



Department
of Energy &
Climate Change

ofgem

Making a positive difference
for energy consumers

Statutory Security of Supply Report 2014

Presented to Parliament pursuant to section 172 of the Energy
Act 2004 as amended by section 80 of the Energy Act 2011

Ordered by the House of Commons to be printed 28 October
2014



Statutory Security of Supply Report 2014

**A report produced jointly by DECC and Ofgem, other
than the Annexes which are produced solely by
DECC**

Annex A: Electricity Capacity Assessment Report
Response from the Secretary of State

Presented to Parliament
pursuant to section 172 of the Energy Act 2004
as amended by section 80 of the Energy Act 2011

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Executive summary

Introduction

This report discharges the Government and Ofgem's obligation under section 172 of the Energy Act 2004 as amended by section 80 of the Energy Act 2011, to report annually to Parliament on the availability of electricity and gas for meeting the reasonable demands of consumers in Great Britain (GB).¹ It also discharges the Government's obligation under certain EU Directives to monitor gas and electricity security of supply issues and publish reports.²

The technical data presented here has been produced from analysis conducted by DECC, Ofgem and National Grid (NG). The statistics relied on in this document are for GB only where possible. However, in some cases where it is not possible to split the GB data out from the United Kingdom (UK) data, UK statistics have been used. Where this is the case, they have been referred to as UK in the accompanying text.

In November 2012, the Government published its *Energy Security Strategy* where it set out the policy considerations relating to security of supply, assessed key cross-cutting risks to energy security and the characteristics that imply a secure system for each key fuel: adequate capacity, diversity, reliability and demand-side responsiveness.³ As in the *Statutory Security of Supply Report 2013*, an annex to this report updates the indicators which were presented in the Strategy.

Electricity

GB's electricity system has delivered secure supplies to date. While the system continues to face the significant challenges of decarbonisation and replacing ageing and polluting plant, developments over the last twelve months mean that the risk of customer disconnections has decreased significantly. Action has and is being taken to address tighter margins.

Ofgem's latest Electricity Capacity Assessment Report, published in June 2014 shows a similar outlook to last year's assessment indicating increased risks to electricity security of supply towards the middle of this decade without policy action.⁴ However, since then the introduction of new balancing services by Ofgem and NG, supported by DECC, has reduced the risk of customer disconnections. The new balancing services extend the tools that NG have to balance

¹ Available from: www.statutelaw.gov.uk/Home.aspx

² Directive 2009/73/EC of the European Parliament and the Council of 13 July 2009 concerning common rules for the internal market in natural gas and repealing Directive 2003/55/EC augmented by Regulation (EU) 994/2010 of the European Parliament and the Council of 20 October 2010 concerning measures to safeguard security of gas supply and repealing Council Directive 2004/67/EC; and Directive 2009/72/EC of the European Parliament and of the Council of 13 July 2009 concerning common rules for the internal market in electricity and repealing Directive 2003/54/EC augmented by Directive 2005/89/EC of the European Parliament and of the Council of 18 January 2006 concerning measures to safeguard security of electricity supply and infrastructure investment.

³ Available from: www.gov.uk/government/policies/maintaining-uk-energy-security--2

⁴ Available from: www.ofgem.gov.uk/ofgem-publications/88523/electricitycapacityassessment2014-fullreportfinalforpublication.pdf

the electricity system. The Secretary of State's response to Ofgem's Electricity Capacity Assessment can be found at **Annex A** to this document.

The Government has legislated for the Capacity Market which will ensure GB's longer term security of supply by providing a payment for reliable sources of capacity. The first auction will be held later this year for the delivery of capacity from October 2018. Contracts for Difference have also been designed to provide long term price stabilisation for low carbon generation plant. In addition, Ofgem is in the process of reforming the cash-out regime which aims to support electricity security of supply by ensuring that price signals accurately reflect the value of flexible electricity sources.

The networks, both transmission and distribution, remain reliable but along with the rest of the electricity system, continue to require investment to ensure they continue to facilitate the transition to a low carbon system. Ofgem's price control settlements through RIIO are ensuring this investment takes place and drives further efficiency savings.

Gas

GB's gas market continues to function well with sufficient capacity and the ability to deliver to meet demand.

The UK Continental Shelf (UKCS) remains a major source of gas in the GB market, with supplies also coming from a variety of international partners via pipelines and LNG cargoes. Nevertheless, there continues to be some uncertainty around the impact that external events could have on the supply of gas to Europe and GB.

Regulators, government and industry continue to work together to implement the detailed EU codes required to deliver a more co-ordinated European energy market, which will increase Europe's overall resilience to energy shocks. Ofgem's work through a Significant Code Review to reform incentives on gas shippers to match demand and supply and improve incentives for demand-side response should also increase the resilience of the GB market.

Oil

Oil continues to provide about a third of total UK primary energy, providing the main energy for transport. The UKCS is still able to deliver equivalent to about two thirds of domestic demand, although oil is a global commodity and the UK exports and imports oil to take advantage of market efficiencies. Total UK oil demand is expected to remain relatively stable until 2030, but the refined products the UK uses will continue to change proportions in the mix as technology changes, in particular as the motor industry develops more efficiencies and renewable solutions.

Global oil use is expected to increase. Although the UK remains a significant producer, and the largest in the EU, UK production has been declining since 1999 and the Government is working with industry to maximise UK production.

