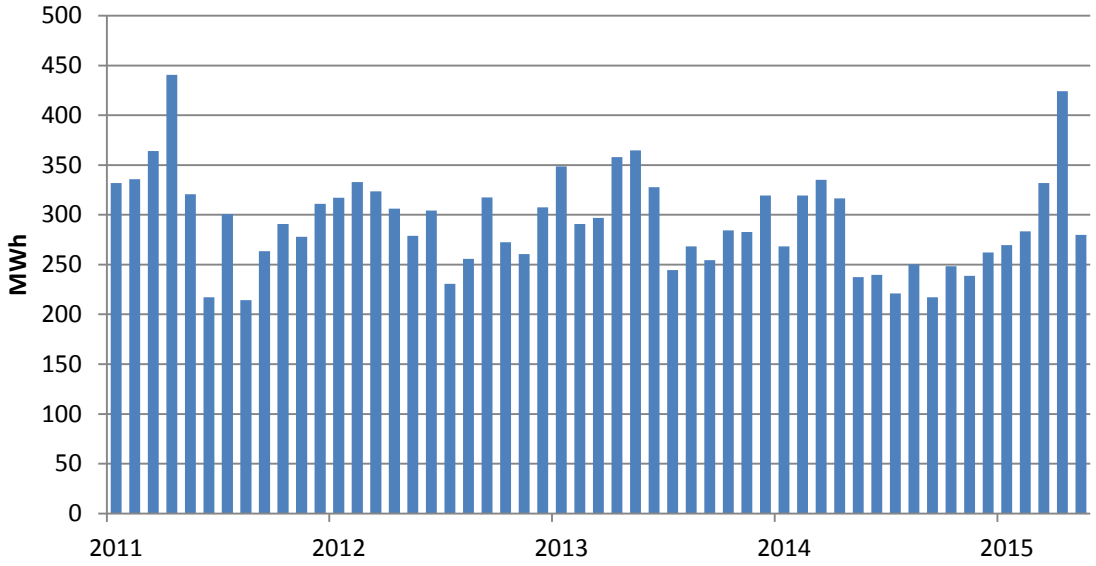
Source: Elexon

4.8. A number of other incidents of negative cash-out prices have already occurred since last August, and this has now started to occur in the traded market, with APX intra-day prices falling below zero on the morning of May 11 2015. Although instances of negative prices are not necessarily a concern, they are indicative of the changes being experienced in GB as more inflexible and intermittent generation comes online.

4.9. Despite the challenges being faced by the market, the overall scale of market imbalances has actually stayed reasonably constant in recent years. This is captured by the Net Imbalance Volume (NIV), shown in Figure 30 below.[59]

[59] NIV is the volume of the overall system energy imbalance, measured per settlement period.

Figure 30: Monthly average absolute NIV, 2011-2015



Source: Elexon

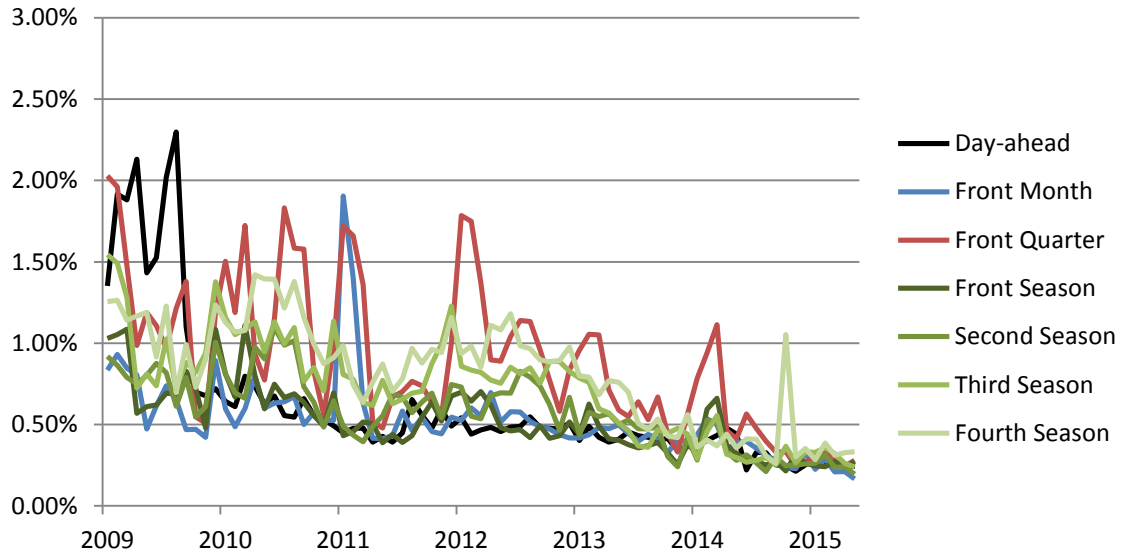
4.10. Other European countries are facing similar security of supply and system management challenges to those being seen in GB. Generation margins are expected to tighten in France, Belgium and Germany due to the closure of conventional plant and the phase-out, or closure, of nuclear. Growing intermittency from new wind and solar capacity is also having a significant impact in managing the system, most notably in Germany.

Access and liquidity

4.11. There are a number of metrics of liquidity, and the health of a market does not depend on one single metric. Historically, the GB electricity wholesale market has been relatively illiquid.[60] However, a number of indicators of liquidity have shown positive trends in the past few years. Notably, **bid-offer spreads** have consistently narrowed over the course of the last four years. Spreads are typically wider for peak products than for baseload, reflecting the higher volume of trading that occurs in baseload products.

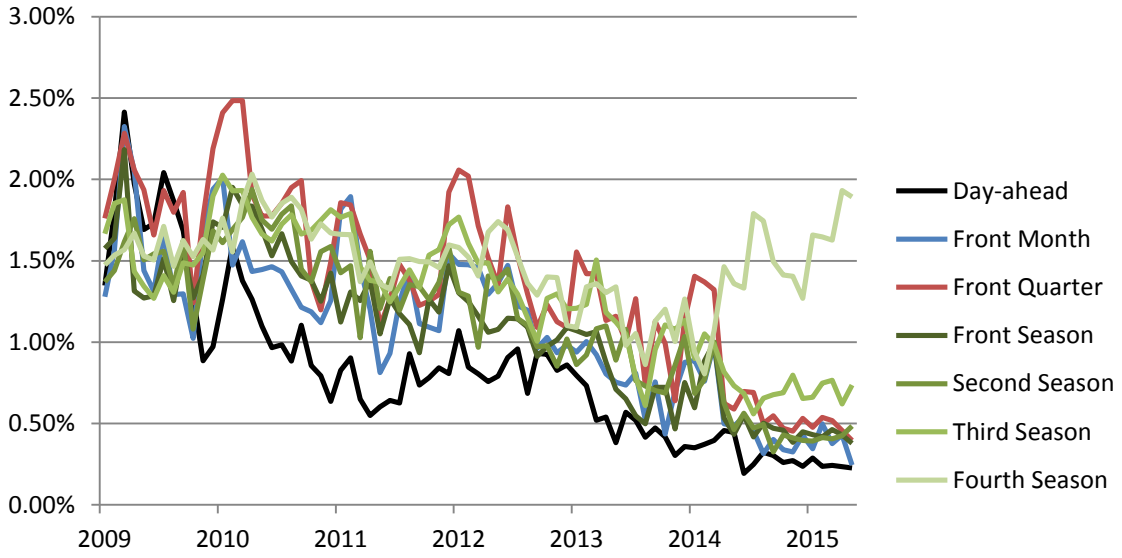
[60] https://www.ofgem.gov.uk/publications-and-updates/liquidity-great-britain-gb-wholesale-energy-markets

Figure 31: Electricity bid-offer spreads for select OTC baseload products, 2009 to 2015



Source: ICIS, Ofgem analysis

Figure 32: Electricity bid-offer spreads for select OTC peakload products, 2009 to 2015

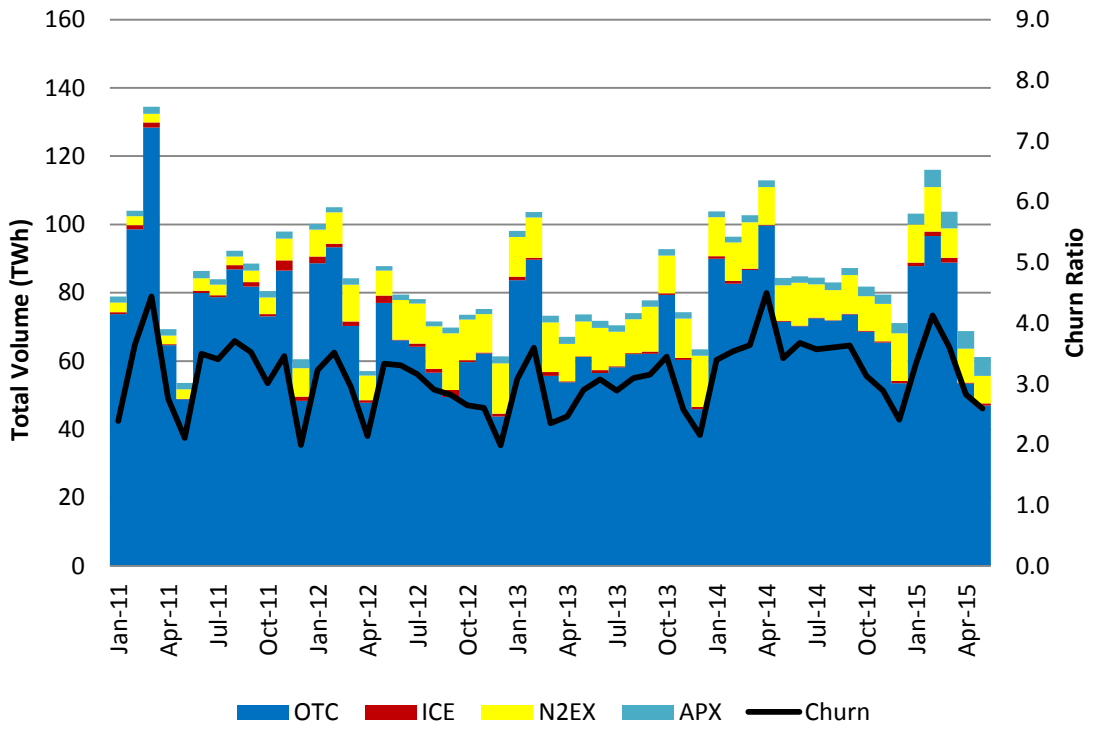


Source: ICIS, Ofgem analysis

4.12. The **churn ratio** is another important indicator of liquidity. Our analysis shows that since it peaked in 2002, churn fell until 2005 and has remained fairly unchanged in the decade since. The last few years of this trend can be seen in Figure 33. Although churn in GB has remained persistently below other European markets, in particular the German and Nordic markets, it is not easily comparable. Trading

activity in a given market is largely driven by the fundamentals and design of the market in question. The liquidity in the German market for example, can largely be attributed to the high interconnection it has with neighbouring markets and the way in which the power sector was privatised.

Figure 33: GB wholesale electricity trading volumes and churn, 2011-2015

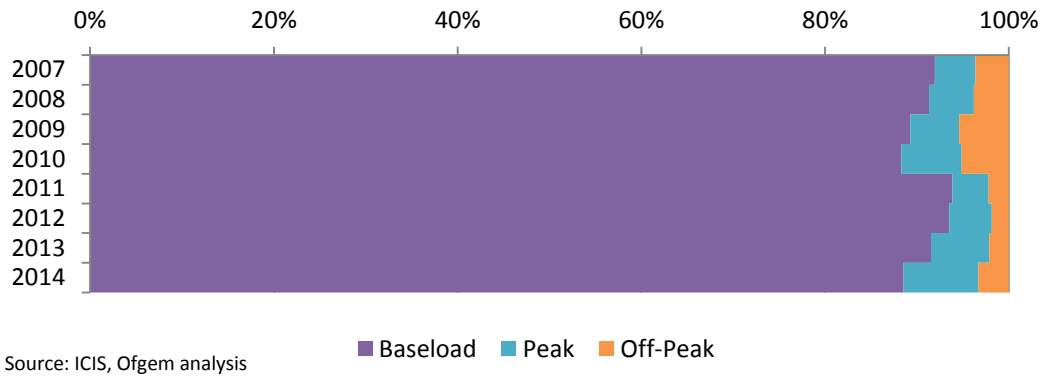


Source: ICIS, APX, Nord Pool Spot, ICE, DECC Energy Trends

4.13. There is a **diverse range of products and platforms** available for those looking to trade power in GB. In addition to over the counter trading, there are a number of exchange platforms, including ICE, N2EX and APX.[61] However, Figure 33 shows how the majority of electricity trades are still conducted OTC. Baseload products persistently dominate; accounting for around 90% of OTC traded volumes (see Figure 34). Furthermore, Figure 35 highlights how the liquidity that does exist in the GB markets tends to be clustered in the near-term markets, with approximately 80% of OTC trading being for delivery within 12 months. The emphasis on trading for near-term delivery is even more extensive for peak and off-peak products.

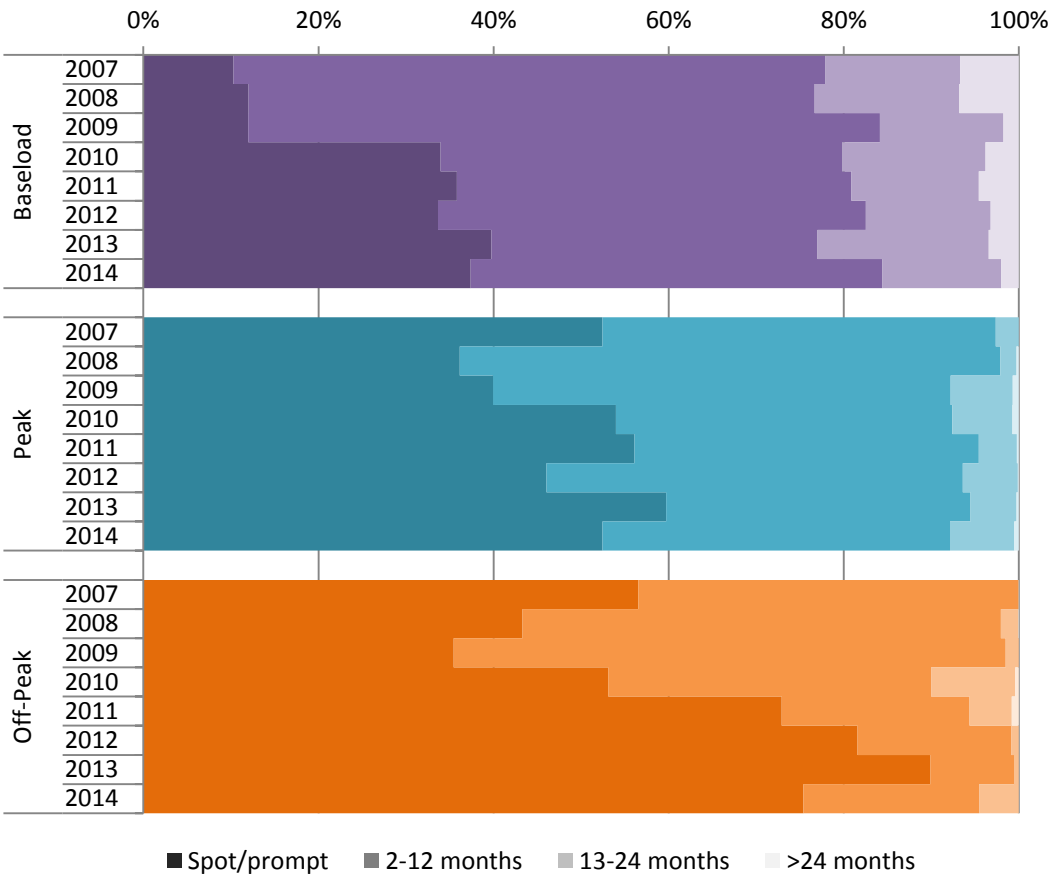
[61] Volumes on the respective platforms tend to reflect the time horizon of the contracts traded and are not reflective of the total contribution to market liquidity.

Figure 34: Shares of OTC power trading volumes by contract type, 2007-2014



Source: ICIS, Ofgem analysis

Figure 35: Shares of OTC power trading volumes by time to delivery, 2007-2014



Source: ICIS, Ofgem analysis

4.14. Liquidity has generally improved since the 'Secure and Promote' licence condition was implemented, although churn has declined in the last quarter. Secure and Promote increases access to selected traded products, particularly for smaller players. Since implementation, several key metrics have moved in a positive

direction, and stakeholders have pointed to greater accessibility and price robustness of products at times of market-making. There have been many factors affecting liquidity since 2014, so it is too early to draw robust conclusions. There is more detail on liquidity and the impact of our reforms in our annual liquidity policy evaluation document.

Competition

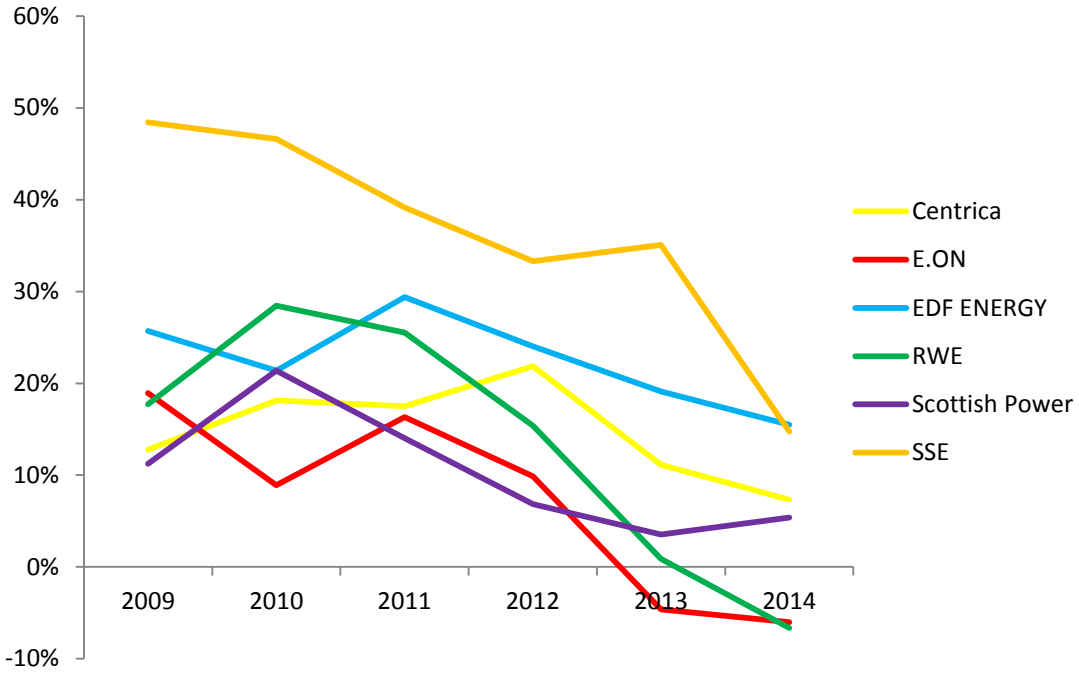
4.15. A market in which prices reflect the economic costs of production should mean that generators and suppliers are not able to use their position in the market to earn excess profits. One measure of the **profitability** of electricity generation is Earnings Before Interest and Tax (EBIT), which can be shown through analysis of the Consolidated Segmental Statements.[62] This is however an imperfect measure of profitability in a capital intensive sector such as energy generation, and must therefore be looked at as part of range of indicators, which show a marked reduction in conventional generator profitability in recent years.

4.16. For further analysis of profitability, please see the CMA's paper on generation return on capital employed.[63] As Figure 36 shows, the average generation profit margin is around 10-15% and has declined over the last four years.

[62] The Consolidated Segmental Statements are an annually published set of accounts covering the retail and generation activities of the six largest suppliers in the GB retail gas and power markets. These are Centrica, EDF Energy, RWE (npower), Scottish Power, SSE and E.ON. The statements are here: https://www.ofgem.gov.uk/publications-and-updates/energy-companies-consolidated-segmental-statements-css.

[63] https://assets.digital.cabinet-office.gov.uk/media/559fb55940f0b6156400003d/Appendix_4.2_Generation_return_on_capital_employed.pdf.