1. Electricity

Introduction

- 1.1. This chapter lays out the current view as to the outlook for the security of supply situation for electricity in Great Britain (GB) for the coming years. The four main areas covered are:
- electricity demand - the future development of peak demand and the role of demand side response;
 - electricity supply – the current amount of capacity to meet requirements as well as that under construction and in the planning pipeline;
 - the network – the current reliability levels of GB’s electricity transmission network and the need for future investment;
 - market functioning – changes to the electricity market to ensure competition and cost reflective prices for consumers.

The chapter relies on data and analysis from DECC and Ofgem’s own work, as well as from National Grid (NG).

- 1.2. Earlier this year Ofgem set out their security of electricity supply outlook in their Electricity Capacity Assessment Report 2014.⁵ This set out the risks associated with the levels of generation that could be delivered by the market (2014/15 to 2018/19). Ofgem’s latest capacity assessment report shows a similar outlook to last year’s assessment; without policy action, risks to electricity security of supply were expected to increase towards the middle of the decade, before improving thereafter. However, since then, due to the new balancing services introduced by NG and Ofgem with DECC support, the risk of customer disconnections has reduced.
- 1.3. Margins have decreased in recent years from historically high (and economically inefficient) levels and at the same time demand has also decreased. In the short-term, NG as system operator, can use the new balancing services to balance the system if the margins are tight. The Government has introduced the Capacity Market (CM) and Contracts for Difference (CfD) to enhance security of supply in the medium term and beyond. Further, action has been taken to improve the market through the Electricity Balancing Significant Code Review and to strengthen the networks. These measures are described in more detail in this chapter. The Secretary of State’s response to Ofgem’s Electricity Capacity Assessment can be found at **Annex A** to this document.

⁵ Available at: www.ofgem.gov.uk/ofgem-publications/88523/electricitycapacityassessment2014-fullreportfinalforpublication.pdf

Demand

Peak Demand

- 1.4. Chart 1.1 shows projections of future peak electricity demand from NG. This includes demand met by generation which is connected to the transmission network as well as embedded generation (generation that is connected directly to the distribution network).
- 1.5. Peak electricity demand has been declining in recent years; peak demand levels were around 60 GW over the winter 2013/14 down from around 66 GW in 2005/06. Declining electricity demand is the result of the economic downturn as well as the impact of improvements to electricity efficiency.
- 1.6. NG have published four scenarios for electricity demand as part of the UK Future Energy Scenarios work: under their Gone Green (GG)⁶ and Low Carbon Life (LCL)⁷ 2014 scenarios, it will take roughly 20 years or longer to see peak electricity demand rise to the level it was in 2005/06; whereas the Slow Progression (SP)⁸ and No Progression (NP)⁹ scenarios see peak electricity demand steadily decline over the next 20 years to around 57GW and 59 GW in 2035/36 respectively. There is a high level of uncertainty involved with estimating future peak demand demonstrated by the Future Energy Scenarios range of nearly 11GW in 2035/36. GG and LCL increase considerably post 2025 primarily due to high electrification of heat and transport. More detail on the Future Energy Scenarios produced by NG can be found in their UK Future Energy Scenarios document.¹⁰

⁶ In the “Gone Green” scenario it is assumed that renewable energy and carbon targets are met and energy efficiency policy delivers, leading to a reduction in demand.

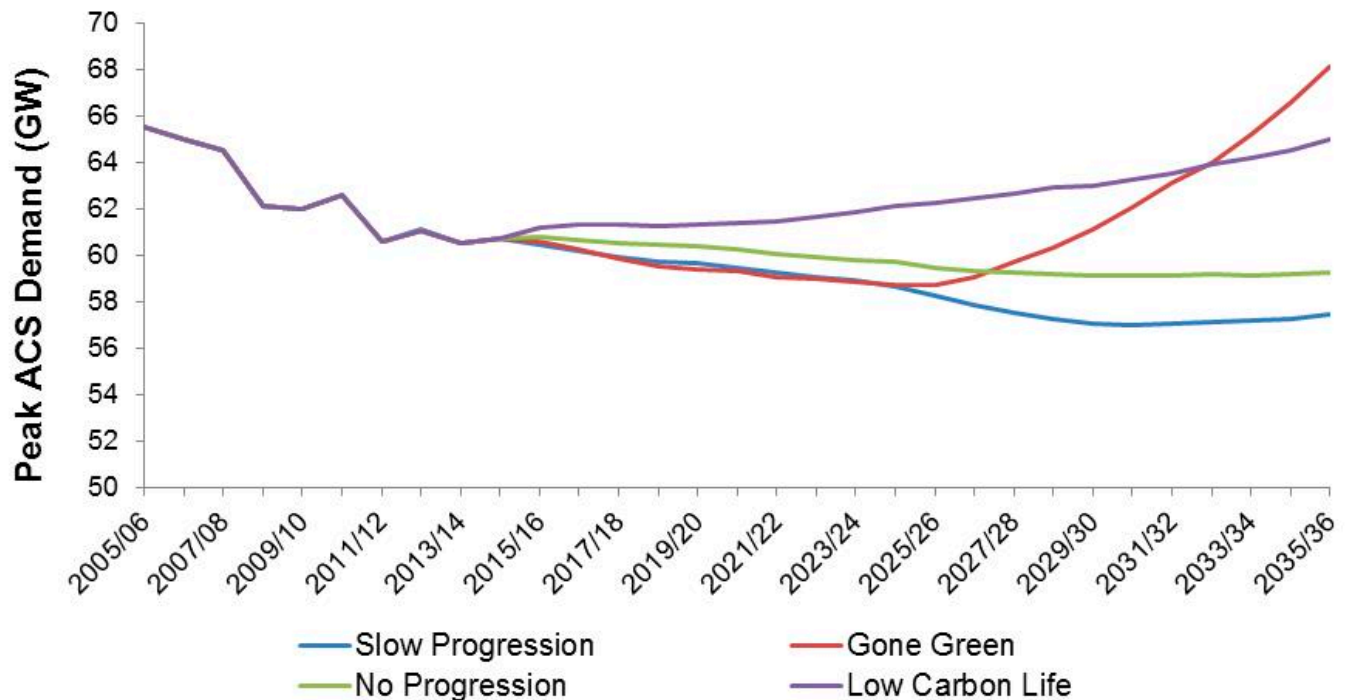
⁷ In the “Low Carbon Life” scenario it is assumed high economic growth, short term volatility regarding energy policy and no additional targets. Government policy is assumed to be focused on long term decarbonisation through purchasing power and macro policy.