Figure 36: Electricity generation profit margins (EBIT), 2009 - 2014[64]

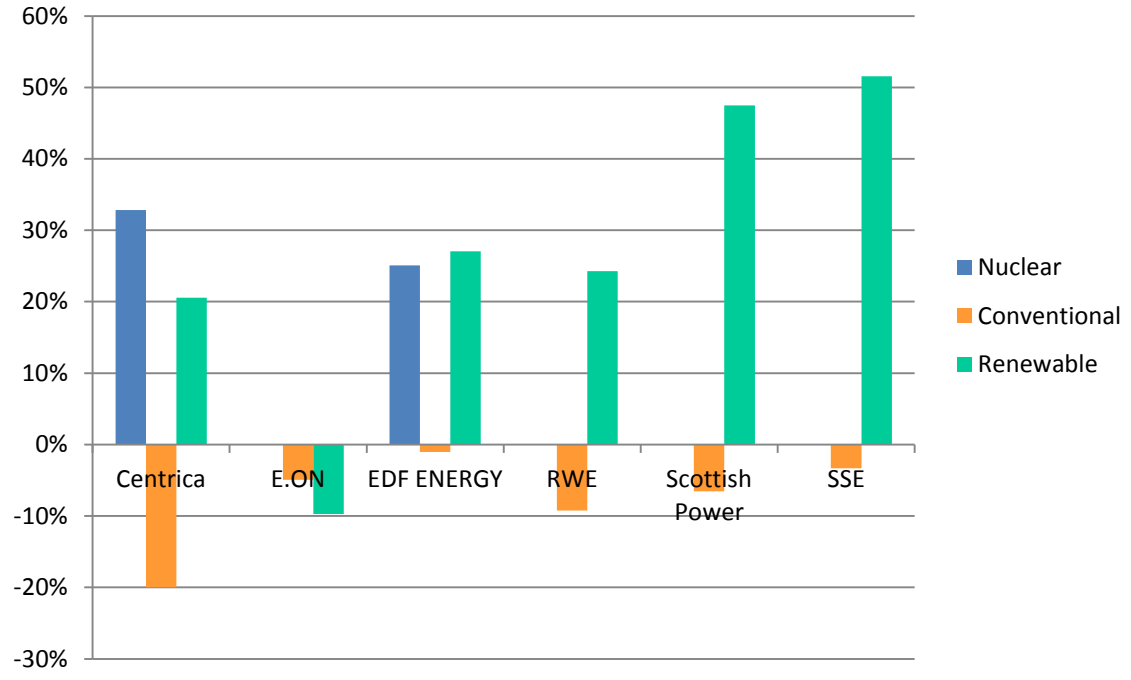


Source: Consolidated Segmental Statements, Ofgem analysis

4.17. The variation between companies is largely due to each company having different generation assets. Figure 37 shows that the key driver of these margins at present is the profitability of renewables and nuclear, with limited current profitability in conventional thermal plant.

[64]Annual data for all companies reflects calendar years, except in the case of SSE whose financial year runs from April to March. The data in this chart includes adjustments we have made to ensure consistency in the way exceptional items are reported among the suppliers and improve comparability. 2010-2013 EDF Energy data is adjusted to reflect the fact that its nuclear capacity is shared 80/20 with Centrica. 2013 Centrica data is adjusted to exclude £11m loss in renewable generation. 2013 E.ON data is adjusted to exclude net £107m impairment loss and profit on disposal. 2014 Centrica data is adjusted to exclude net £16.6m loss in renewable generation and £20.8m profit in nuclear generation. 2014 E.ON data is adjusted to exclude £1,121m impairment charge and £20.9m restructuring costs from generation. Since 2012, EDF Energy has made changes to its accounting methodology. The 2013 CSS figure for RWE includes earnings from Power Purchase Agreements (PPA's) that are not included in any other CSS. Please refer to the published statements for the figures as provided by suppliers.

Figure 37: Electricity generation EBIT margins by generation type, 2014[65]



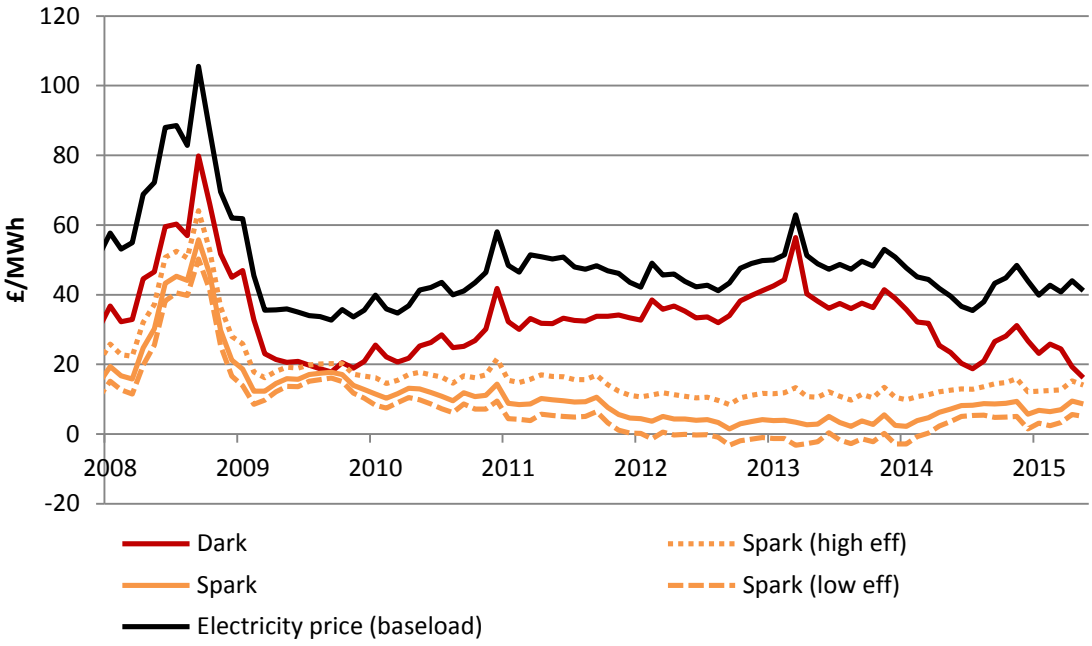
Source: Consolidated Segmental Statements, Ofgem analysis

4.18. Profitability for conventional generation can be linked to two key metrics: fuel spreads and price volatility. Fuel spreads, such as the clean dark or spark spread, are an indicator of the average revenue a power station can expect from generating a unit of electricity during baseload operation, after accounting for fuel and carbon costs. Clean spark spreads refer to gas generation and clean dark spreads refer to coal generation. Short-term price volatility is also relevant for the profitability of conventional generation. This is because gas, coal and oil plant are all relatively flexible, particularly when compared to nuclear or renewables. As such they are best placed to profit from power price volatility by increasing output when prices are high and decreasing output when prices are low.

4.19. Trends in clean dark and clean spark spreads can be seen in Figure 38. Higher clean dark spreads relative to clean spark spreads indicates that coal generation has been more profitable than gas for the last five years. This has resulted in coal generation being run more intensively. Clean spark spreads near to zero suggest that gas has been the marginal source of generation and so has limited profitability in the current climate. The particular unprofitability of older, less efficient gas plant has been reflected in a number of these being closed or mothballed in recent years.

[65] Annual data for all companies reflects calendar years, except in the case of SSE whose financial year runs from April to March. The data in this chart include adjustments we have made to ensure consistency in the way exceptional items are reported among the suppliers and improve comparability. Please refer to the published statements for the figures as provided by suppliers. See footnote for Figure 36 for further details on these adjustments.

Figure 38: Clean dark and spark spreads, 2008 to 2015[66]

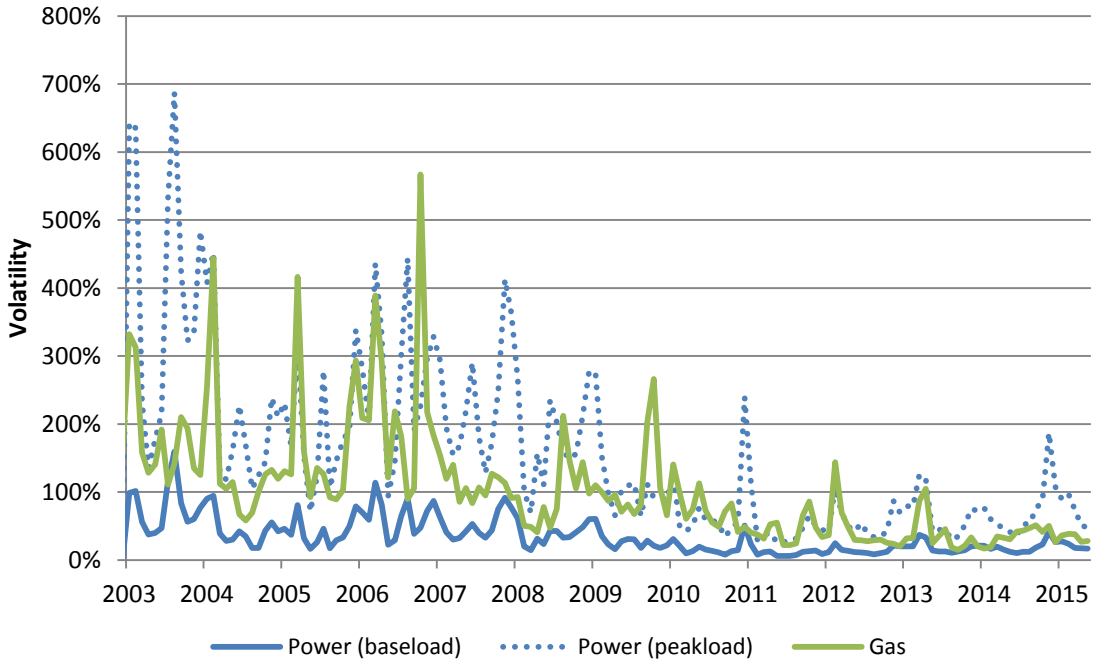


Source: ICIS, Bloomberg, Ofgem analysis

4.20. As for short-term price volatility, Figure 39 shows a clear trend of decreasing volatility over the past decade. This is consistent with a number of recent trends, including: the declining profitability of conventional flexible generation, the closure or mothballing of old gas and oil-fired plants, and low levels of investment in new flexible gas capacity.

[66] Efficiencies: Coal = 35%, Spark = 50%, Spark (high eff) = 60%, Spark (low eff) = 45%. Gas and power price contracts used are the OTC Day-ahead contracts assessed by ICIS. The coal price contract used is the front month Amsterdam Rotterdam Antwerp (ARA) coal contract as reported by Bloomberg. The carbon price contract used is the front month EU ETS price traded on the EUX exchange also as reported by Bloomberg. The relevant Carbon Price Support levels as set by DECC are added to the EU ETS carbon prices to get the effective GB price for carbon. The methodology for calculating dark and spark spreads is taken from Platts and can be found here: https://www.platts.com/IM.Platts.Content/methodologyreferences/methodologyspecs/european_power_methodology.pdf.