⁸ In the “Slow Progression” scenario low economic growth, low fuel prices, a failure of government policy to meet energy efficiency and renewable energy targets and a lack of change in consumer behaviour lead to sustained demand for gas.

⁹ In the “No Progression” scenario economic recovery is slower than in the slow progression scenario. No new targets are introduced and there is political volatility which means that government is focused on short term affordability measures.

¹⁰ Available at www.nationalgrid.com/uk/Gas/OperationalInfo/TBE/Future+Energy+Scenarios/

Chart 1.1: Future Development of Peak Demand



Source: National Grid Future Energy Scenarios (NG FES) 2014

Demand Side Response

- 1.7. Demand side response (DSR) is defined by Ofgem as ‘customers responding to a signal to change the amount of energy they consume from the grid at a particular time’.¹¹ In practice DSR means the active reduction in electricity consumption at a given moment in time. This term is typically used to describe two activities:
- lowering demand directly through load reduction, for example by shifting a process to a different time of the day; or
 - generation that offsets electricity demand on the transmission network level, so that NG, as the system operator, no longer see the consumption as demand. This generation could be of the form of small scale back up generation.
- 1.8. NG currently utilise DSR as part of its role as residual balancer of the electricity transmission system – fine tuning the balance between the demand and generation of electricity in real time. NG contracts power sources, including DSR, for balancing the system through its Short Term Operating Reserve (STOR),¹² among other balancing services. NG typically has around 3GW of STOR contracted, and dispatches STOR 5 days out of seven.
- 1.9. To provide a snapshot of the types of providers participating in STOR, from mid-August to mid-September 2013, 1.35GW of ‘non-Balancing Mechanism’ (non-BM) providers were contracted in STOR – this broadly equates to DSR provision (a further 1.75GW of STOR coming from larger generators).¹³ Of the 1.35 GW of DSR in STOR, around

¹¹ Available from: www.ofgem.gov.uk/ofgem-publications/75245/creatingtherightenvironmentfordemand-sideresponse.pdf

¹² Available from: www.nationalgrid.com/uk/Electricity/Balancing/services/STOR/

¹³ Available from: www2.nationalgrid.com/WorkArea/DownloadAsset.aspx?id=30376

135MW (10%) was actual 'load reduction/turn-down' – meaning organisations reducing the amount of electricity they take from the grid – for example, by turning off refrigeration or air conditioning units for a short period of time. The remainder of the 1.35GW was made up of smaller 'on-site' generators – including diesel, gas, hydro, combined heat and power (CHP) and biomass.

- 1.10. The Transmission Network Use of System (TNUoS) charging regime is used to pay for the recovery of installation, reinforcement, maintenance costs and renewal of assets by the owners of the transmission network. 73% of these charges are paid by demand customers, with an estimated 30% of this by large industrial and commercial electricity consumers.
- 1.11. Each qualifying customer's charge is based on their electricity demand during the 3 periods of peak system demand each year, known as 'triads'. To reduce their TNUoS charges, organisations will aim to predict these peaks and reduce their electricity when they expect them to occur. These triad periods are not known in advance, so typically companies will reduce on numerous occasions during the winter period in the expectation that a peak is about to occur. This is known as 'triad avoidance'. Triad avoidance is another example of DSR in the current market.
- 1.12. In its 2014 Winter Consultation NG stated that DSR levels related to triad have risen relative to previous years, typical DSR levels of 1.2GW were experienced throughout the triad period (November to February), and up to almost 2GW on occasion.¹⁴ The new Demand Side Balancing Reserve (DSBR) service for winter 2014/15 will offer new opportunities for businesses which have the flexibility to sign up for payments in return for reducing the amount of electricity they take off the grid at times of high demand. For more detail on the new balancing services, please see Box 1.3.

Electricity Supply

Present Capacity

- 1.13. Electricity generating capacity is typically transferred to a high voltage transmission network which subsequently feeds into a lower voltage distribution network that connects to households and firms. Generation that takes this route is referred to as transmission connected, whereas generation that is connected directly to the distribution network is referred to as distributed or 'embedded' generation.
- 1.14. As of end of March 2014, the UK had a total of around 77.6 GW of installed electricity capacity connected directly to the transmission system, including available interconnection capacity.¹⁵ The overall figure is little changed from the year before, but as shown in Chart 1.2, the components parts have changed proportions as some coal has closed, while more wind and biomass generation has become available.
- 1.15. In addition to transmission connected capacity, there is an estimated 11 GW of electricity capacity connected directly to the distribution network also known as 'embedded' generation.¹⁶

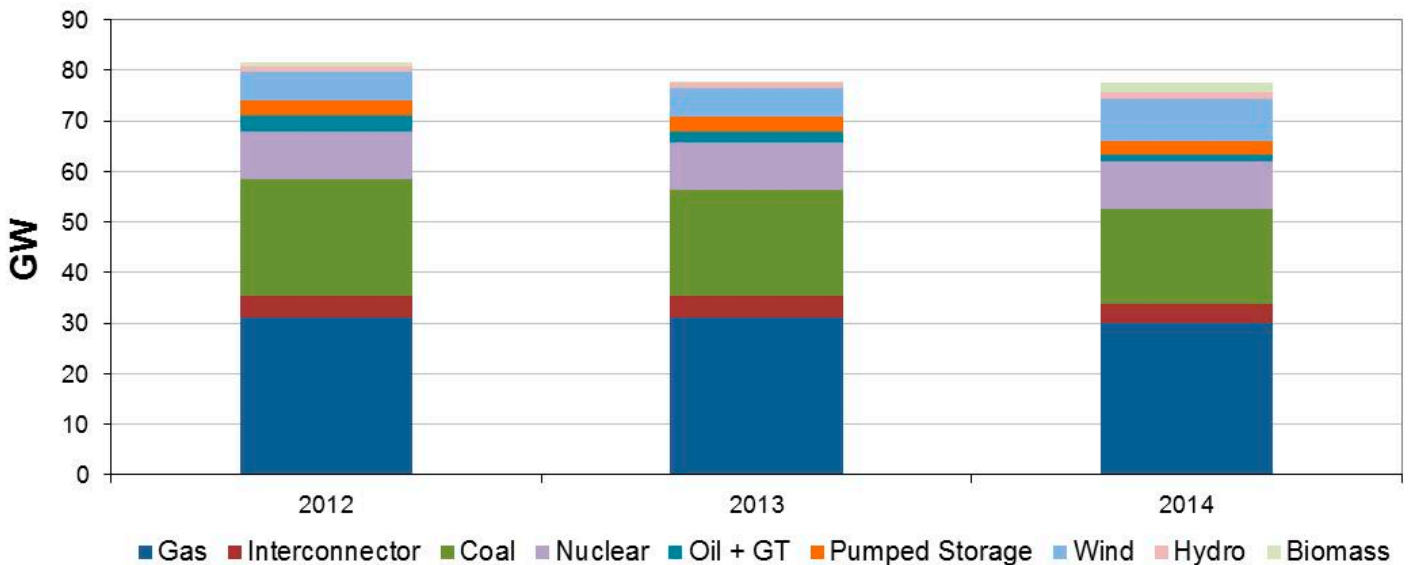
¹⁴ Available from: www2.nationalgrid.com/WorkArea/DownloadAsset.aspx?id=34787

¹⁵ NG 2014: Installed capacity refers to the maximum potential generating capability of the power station and includes interconnection capacity. Other measures, such as de-rated capacity, adjust the capacity figure to account for the reliability characteristics of the plant.

¹⁶ Source from NG as above in footnote 15. Figure excludes micro-generation.

1.16. GB also has the means to import from and export to other countries; the equivalent of just under 4 GW of capacity can be transmitted to and from France, the Netherlands and Ireland.

Chart 1.2: Transmission connected capacity, by generation technology, in 2012, 2013 and 2014



Source: National Grid 2014¹⁷

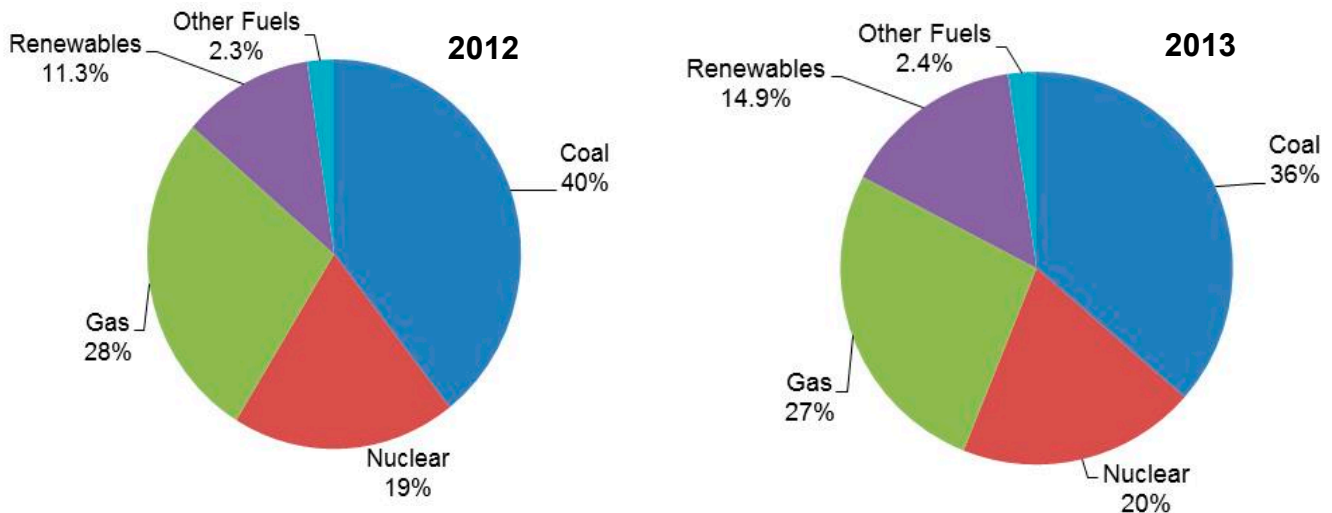
- 1.17. The proportion of electricity produced by each generating technology is different from the proportion of each technology’s total potential capacity. This is because some plant generates more or less continuously (for example nuclear, due to its low marginal cost and high availability), some only at times of extremely high prices and/or demand (for example oil), and some depending upon whether the power source is available, for example whether the wind is blowing.
- 1.18. In 2013, there was 359 TWh of indigenous electricity production, down from 363 TWh in 2012.¹⁸ The breakdown of this by technology type is shown in Chart 1.3. Coal decreased its share from 40% to 36% while the proportion of gas generation fell from 28% to 27%. Coal generation has broadly remained more profitable than gas generation. This has been due to lower coal prices relative to gas and low EU Emissions Trading System carbon prices.¹⁹ Renewables increased their share from 11.3% to 14.9%, primarily due to higher wind output (see Box 1.1) and nuclear increased its share from 19% to 20%.