Figure 39: Day-ahead gas and power price annualised volatility, 2003-2015[67]



Source: ICIS, Ofgem analysis

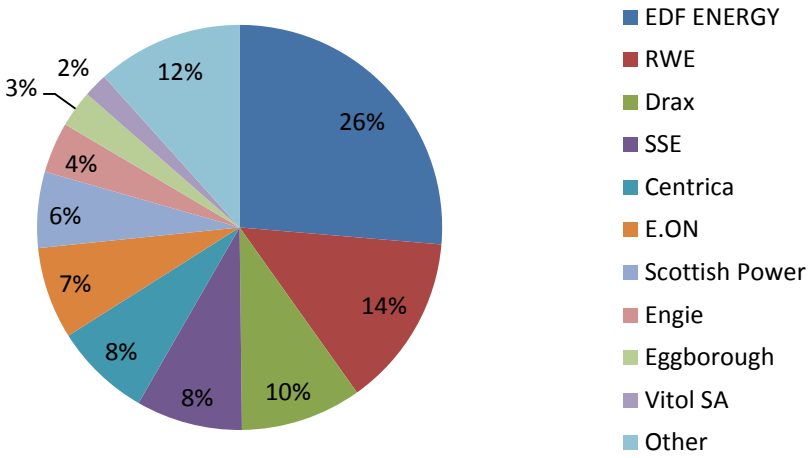
4.21. Our analysis of **market concentration** suggests that compared to EU markets, the GB market appears to have relatively low levels of concentration.[68] The wholesale market is somewhat concentrated when considering generation output with a HHI of 1243. There are relatively similar levels of concentration when looking at ownership of overall capacity and flexible capacity.

4.22. In 2014, EDF Energy had the largest share, accounting for over a quarter of total generation. However, EDF Energy's generation portfolio is mostly nuclear plant. Nuclear plant have low marginal costs and are very costly to increase or decrease output. This means they generally run as a flat baseload source of power at high load factors. As such, they are price takers in the electricity market. This means it is unlikely that it would be economic to use these nuclear plant to exert market power by withholding electricity.

[67] The price volatility calculation takes the logarithmical differences of the daily average prices of two consecutive trading days. These values are then used to compute the relative standard deviation on a rolling monthly basis (21 trading days). To annualise the data the value obtained is then multiplied by the square root of the total number of trading days in a year (252 trading days). Finally, the annualised volatility values are multiplied by 100 in order to express them as a percentage. This approach is consistent with the methodology in the European Commission's guidelines, here: http://ec.europa.eu/energy/sites/ener/files/documents/volatility_methodology.pdf

[68] European Commission (2014) "Progress towards completing the Internal Energy Market"

Figure 40: Shares of generation output, 2014[69]



Source: Elexon, NETA Reports, Ofgem analysis

4.23. We also use **pivotality** analysis in our monitoring of the wholesale electricity market. Pivotality analysis essentially looks at whether a given company's portfolio of power stations is needed to clear supply and demand in a particular period. Pivotality only looks at the *possibility* for market power. It does not account for the incentives on firms to exploit any dominant position, and is not an indicator of actual market abuse or anticompetitive behaviour.

4.24. This kind of analysis is generally used to assess whether a company can exert market power by withholding electricity (ie by choosing not to generate in order to restrict supplies and push up prices). However, it is also possible to conduct pivotality analysis to look at situations of excess supply where generators may be required to reduce generation at their power stations. This will become more important as the amount of inflexible, intermittent generation on the system increases and the need for both downward and upward flexibility grows.

4.25. Our assessment of the GB market as a whole has shown very few instances of pivotality. When accounting for the flexibility of different kinds of capacity, only one company exhibited a small number of periods in which its power stations were pivotal to meeting GB demand in 2014. This is consistent with this company's relatively large portfolio of conventional flexible power stations. However, it is possible that there is greater scope for market power at a sub-national level (eg as a result of transmission constraints). This is discussed in more detail in Box 5.

[69] Market shares are calculated based on metered volumes associated with individual generation units (called Balancing Mechanism Units). Assumptions have been made regarding which companies own each BM unit. Volumes have been split based on equity stakes. As with Figure 27, some degree of netting may have taken place for the underlying data. As such generation and demand from pumped storage and interconnectors may be underestimated.

Box 5: Locational market power in the wholesale electricity market

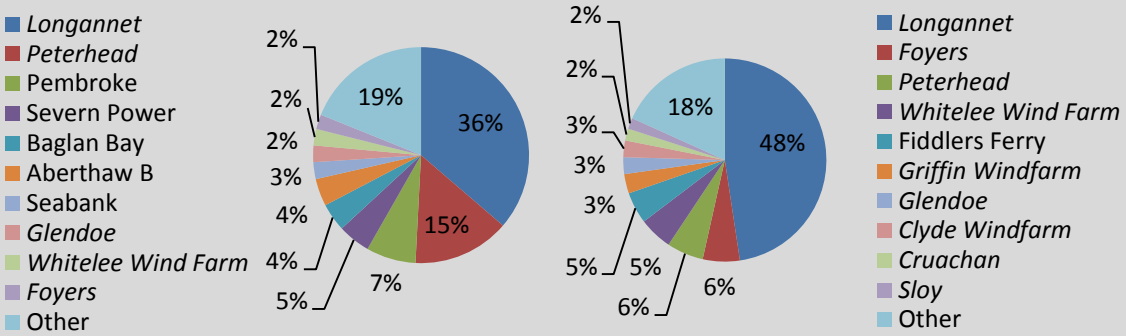
The wholesale electricity market arrangements allow market participants to trade within GB as if there were no limits on being able to transfer power from one part of the network to another. In reality, the network has locational constraints on its safe and reliable operation. When the traded wholesale market produces a situation that is incompatible with these constraints, the system operator must step in and resolve the issue. The Balancing Mechanism (BM) is where generators located at different points in the network post bids and offers to increase or decrease their intended power output. The system operator will then accept some of these bids and offers to fine-tune the system until the whole of the network balances.

This aspect of the wholesale market means there is potential for market power at both a national and regional level. If a generator knows it is critical to ensuring the system balances in a particular location, it can exert market power by adapting its bidding behaviour in the BM in order to capture excess profits.

Many of the main transmission constraints that currently affect the GB network relate to the transfer of power from north to south. These constraints usually arise when there is an excess of generation in Scotland and insufficient transmission capacity to transmit this power south to demand centres in England & Wales. These constraints are most prevalent during periods of high wind output and low demand.

Our pivotality analysis indicates that at a locational level the scope for market power is also relatively limited. The main exceptions to this are in Scotland where we find that in 2014 there were numerous periods in which two companies were pivotal in providing downward flexibility. In these periods, certain power stations that are located in Scotland and are within these two companies' portfolios must reduce or cease generating if the system is to remain in balance. These findings appear to be consistent with Figure 41 which shows the extent to which power stations have their bids to reduce generation for system reasons accepted in the BM. The ones in Scotland are italicised.

Figure 41: Market share of total accepted BM bids downwards for system actions, 2013 (left) and 2014 (right)

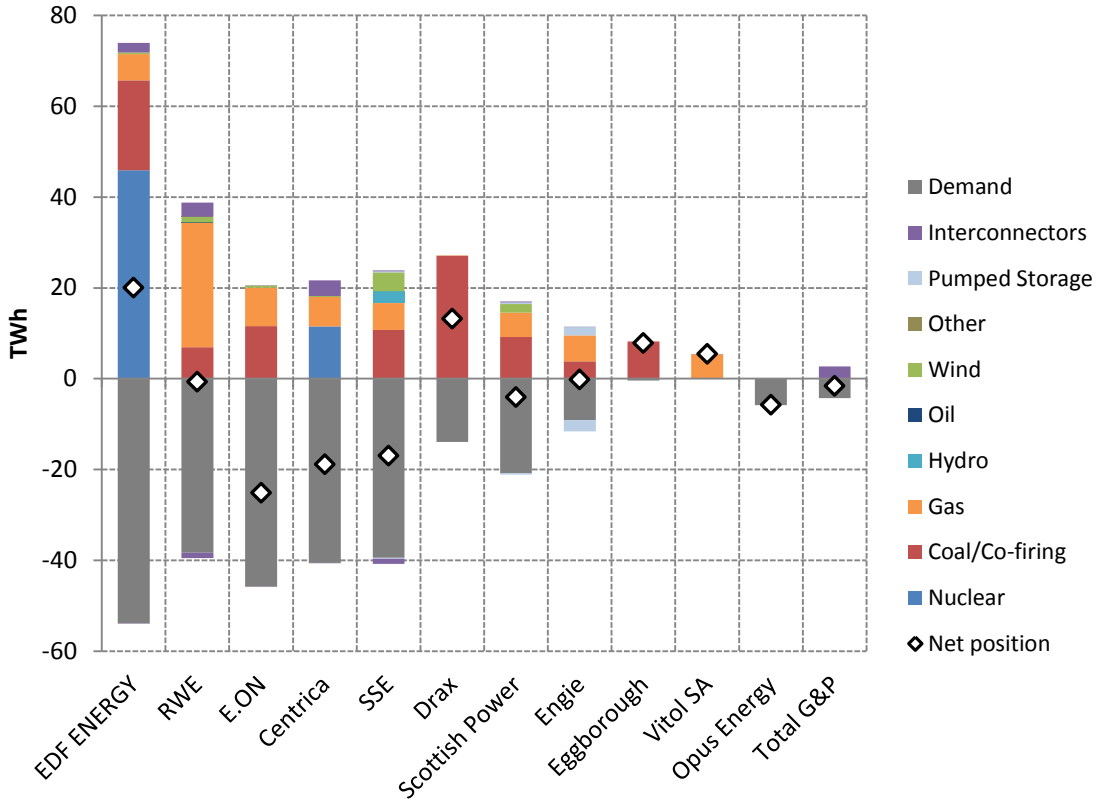


Source: Elexon, Ofgem analysis

Although our analysis shows that two companies may have market power in certain periods in Scotland due to network constraints, it is important to acknowledge that this does not mean that these companies have used their market power to act anti-competitively. In fact, the TCLC specifically prohibits companies from taking actions to exploit any such dominant position. We continue to monitor compliance with the Competition Act, REMIT and the TCLC to ensure parties are not abusing any dominant position. Furthermore, there are several network reinforcement projects, both planned and underway, that should alleviate these constraints in the next few years.

4.26. **Vertical integration** (VI) is more extensive in the electricity market than it is in the gas market.