¹⁷ In this chart, biomass refers to dedicated biomass only. Biomass conversions are represented under coal.

¹⁸ DUKES, 2014, Table 5.1. Figure excludes foreign imports of electricity and generation from pumped storage.

¹⁹ The EU Emissions Trading System (EU ETS) is the European Union’s cap and trade market for greenhouse gas emissions. Coal is a more carbon intensive form of generation than gas and hence has a higher emission cost under the EU ETS.

Chart 1.3: Shares of electricity generation, by fuel, in 2012 and 2013



Source: Digest of UK Energy Statistics produced by DECC July 2014 (DUKES 2014), Chart 5.2

Box 1.1 – record levels of Wind generation last year

Increasing penetration of wind generation, as well as increased availability (mainly due to high wind speeds in the second half) in 2013/14, has led to rapidly increasing amount of GB electricity from wind generation. In the fourth quarter of 2013 and first quarter of 2014, 11% and 11.8% of GB's electricity generation came from wind generation; taken over the six months as a whole, this was 11.4% compared with 6.7% over the same period in 2012/13.²⁰

Over December 2013 to February 2014 (the coldest, but also windiest, three months of 2013/14), electricity from wind generation accounted for 12.4% of electricity supplied by major power producers (who operate the majority of wind capacity) compared with 7.2% in 2012/13.²¹

Pumped Storage

1.19. In GB there is around 2.8 GW of pumped storage capacity. This technology can be operated flexibly, meaning it can come on and off of the electricity system within seconds, and is widely used, alongside other technologies, by NG to balance and maintain the integrity of the electricity system. There are no firm plans for significant new storage sites in GB at present.

²⁰ Energy Trends table ET 6.1, available at: www.gov.uk/government/statistics/energy-trends-section-6-renewables and Energy Trends table ET 5.1, available at: www.gov.uk/government/statistics/electricity-section-5-energy-trends

²¹ Energy Trends table ET 5.4, available at: www.gov.uk/government/statistics/electricity-section-5-energy-trends

Box 1.2: Security of Primary Fuel Source

Coal

Coal-fired generation accounted for 36% of total UK generation in 2013 and is currently central to the security of electricity supply.²² Most of the UK's coal supply (83%) was used in electricity generation in 2013 with 21% of total supply coming from indigenous production and 79% from imports.²³

There continues to be readily available imports to meet any shortfall, with the current over-supply of thermal coal on European markets keeping spot prices at low levels. The relative over-supply has been attributed to the shale gas boom in the United States leading coal prices to generally decline since 2011. In addition, data for 2013 indicates coal stock levels are typically sufficient to meet around 12 weeks of generators' coal demand.²⁴

Uranium

Nuclear generation accounted for 20% of UK generation in 2013.²⁵ Uranium is supplied on global markets. There is no major concern for the security of uranium supply, now or for the foreseeable future.²⁶

Plant Closures

- 1.20. Ofgem's Electricity Capacity Assessment published in June 2014 sets out the impacts of plant closures over the period to 2018/19. Annex A to this report describes the high level results. The table below summarises recent closures, capacity reductions, full or partial mothballing and conversion to biomass of power stations.²⁷

²² DUKES, 2014, Chart 5.2

²³ DUKES, 2014, Table 2.4

²⁴ DECC Energy Trends 2014, Table 2.1

²⁵ DUKES, 2014, Chart 5.2

²⁶ The Nuclear Energy Agency (NEA) undertakes a regular and comprehensive analysis of world uranium reserves, production capacity and envisaged global demand. Their findings are made available every two years in their respected publication "Uranium: Resources, Production and Demand (The Red Book)". The latest edition, published in 2014, concluded that total identified global resources are sufficient for over 120 years of supply, based on current requirements.

²⁷ Mothballing refers to closing a plant but keeping it in a condition where it can return to operation if required. The time required to bring a mothballed plant back to operation depends on a number of factors (e.g. maintenance levels during the period of mothballing).

Table 1.1: Major Power Producers capacity closed, converted or reduced (as at the end of May 2014), since end-2012

Site	Fuel	Status	Previous Capacity (MW)	New Capacity (MW)	Year of closure, capacity reduction or conversion
Keadby	CCGT	Mothballed	749	0	2013
Kings Lynn	CCGT	Mothballed	340	0	2013
Roosecote	CCGT	Mothballed	229	0	2013
Cockenzie	Coal	Closed	1,152	0	2013
Drax	Coal (1)	Partially Converted	3,870	3,870	2013
Ironbridge	Coal (2)	Converted	940	360	2013
Tilbury B	Coal (3)	Closed	750	0	2013
Didcot A	Coal/Gas	Closed	1,958	0	2013
Fawley	Oil	Closed	1,036	0	2013
Teeside	CCGT (4)	Closed	45	0	2013
Ferrybridge C	Coal (5)	Partially Closed	1,960	980	2014
Uskmouth	Coal (6)	Closed	363	0	2014

1. Partly converted to biomass. Overall capacity remains at 3,870 MW (coal 3,225 MW, biomass 645 MW).
2. Converted from coal to dedicated biomass in 2013 (at 900 MW), before reducing to 360 MW in April 2014.
3. Converted from coal at 1,063 MW capacity to dedicated biomass at 750 MW capacity in 2011 before closing in 2013.
4. Reduced capacity from 1,875 MW (CCGT 1,830 MW / OCGT 45 MW) to 45 MW (OCGT) in 2011 before closing in 2013.
5. Two units (980 MW) closed in April 2014.
6. One unit (120 MW) closed in April 2013, with the remaining two closing in April 2014.

Source: DUKES 2014, Table 5C²⁸

²⁸ Some of the developments since May are discussed below in paragraph 1.22.

- 1.21. Some of these plants have closed as a result of requirements imposed by EU Directives, including the EU's Large Combustion Plant Directive (LCPD).²⁹ Of the 12 GW of generating capacity that originally opted out of the LCPD, only two plants are still operational. Littlebrook (a 1.1GW oil-fired plant) is due to close in March 2015; Ironbridge (a 340 MW biomass conversion plant)³⁰ must close by the end of 2015 or as soon as it uses its allowance of 20,000 hours.
- 1.22. Table 1.1 shows changes up to May 2014 and does not include any developments since then, which include:³¹
- a fire at two coal plants, Ferrybridge (2x 500MW coal units) and one unit at Ironbridge (340MW). This resulted in the permanent closure of the unit at Ironbridge. It is still uncertain as to when the units at Ferrybridge will return, although the owners expect one unit to return for this winter.
 - Operational data indicates that the two Barking units (950MW) will be unavailable during the next year. Barking announced it is planning to shut down permanently in the next two years.
 - Following the discovery of a crack in the boiler spine of the Heysham 1 nuclear reactor, EDF closed both units at Heysham and a further two units at Hartlepool, which all share the same unique boiler spine design (2400MW in total across the four units). The closure of all four units was a precautionary measure to allow EDF to undertake detailed inspections and also allow repair of the spine at Heysham 1. It is currently expected that all four units at Heysham and Hartlepool will return to full operation during 2014 although the exact dates are still to be confirmed.³²
 - Roosecote, a mothballed CCGT plant, gained approval for demolition in September 2014. The plant had previous capacity of 229 MW under full operation.

Ofgem's Electricity Capacity Assessment and new balancing services for mid-decade

- 1.23. Ofgem's Electricity Capacity Assessment 2014 gives an assessment of the outlook for security of electricity supply for the following five winters. The analysis is based on the first four years of NG's FES, complemented by Ofgem's sensitivity analysis to capture the significant uncertainties around the supply and demand outlook. It focuses on the de-rated capacity margins, the average excess of available supply over demand, that could be delivered by the market over the next five winters and the risks to security of supply associated with these.
- 1.24. The analysis shows that without the new measures introduced by the Government, Ofgem and NG, the outlook for security of supply would be broadly the same as seen in the 2013 report. The de-rated margins would be expected to fall over the next two winters as older power stations close, before improving after the middle of the decade.

²⁹ Directive 2001/80/EC to be found at: eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=CONSLEG:2001L0080:20090625:EN:PDF. The LCPD aims to reduce acidification, ground level ozone and particles throughout Europe by controlling emissions of sulphur dioxide (SO₂) and nitrogen oxides (NO_x) and dust (particulate matter (PM)) from large combustion plants (LCPs). The directive applies to any combustion plant with a thermal output above 50 MW and includes power generation.

³⁰ Ironbridge has converted to biomass although it is still classed as coal for LCPD purposes.

³¹ The list here is not comprehensive of all the changes which have occurred since May 2014.

³² EDF announced in September 2014 that the four reactors are expected to return to service between the end of October and the end of December. For more information see: newsroom.edfenergy.com/News-Releases/EDF-Energy-update-on-Heysham-1-and-Hartlepool-Power-Stations-2e5.aspx

However, the introduction of new measures means that the risk of customer disconnections in the coming winters has reduced compared to last year's report.³³

Box 1.3: New Balancing Services

In light of the uncertain outlook to security of supply during the middle of the decade, DECC, National Grid Electricity Transmission and Ofgem have worked together to explore options to ensure additional safeguards for consumers in the form of new balancing services, which would enable NGET to maintain system balance.

NG has announced two new services as an extension to the existing tools it uses to balance the grid. The first is Demand Side Balancing Reserve (DSBR) – this will offer new opportunities for businesses which have the flexibility to sign up to payments in return for reducing the amount of electricity they take off the grid at times of high demand. These products were approved by Ofgem in December 2013.