Figure 42: Electricity generation and demand positions of major firms, 2014[70]



Source: Elexon, NETA Reports, Ofgem analysis

4.27. Figure 42 shows that the generation assets of five out of the six largest suppliers are not able to meet their customers' demands. For some, this is by a significant margin. EDF Energy is the exception to this. VI is not just limited to these companies. Engie (formerly GDF Suez) and Drax are other large generators that are integrated into the non-domestic supply market. Figure 42 also highlights how each firm has a different mix of capacity.

4.28. There has been **entry and exit** in the wholesale electricity market in recent years. As with the gas market, a number of financial institutions have exited the market. This has been counterbalanced by the entry of new generators, particularly

[70] Calculated based on metered volumes associated with individual generation and demand units (BM units), excluding Supplier Units. Assumptions have been made regarding which companies own each BM unit. Volumes have been split based on equity stakes. As with Figure 27, some degree of netting may have taken place for the underlying data. As such the full extent of generation and demand from pumped storage and interconnectors may be underestimated. Fuel types are based on classifications used by Elexon so may not be consistent with those used elsewhere in this report (eg in Figure 27 or Figure 28 which use data from DECC). In particular, the conversion of certain coal plants to co-firing is not captured here.

new wind farm operators and interconnector capacity holders. There have also been a growing number of new small suppliers entering from the retail market.

4.29. New entry has taken place despite some concerns over barriers to accessing the wholesale electricity market. For instance, analysis recently published by DECC[71] notes that the complexity and extent of credit requirements may pose challenges to new entrants in both the gas and electricity markets. There have also been historical concerns that low levels of liquidity in the wholesale electricity market may constitute a barrier to entry. As mentioned earlier, our Secure and Promote reforms have sought to remedy this through increasing access to selected traded products, particularly for smaller players. There is more detail on liquidity and the impact of our reforms in our annual liquidity policy evaluation document.

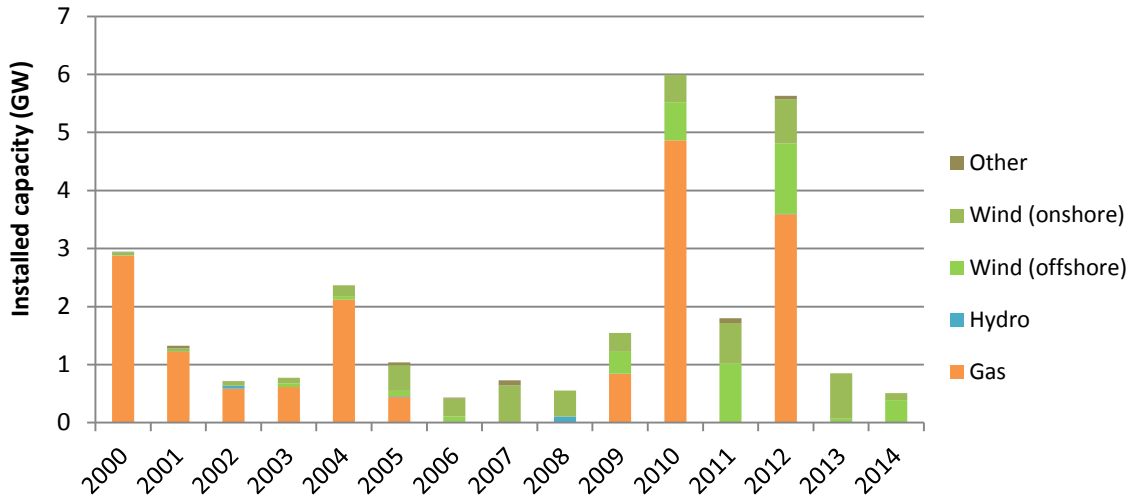
Investment and sustainability

4.30. **Regulatory burden and the quality of institutional processes** both affect the market's ability to improve over time. As with the gas market, assessing governance and the quality of institutional processes remains difficult. The length of key documents, like the Generation Licence, has marginally decreased in recent years. The numbers of modifications and change proposals to the Balancing and Settlement Code (BSC) have been largely steady, fluctuating between 10 and 20 since 2005. However, the development and implementation of various policies may well have added to the overall complexity of compliance and the regulatory burden facing GB market participants. More detailed work on governance issues can be found in a working paper we submitted to the CMA.[72]

4.31. Levels of generation **investment** suggest a mixed picture. Since 2000, over 27 GW of new generation has been added to the GB market. However, this has still failed to halt a trend of tightening de-rated margins. This is largely due to the pace of old plant closing and the intermittent nature of a significant portion of the new generation.

[71] DECC (2014) "Credit and Collateral in GB Energy Markets".
[72] https://www.ofgem.gov.uk/publications-and-updates/market-investigation-reference-code-governance-submission

Figure 43: Annual installation of new grid-connected generation capacity, 2000-2014



Source: DECC DUKES

4.32. The "energy-only" market[73] has not yet brought forward sufficient investment in new conventional generation to prevent margins from tightening. With respect to conventional flexible generation (eg gas), the difficulties experienced by the market are generally referred to as the "missing money" problem. This is where generators face a shortage of available revenues to cover their costs.[74] The market factors driving low profitability in these kinds of generation (eg low price volatility) were discussed in the previous section. The challenges for intermittent, inflexible and low carbon generation sources (eg wind and nuclear) are slightly different. The main issues they face are ensuring stable revenue streams and ensuring their low carbon costs are properly reflected in the market.

4.33. A number of policy changes are being introduced to resolve these issues and encourage generation investment. Our EBSCR reforms and Government's EMR both include changes that impact investment incentives.

4.34. Firstly, these policy changes will mean that the revenues that generators can expect from the energy-only market are changing in a number of ways:

[73] By "energy-only" we mean the traded commodity market for electricity where generators receive revenues for their actual output. This is distinct from other parts of the market where generators receive revenues for being available (capacity payments) or for providing ancillary services. Historically the "energy-only" market has been where most generators received the majority of their revenues, and so expected "energy-only" revenues have usually been an important part of any decision to invest in new generation capacity.

[74] This is usually attributed to two factors. First, prices fail to reflect the true costs of balancing the system when there is scarcity. Second, at times when there is scarcity and prices rise, investors fear that regulators or government will act to limit this (eg due to perceived abuse).

- Our EBSCR reforms will make cash-out prices more reflective of system conditions and costs. This should allow the wholesale market to better reflect the value of flexible generation, therefore helping solve the "missing money" problem.

- CfDs look to drive investment in inflexible low carbon generation (eg wind, nuclear) by removing the uncertainty of relying on volatile power prices in the energy-only market. Long-term revenue certainty for investors is achieved through government-agreed contracts with a guaranteed strike price that generators receive for their output.

- The CPF is affecting the energy-only market by effectively creating a minimum price for carbon in GB. This should encourage investment in low carbon generation by providing predictability over future carbon prices. As the carbon price increases this also reduces the profitability of existing carbon intensive generation (eg coal).

4.35. At the same time, the wholesale market is changing. Currently, we have an energy-only market in which generators get payed purely for producing energy only. With the introduction of the CM generators will get payments for capacity availability. These new revenues are in addition to the energy-only market revenues that generators receive for actual output and are also intended to help counter the effects of the "missing money" problem. The first CM auction was held in December 2014 and the results of the auction are shown in Box 6. It is too early to say how the wholesale market will be affected by the introduction of the CM. We will continue to monitor this closely.

Box 6: Capacity market auction results (for delivery in 2018/19)

The first auction for the GB Capacity Market, procuring capacity for delivery in 2018/19, was completed at the end of 2014. A capacity agreement obliges a party to be delivering electricity (or DSR) at times of system stress, during the relevant delivery year. Agreements are available for different lengths for different types of participant. New generators ('New Build') can qualify for agreements of a maximum of 15 years. Generators who invest to renovate or restore an existing asset ('Refurbishing') can qualify for agreement of up to three years. Current generators ('Existing') and DSR ('Proven and Unproven DSR') are eligible for one year agreements.

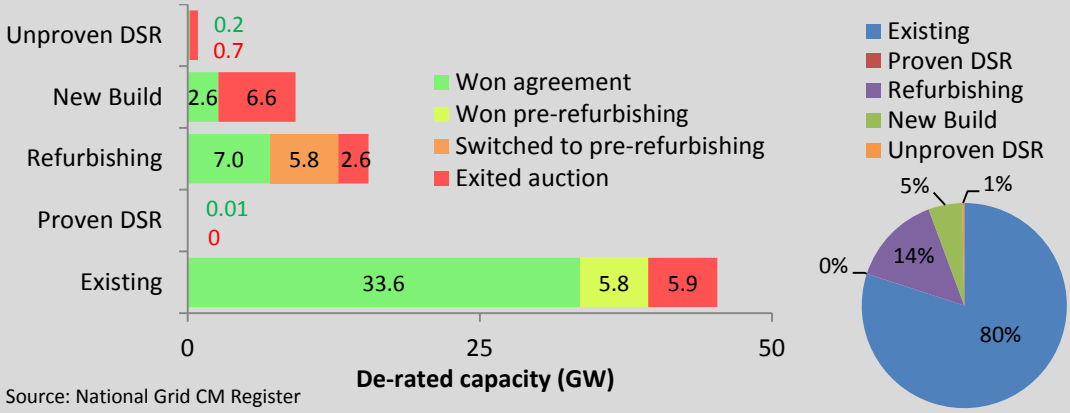
In total, almost 65 GW of de-rated capacity successfully entered the auction to compete for a total procurement target of 48.6 GW. Existing generators were the largest group participating (57%) as expected, with refurbishing plant (27%), new build (14%) and DSR (1%) making up the remainder.

A total of 49.3 GW of capacity was procured at a cost of £955.6m (in 2012 prices). As a 'pay-as-clear' auction all successful bidders received a clearing price of £19.40/kW/year. This was below most market expectations which anticipated a £25-50/kW/year clearing price.

The majority of the new build capacity that participated in the auction was entered by smaller, less established companies. New build ended up comprising 5% of the total capacity that secured agreements.

The majority of the existing and refurbishing capacity that participated in the auction was entered by larger established companies. Existing (80%) and refurbishing (14%) capacity ultimately made up the vast majority of the capacity that secured agreements. However, a number of older coal and gas plants did fail to secure agreements.

Figure 44: Capacity Market December 2014 auction results



Source: National Grid CM Register

4.36. The policy changes above should help secure investment in the medium-term. While the policy changes are embedded, investment may be affected as a result of uncertainty and potential political risk for investors. We are carefully monitoring the impact on generation plant availability.

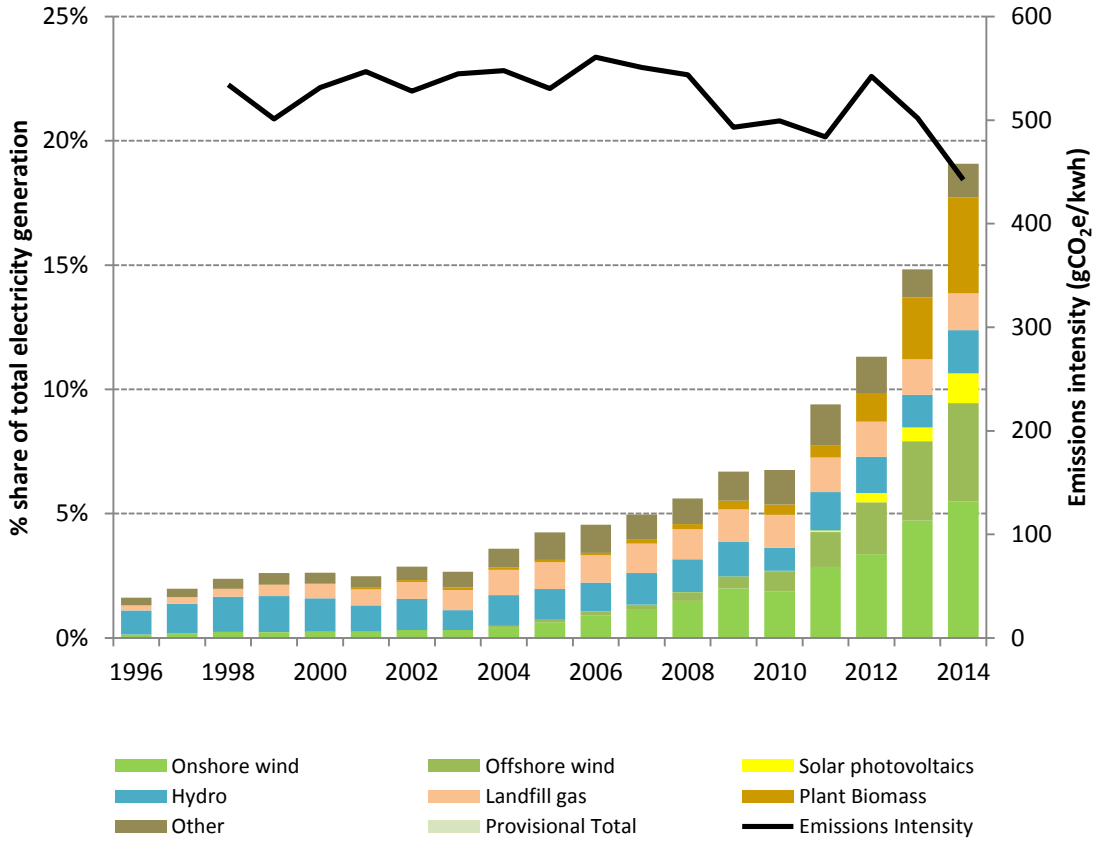
4.37. On **environmental sustainability,** there have been a number of interesting recent trends in the wholesale electricity market. Both peak and average demand have fallen over the last few years. This is likely because of a range of factors, including energy efficiency measures, growing amounts of distributed and micro generation,[75] consumers economising due to higher prices, benign weather conditions and broader economic conditions.

4.38. On the supply side, renewable power output continues to grow and was over 19% of total generation in 2014 (see Figure 45). In particular, wind output has increased significantly and there continue to be new record levels of wind generation as more wind capacity comes online. Provisional estimates of emissions intensity for the GB power sector (ie the amount of emissions per unit of electricity generated) indicate that in 2014 this fell to its lowest recorded level. This has been driven by the continued growth of renewables and a year-on-year decline in the amount of coal-fired generation. In the years before this, emissions intensity had been largely

[75] Distributed and micro generation are small-scale generation connected to the distribution network. This consists of a wide range of technologies such as: small-scale solar PV, hydro, Combined Heat and Power (CHP), generation from landfill gas, and biomass. The electricity generated by such schemes is typically used in the local system rather than being transported across GB, and hence manifests as a reduction in demand from the transmission grid.

unchanged. This was because the impact of increasing renewable output had been blunted by higher levels of coal-fired generation.

Figure 45: UK renewable output as a share of total generation and power sector GHG emissions intensity, 1996–2014[76]



Source: DECC DUKES, DECC Energy Trends, Committee on Climate Change

[76] 2014 estimates of the total share of renewables and emissions intensity are both based on provisional data. Emissions intensity is from the CCC.

Appendices

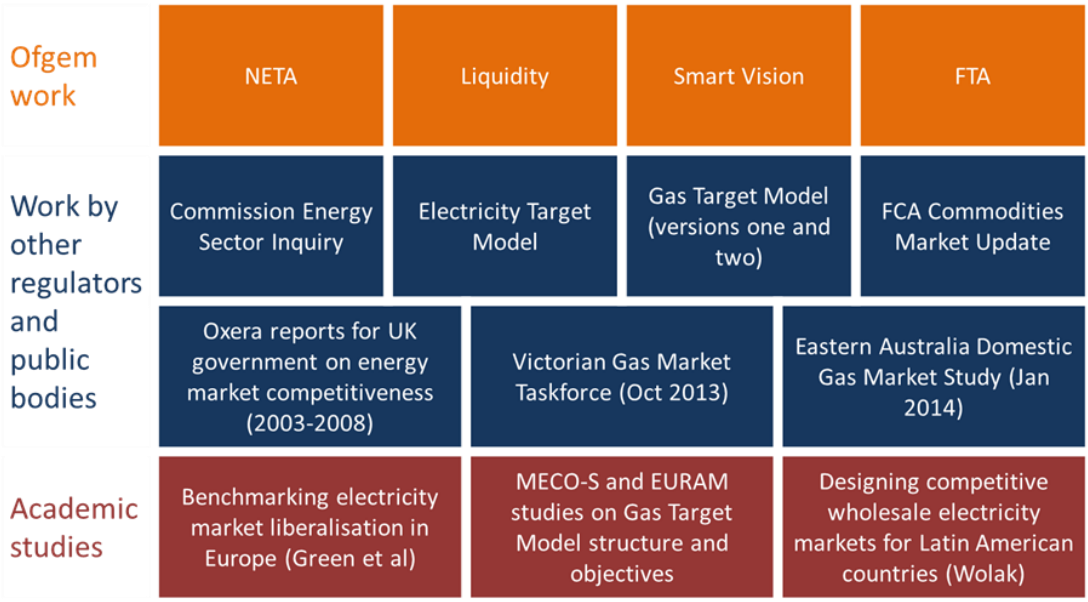
Index

Appendix 1 – Our wholesale markets framework in detail

Background

1.1. In formulating our framework we reviewed a range of prior market studies to understand more about how others had approached such a task. A selection of the studies we looked at are summarised in Figure 46 below.

Figure 46: Selection of relevant studies covered



1.2. Some notable features of the literature we looked at included:

- Attempts at a short, concise statement of an overall market objective;
- Hierarchical approaches to highlight how important aspects of the market relate to one another;
- Emphasis on qualitative as well as quantitative assessment;
- Most avoided ranking or prioritising certain aspects of the market over others. Directly addressing trade-offs seemed problematic and highly subjective;
- Many emphasised the importance of current and future outcomes; and

- Some opted for quite a broad approach so as to capture things like the regulatory environment, transparency and sustainability.

Our approach to developing the framework

1.3. Our approach to creating a framework for assessing the wholesale market uses a hierarchy of categories. It starts with a broad objective and ends with a range of indicators that can be assessed against benchmarks, and over time.

↓ The **Objective** is a single sentence setting out our view of the purpose of the market. It summarises desired market outcomes.

↓ The **Features** are what we consider the market should have if it is to achieve the objective. These are first set out as broad **high-level features**. These are then further sub-divided into more **detailed features**.

↓ The **Indicators** are detailed metrics that can be measured in order to determine the extent to which a given feature is present.

1.4. Our framework is underpinned by a number of basic assumptions:

- Competitive markets drive the most efficient outcomes (making bills lower than they otherwise would have been);
- Markets are generally the most efficient mechanism for matching consumers' demand and producers' supplies;
- Well-functioning wholesale markets are important for well-functioning retail markets;
- Government and EU policy are the context in which the market must operate. They are generally taken as given, although appreciating how they affect the market's ability to function is important; and
- Regulatory and institutional aspects that are within our and/or the industry's control are not taken as given and fall within the framework.

1.5. It is also worth noting there are things framework does not attempt to do. The framework does not seek to:

- Provide a perfect representation of how a well-functioning wholesale market is structured or operates (any market is necessarily complex and there will be interactions and overlaps);
- Weight or prioritise different elements of the market (eg, it does not take a view on the policy trilemma);

- Specify how to manage trade-offs between indicators, although it may help highlight them;

- Provide minimum criteria for the indicators it identifies. It is about flagging up what we should be looking at and how; or

- Provide different approaches for gas and electricity. There is understandably some difference with respect to the detailed indicators but the high-level aspects of the framework are consistent.

The framework

1.6. We have taken the overarching objective of gas and electricity wholesale markets is: **to provide a dynamic and sustainable mechanism in which informed participants can confidently and efficiently buy and sell the energy they need at a price that reflects economic costs**.

1.7. This objective effectively summarises four key features we consider the market needs to deliver if it is to function well. These are set out below. A visual representation of the framework was shown earlier in Figure 1.

Security of supply

1.8. Markets are a mechanism for determining the allocation of limited resources. Gas and electricity are also essential services whose supply and demand must be matched on a day-by-day or even second-by-second basis. We therefore consider clearing supply and demand in order to ensure security of supply to be a key feature of gas and electricity wholesale markets. This feature in our wholesale market framework fits very well with our strategic consumer outcome to improve reliability.

1.9. Two detailed features that a wholesale market needs for security of supply are:

- **Secure and adequate supplies** to ensure demand can be met; and

- **Efficient system operation** to ensure the networks remain balanced.

Access and liquidity

1.10. No market is perfect and there are always costs associated with trading.[77] To ensure it is easy for parties to trade, it is important that market minimises

[77] These include the costs of finding the desired good at the lowest price (search and information costs), the costs of striking a deal according to mutually agreed terms (bargaining costs) and the costs of ensuring any counterparty sticks to the deal (enforcement costs).

transaction costs. This feature in our wholesale market framework is linked to our strategic consumer outcome aimed at lowering bills.