These types of services are already widely used, and will become increasingly important in the future as a smart grid allows for more responsive use of electricity. This represents a very positive step towards reducing the cost of the transition to a low carbon economy – keeping costs down for consumers by avoiding the need to build additional “peaking” power plants.

The second service is Supplemental Balancing Reserve (SBR) which is targeted at power stations that would otherwise not be available, so that they can provide power as a last resort when needed by NG.

NG announced it has contracted 319 MW of DSBR for the coming winter across 431 individual sites.³⁴ Recently, NG also announced a tender for SBR as a precautionary measure to help manage the uncertainty for winter 2014/15 due to recent market developments. This tender closed on 30th September 2014. NG is now firming up its requirement and will confirm the amount it intends to procure, if any, before the start of the winter period.

For the DSBR and SBR required for winter 2015/16, NG is intending to contract the services required across two tenders. The first of those would be launched in October 2014, while the second round would be held during spring 2015.

If there is an ongoing requirement for these products, and this is approved by Ofgem, NG will also procure further volumes for 16/17 and 17/18 when margins are also expected to be low in advance of the CM.

More information on these services can be found at: <http://www.nationalgrid.com/uk/Electricity/AdditionalMeasures/>

- 1.25. From 1st January 2016, the LCPD will be replaced by the Industrial Emissions Directive (IED),³⁵ which places more stringent emission requirements on power plants than the LCPD. This will affect the UK coal capacity that has already complied with the LCPD, as well as some gas capacity. The following options were available to plants:
- i. opt in to the IED and meet its emission requirements from 1 January 2016;

³³ In the short-term NG can use new tools (the new balancing services) to help balance the system when margins are tight. The Government has also set out firm plans to introduce the Capacity Market to reduce risks to security of supply in the medium term and beyond.

³⁴ Available from: www.ofgem.gov.uk/licences-codes-and-standards/codes/electricity-codes/balancing-and-settlement-code-bsc

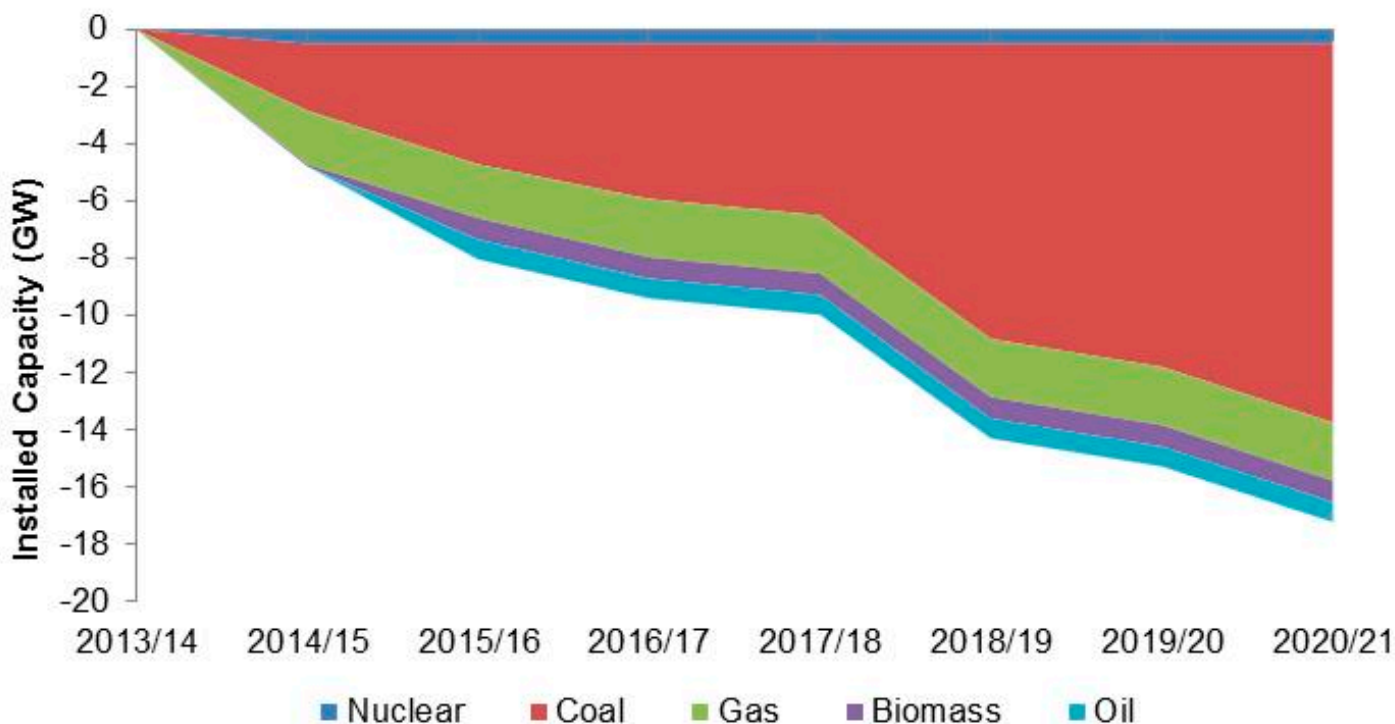
³⁵ Available from: eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=CONSLEG:2010L0075:20110106:EN:PDF