1.11. Two detailed features that are needed for easy access and liquidity are:

- **A diverse range of products** to ensure the variable nature of consumer demand and supply output can be efficiently matched; and

- **A liquid market** to ensure that buyers or sellers that have identified the products they need can then reliably make transactions in a timely way without having to settle for a substantially worse price.

Competition

1.12. Even if the wholesale market clears supply and demand and minimises transaction costs, it is not the case that this alone will produce the best result for the consumer. Ensuring that the market is sufficiently competitive to produce prices that reflect economic costs is an important third feature. This feature in our wholesale market framework has strong ties to our strategic consumer outcomes aimed at lowering bills and improving the quality of service.

1.13. When breaking competition down into more detailed market features it is useful to differentiate between market structure and market outcomes:[78]

- **Competitive market structure** relates to the broader characteristics and structure of the market (eg concentration, vertical integration) that can affect the ability for the market to function in a competitive manner.

- **Competitive market outcomes** relates to the actual results of the competitive process (eg prices, profits) that directly affect consumers.

1.14. When looking at the wholesale markets for gas and electricity it is important to be mindful of the nature and structure of these markets. Accounting for this can alter the way that we may look at competition relative to other sectors.

1.15. The wholesale energy markets are typically characterised by high investment costs. Generation and gas supply assets are large, lumpy investments that take a long time to commission and build. Their returns are also spread over several decades. As such these investments carry a relatively high degree of risk, particularly given the recent and ongoing changes in the industry, as well as the increasing political importance placed on energy.

[78] See Competition Commission (2013), "Guidelines for market investigations".

1.16. We therefore consider that any assessment of market competition must be mindful of these factors. When looking at whether prices reflect economic costs, it is important to look at long-run as well as short-run marginal costs. This is because market participants must recover their long-run costs if their initial investment is to remain viable. Similarly, profits are not necessarily a problematic feature unless they a symptom of ineffective competition. In a competitive market, some firms could quite legitimately turn a profit, particularly at certain points in time due to cyclical factors or gains made through innovation or efficiency. Because of the large, lumpy and risky nature of new investment, it takes time for competition to respond to these signals and allow new entrants to compete profits back in line with long-run levels.

1.17. Investment and sustainability

1.18. So far, this framework has painted a static view of the market. Our obligations are to both present and future consumers, and so we believe it is very important that the market invests, adapts and improves over time in a sustainable manner. A well-functioning market should provide efficient outcomes now and in the future. Ensuring this is the case has relevance for all five of our strategic consumer outcomes.

1.19. Four detailed market features that are critical to achieving this are:

- **Good governance** underpinned by predictable, simple and flexible regulatory institutions. This is vital to ensuring that the "rules of the game" by which the market operates are conducive to investment, minimise regulatory burden and evolve over time when this is needed;

- **Investment** that is efficient (ie in proportion to need) to ensure we have secure, sustainable and affordable supplies in the future;

- **Innovation** to bring economic and transaction costs down and improve the efficiency with which the market operates; and

- **Environmental sustainability**. Where the wholesale markets are the vehicle that policymakers use to achieve environmental objectives, a well-functioning market will respond to the incentives placed on it. Importantly, the ability of the market to efficiently deliver desired environmental goals is dependent upon the appropriateness of the policy approach.

Appendix 2 – The GB wholesale market arrangements

1.20. In 1980s and 1990s, the gas and power industries were privatised. As a result of this the wholesale markets for gas and power were established and this opened much of the sector up to competition. The process of privatisation has played an important role in formulating the arrangements that exist today.

Brief history of the wholesale gas market

1.21. Privatisation of the gas industry began with the Gas Act of 1986 which started to dismantle the monopoly retail supply position of the British Gas Corporation.[79] This was an incremental process that started with the opening up of competition for larger industrial consumers. The Gas Act of 1995 completed this process, with full retail market competition for all consumers, including domestic households and small businesses, by 1998.

1.22. The Gas Act of 1995 continued the process of privatisation. Following its passage there was a process of de-mergers and acquisitions that broke up British Gas plc. Centrica took over the retail supply business, National Grid took over the transportation business, and BG Group took over the upstream production assets. The market arrangements for full third party access to the pipeline network and daily balancing at the NBP were introduced in the same year. These market arrangements were codified in the industry Network Code.

1.23. There have been numerous changes to the market arrangements introduced in their nearly twenty year history. The nature and extent of trading has also changed considerably over that period. Even so, the basic building blocks of the wholesale gas market arrangements have remained largely unchanged to this day.

Brief history of the wholesale electricity market

1.24. The Central Electricity Generating Board (CEGB) historically owned and operated the power stations and transmission system in England and Wales. It sold the power it generated to twelve area boards, which were responsible for distributing and supplying to end consumers. There were also a further two area boards in Scotland and these were responsible for their own generation and transmission.

1.25. Privatisation of the electricity industry began with the Electricity Act of 1989. This restructured the industry by first splitting the CEGB into a transmission company

[79] Source: Patrick Heather (2012), "The Evolution and Functioning of the Traded Gas Market in Britain".

and three generating companies. The twelve area boards were replaced by twelve regional electricity companies. The two boards in Scotland were also replaced. Britain's first set of trading arrangements were also established in 1990, known as the "Pool".

1.26. Between 1990 and 1996 almost all the newly created companies were sold off, with the exception of some of the nuclear generation assets which took longer to be transferred to private ownership. From 1990 the retail market also began to be opened up to competition, and this was achieved for all consumers by 1999.

1.27. The Utilities Act of 2000 led to the introduction of the New Electricity Trading Arrangements (NETA). NETA was introduced following concerns about competition and price-setting in the Pool. The central theme underpinning NETA was that the wholesale market for electricity should be more similar to other commodity markets. NETA has been subject to numerous modifications over the years, including an extension to incorporate Scotland in 2005, which became known as the British Electricity Trading and Transmission Arrangements (BETTA). Despite these changes, many of the same broad market arrangements that were implemented in 2001 remain in place today.

The current arrangements

1.28. The system of transporting energy through transmission and distribution networks is a natural monopoly. We regulate these activities through our price control process, which sets the amount of revenue that network companies can earn over a given period. Network companies must also hold a license if they are to engage in energy transportation. These licences set out a range of rules and responsibilities that network companies must adhere to. We govern and grant these licences.

1.29. Unlike transportation, the production, exchange and sale of energy are not natural monopolies. As such these activities take place in markets where there can be strong competition between participating companies. These are the wholesale and retail markets. A different set of licences with a range of rules and responsibilities apply to companies engaging in these activities. We also govern and grant these licences.

1.30. Table 4 below summarises the key features of the GB wholesale market arrangements as they exist today.

Table 4: Summary of the key features of our wholesale market arrangements

Question:	Gas:	Electricity:
Who are the main wholesale market participants?	Shippers are companies that put gas into, or take gas from, the gas network. Most upstream gas producers or importers are also gas shippers and focus on supplying gas to	Generators are companies that primarily supply power to the grid and then sell it on to suppliers in the wholesale market. Suppliers are companies that primarily buy

	the network. They then sell it in the wholesale market. Similarly, most retail gas suppliers are also gas shippers and focus on buying gas in the wholesale market. They then take it from the network to pass on to their end consumers.	power in the wholesale market. They then demand this power from the grid and provide it to their end consumers.
Who operates the gas and power networks?	NGG is the gas SO. It is responsible for ensuring the system remains balanced in real-time. The SO is incentivised to balance the system.	NGET is the electricity SO. It is responsible for ensuring the system remains balanced in real-time. The SO is incentivised to balance the system at least cost.
Who operates the interconnectors?	Interconnector operators are companies that operate the various interconnectors that connect GB's gas and power networks with the networks in other neighbouring countries.	
How are these various companies regulated?	A specific license is required for any company wishing to engage in any of the above activities. These licenses are governed and granted by Ofgem. They set out a range of rules and responsibilities that licensees must adhere to.	
What other companies participate in the market?	A range of trading houses and financial institutions are also involved in wholesale market trading. They look to manage market risk, optimise assets and act as an intermediary for smaller companies that might struggle to trade on their own.	
Over what time period is the *market* balanced?	The gas market is balanced daily. Each "gas day" starts and ends at 6am. This is due to change to 5am soon to bring us in line with the rest of Europe.	The electricity market is balanced on a 30 minute basis. Each day is therefore divided into 48 balancing periods, known as "settlement periods".
What do market participants balance?	In each gas day or settlement period, market participants aim to balance the combination of their physical positions and their traded positions. Their physical position is the gas/power that they physically supply to, or demand from, the network. Their traded position is the gas/power they contract to buy or sell. Balance = gas/power input – gas/power output + gas/power bought – gas/power sold	
How and when do market participants balance?	Market participants have the freedom to choose how to trade and who to trade with. For a given gas day, they may trade before or during that gas day.	Market participants have the freedom to choose how to trade and who to trade with. For a given settlement period they may trade at any point up to one hour before the settlement period begins. This cut-off point is known as "gate closure".
Over what time period is the *network* balanced?	The gas network must be balanced throughout each day. Because gas can be stored and the pressure of the gas in the network is able to fluctuate within certain limits (known as	The electricity network must be exactly balanced on a second-by-second basis. This is managed after gate closure when the SO becomes the sole party responsible for balancing

	linepack) the gas network does not need to be perfectly balanced on a second-by-second basis.	the system. It does this using a range of tools, most notably through the Balancing Mechanism (BM). In the BM the SO contracts with generators and suppliers in order to fine-tune their inputs and outputs. The SO also contracts for a range of ancillary services to ensure system stability (eg frequency response).
How are market participants incentivised to balance?	Market participants are not obliged to balance but are incentivised to do so because they face charges on any imbalance. These charges are called "cash-out" charges and reflect the costs that the SO incurs when balancing the system. Cash-out charges ensure that any imbalanced party is worse off than if they had balanced. This ensures downstream companies are incentivised to contract with upstream companies to buy the gas or power they need to meet their expected demand. In turn, upstream companies are also incentivised to contract with downstream companies to sell their output. Both parties are incentivised to forecast accurately and meet their contractual commitments. These market arrangements ensure the SO only undertakes a small, residual role when it takes control after gate closure.	
Where are the market arrangements set out and how can they change?	Besides the various licenses that market participants must have, the actual market arrangements are set out in a range of industry codes. These include the BSC in electricity or the UNC in gas. Inclusive governance arrangements allow industry participants to propose changes to the codes. We have the final decision on whether any changes are implemented. We can also propose our own changes through the Significant Code Review (SCR) process.	
What determines the wholesale price that participants buy and sell at?	There is no single wholesale price. Each individual trade between market participants exchanging gas or power involves agreeing an individual price. Those that are selling (eg generators) want to obtain a higher price. Those that are buying (eg suppliers) want to obtain a lower price. In a competitive market, prices should reflect the economic costs of delivering the supplies necessary to meet demand. Importantly, we do not set wholesale prices, but we do monitor the market to ensure that it is competitive.	
How can anyone know what the wholesale price is?	Many trading venues report the prices and volumes of the trades that take place in the market. Price reporting agencies also provide information on what wholesale prices were on any given day. Often this is in the form of an index that involves some kind of averaging or assessment of the deals that were struck.	

Appendix 3 - Glossary

A

Agency for the Cooperation of Energy Regulators (ACER)

ACER is a European Union body which cooperates with EU institutions and stakeholders, notably National Regulatory Authorities (NRAs) and European Networks of Transmission System Operators (ENTSOs), to deliver a series of instruments for the completion of a single energy market.

APX

APX owns and operates energy exchange markets in the Netherlands, UK and Belgium. APX provides a power spot exchange service in the UK.

B

Barrier to entry

A factor that may restrict entry into a market.

Baseload product

A product which provides for the delivery of a flat rate of electricity in each hourly period over the period of the contract.

BBL

The Balgzand-Bacton Line (BBL) interconnector is a gas interconnector between Balgzand in the Netherlands and Bacton in GB. At present, it can only physically flow gas into GB, though a virtual reverse flow product is also available.

BETTA

British Electricity Trading and Transmission Arrangements.

Bid-offer spread

The bid-offer spread shows the difference between the price quoted for an immediate sale (offer) and an immediate purchase (bid) of the same product; it is often used as a measure of liquidity.

Broker

A broker handles and intermediates between orders to buy and sell. For this service, a commission is charged which, depending upon the broker and the size of the transaction, may or may not be negotiated.

C

Capacity Market

With the introduction of the Capacity Market (CM), generators will get payments for capacity availability. These new revenues are in addition to the energy-only market revenues that generators receive for actual output and are also intended to help counter the effects of the "missing money" problem.

Carbon Price Floor (CPF)

The CPF, introduced in the UK on 1 April 2013, effectively sets a minimum price for carbon in the UK by "topping up" the EU ETS carbon price. The main intent of the CPF is to send a strong, stable incentive to invest in low carbon generation.

Central Electricity Generating Board (CEGB)

The CEGB historically owned and operated the power stations and transmission system in England and Wales. It sold the power it generated to twelve area boards which were responsible for distributing and supplying to end consumers. There were also a further two area boards in Scotland and these were responsible for their own generation and transmission.

Churn rate

Churn is typically measured as the volume traded as a multiple of the underlying consumption or production level of a commodity.

Clearing

The process by which a central organisation acts as an intermediary and assumes the role of a buyer and seller for transactions in order to reconcile orders between transacting parties.

Competition and Markets Authority (CMA)

The CMA is a non-ministerial government department which promotes competition. Its responsibilities include investigating mergers which restrict competition, conducting market studies and investigations in markets where there may be competition and consumer problems, and investigating breaches of competition law.

Contract for Difference (CfD)

A contract where the payoff is defined as the difference between a pre-agreed 'strike' price and a reference price (determined in relation to an underlying commodity). The Government has proposed the use of CfDs as part of Electricity Market Reform. CfDs under EMR are intended to encourage investment in low-carbon generation by providing greater long-term revenue certainty to investors.

D

Day-ahead market

A form of near-term market where products are traded for delivery in the following day.

Demand Side Response (DSR)

A demand side response is a short-term change in the use of gas or electricity by consumers following a change in the balance between supply and demand.

Department of Energy and Climate Change (DECC)

The UK Government department responsible for energy and climate change policy.

E

Electricity Balancing Significant Code Review (EBSCR)

EBSCR was an Ofgem-led project aimed at improving balancing incentives in the electricity market by making cash-out prices more reflective of the costs of balancing the system.

Electricity Market Reform (EMR)

EMR is the Government's approach to reforming the electricity system to ensure the UK's future electricity supply is secure, low-carbon and affordable.

Emissions Performance Standard (EPS)

The EPS effectively prohibits the construction of new generation sources that exceed a certain level of carbon-intensity.

EU Emissions Trading System ETS

The EU ETS is an EU greenhouse gas emissions trading system. It works on a 'cap and trade' basis, so there is a 'cap' or limit set on the total greenhouse gas emissions allowed by all participants covered by the System and this cap is converted into tradable emission allowances.

Exchange

A type of platform on which power products are sold. Typically an exchange would allow qualifying members to trade anonymously with other parties and the risks between parties would be managed by a clearing service.

F

Financial Product

A contract that is settled financially at maturity rather than by the delivery of a physical commodity.

Forward Curve

A series of sequential time segments within which it is possible to trade a particular commodity and for which prices are available.

Forward trading

The trading of commodities to be delivered at a future date. Forward products may be physically settled – by delivery – or financially settled.

G

Gas Year

The Gas Year runs from 1 October to 31 September each year.

Gas Significant Code Review (SCR)

The Gas SCR was an Ofgem-led project focusing on measures to enhance security of gas supply by reducing the likelihood, severity and duration of a Gas Deficit Emergency (a period when the supply of available gas is not sufficient to meet GB demand). A key element of the Gas SCR is the reform of cash-out arrangements in an emergency to increase the incentives on shippers to avoid an emergency.

H

HHI

The Herfindahl-Hirschman Index (HHI) is a measure market concentration and competition. It is calculated by squaring the market share of each company competing in a market, and then summing the resulting numbers.

I

ICE

Intercontinental Exchange, an American financial company that operates Internet-based marketplaces which trade futures and over-the-counter (OTC) energy and commodity contracts as well as derivative financial products.

Imbalance (cash-out) charges

Cash-out arrangements are operated in both the gas and electricity wholesale markets. Under these arrangements, parties who are not in balance incur charges that reflect the costs incurred by National Grid in addressing the imbalance. These

charges are known as cash-out prices. Cash-out prices are designed to provide market participants with strong commercial incentives to balance their contractual and physical positions and therefore avoid exposure to cash out prices. This may include contracting for supply ahead of time, or by maintaining the reliability of their production plant, for example.

Intra-day trading

Refers to the market in which products traded are on the same day as delivery.

IUK

Interconnector (UK) Limited (IUK) is a bidirectional gas interconnector between Zeebrugge in Belgium and Bacton in GB.

L

Liquefied Natural Gas (LNG)

Liquefied Natural Gas is natural gas (predominantly methane, CH4) that has been converted temporarily to liquid form for ease of storage or transport.

Liquidity

Liquidity is the ability to quickly buy and sell a commodity without a significant change in its price and without incurring significant transaction costs.

M

Market Maker

A firm which is regularly prepared to buy and sell in a commodities or financial market. Market makers post two-sided (bid and ask) prices on a regular basis, encouraging greater liquidity.

Market Power

Market power exists where an individual firm has the ability to profitably raise prices above competitive levels (or reduce the value of its offer to consumers in other ways) independently of the behaviour of rival firms.

N

N2EX

The N2 Exchange, a GB electricity market platform, is operated by Nord Pool Spot AS (NPS).

National Balancing Point (NBP)

The NBP is a virtual trading location for the sale and purchase of all gas in the GB market.

Near-term market

The market in which the products are traded close to delivery (for example, on the day of delivery or day-ahead of delivery.

NETA

New Electricity Trading Arrangements.

New Balancing Services (SBR and DSBR)

The Supplemental Balancing Reserve (SBR) and Demand Side Balancing Reserve (DSBR) provide NGET with additional tools to help balance the system in anticipation of tighter generation capacity in the middle of this decade.

SBR is a supply based balancing service that is available for NGET on non-holiday weekdays in the winter months of November to February. In return for payments SBR contracts specify that providers are not able to participate in the market for the duration of their contracts. If called upon SBR providers must provide generation, as required, between 6am and 8 pm during the contract period. DSBR is a demand-side service that offers payments for non-domestic consumers to reduce their demand for specified half-hourly periods between 4pm and 8pm on winter weekdays.

O

Off-peak product

A product which provides for the delivery of a flat rate of electricity for the period of the day when demand is typically lowest for the duration of the contract.

On-the-day Commodity Market (OCM)

The OCM is a gas trading platform in GB. It has been used for short-term balancing since the market was first created. The OCM is operated by ICE ENDEX.

Over the Counter (OTC)

Trading of financial instruments, including commodities, that takes place directly between counterparties. This is in contrast to exchange-based trading where the exchange acts as a counterparty to all trades.

P

Peak product

A product which provides for the delivery of a flat rate of electricity for the period of the day when demand is typically highest for the duration of the contract.

Physical (settlement)

A contract that, at maturity, results in an exchange of the contracted good for its contracted value.

Product

The type of contract available. Examples include day-ahead, weekly, weekend, block seasonal, year, etc. Standard products are those that are widely traded on well-established terms, so exchanges generally deal in standard products. By contrast, structured products are those where the terms are precisely tailored to match the contract buyer's requirements, and they usually involve variable contract volumes and/or non-standard volumes and durations.

Pivotality

Pivotality analysis focuses on gas supply or electricity generation capacity and assesses whether a certain company's supply/generation is necessary to meet demand. Pivotality is an indicator of the possibility for market power; it does not account for the incentives on firms to exploit any dominant position, and is not an indicator of actual market abuse or anticompetitive behaviour.

R

REMIT

REMIT is an EU regulation on energy market integrity and transparency (No 1227/2011). It has been in force since 28 December 2011.

S

Secure and Promote

The Secure and Promote licence condition was introduced to improve liquidity in the GB wholesale power market so that it is sufficient to underpin well-functioning, competitive generation and supply markets. Secure and Promote came into effect on 31 March 2014.

Shippers

Gas shippers buy gas from producers and sell the gas onto suppliers. They are defined as an entity which introduces, conveys and takes out gas from a pipeline system.

Spot market

Refers to the market in which products traded are delivered at (or close to) delivery.

T

TCLC

The Transmission Constraint Licence Condition (TCLC) specifically prohibits companies from taking actions to exploit a dominant position during periods of transmission constraint.

TTF

The Title Transfer Facility (TTF) is a virtual trading point for natural gas in the Netherlands.

U

UKCS

United Kingdom Continental Shelf.

V

Vertical Integration

Where one corporate group owns two or more parts of the energy supply chain. For example, where the same group features both generation and supply businesses.