- ii. opt in via the Transitional National Plan (TNP), which allows a gradual adjustment to the new emission requirements between 2016 and 2020 with restrictions on absolute emissions levels in this period. Plants which do not meet the requirements by the end of 2020 can continue to operate for up to 1,500 hours a year (17% annual load factor). Plants can also leave the TNP at any time prior to 30 June 2020 to become IED-compliant;
- iii. opt out, which means that these plants will be subject to a Limited Lifetime Derogation (LLD) of 17,500 running hours between 2016 and 2023 and must close when the hours are exhausted or by the end of 2023, whichever is reached first. Plants can withdraw their LLD undertaking (and opt in via the TNP) up to 1 January 2016 after which the LLD will be binding; and
- iv. opt out, which means that these plants will be subject to a Limited Hours Derogation (LHD) of indefinite operation of up to 1,500 hours per year, averaged over a rolling 5 year period.

1.26. Operators wishing to opt-out under the Directive were required to give notice of such by 1 January 2014. Five coal plants (available 10.5 GW) chose not to opt-out and remain in the Transitional National Plan (TNP). Plants that have chosen not to opt-out cannot now do so. Seven coal plants (available 8.7 GW) chose to opt-out taking a Limited-Lifetime Derogation (LLD). Operators can revoke their decision to opt-out and re-enter the TNP up until 1 January 2016. To date only E.ON has invested in equipment necessary to fully meet the requirements at its Ratcliffe-on-Soar 2000 MW coal-fired power station.

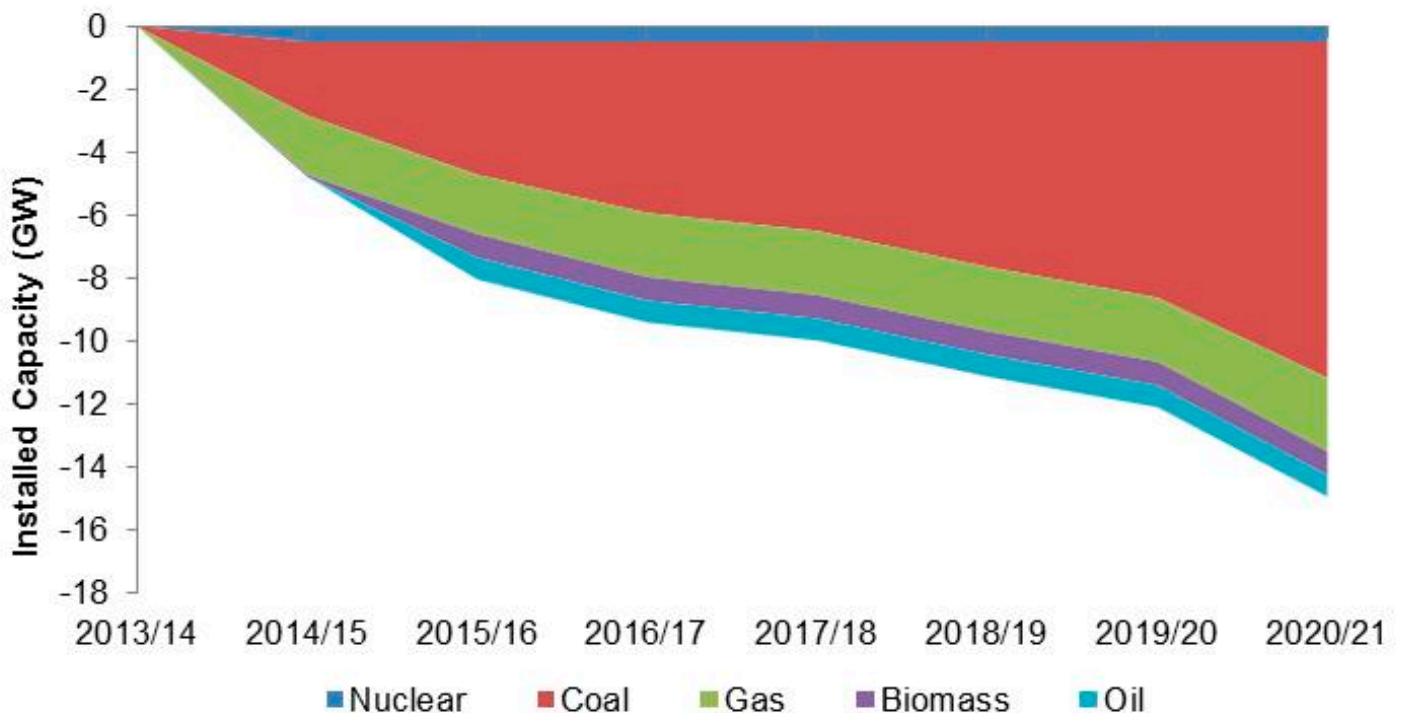
1.27. Charts 1.4a and 1.4b below show the cumulative amount of capacity that is currently scheduled to close up to 2020/21, from NG's GG and NP scenarios.

Chart 1.4a: Cumulative capacity closures under the GG Scenario



Source: National Grid, Future Energy Scenarios, GG 2014

Chart 1.4b: Cumulative capacity closures under the NP Scenario



Source: National Grid, Future Energy Scenarios, No Progression 2014

Nuclear Plant Closures

- 1.28. Nuclear operators, have previously published indicative dates by which they expect individual nuclear sites to close. According to these timetables, around 3.9 GW of existing nuclear generation capacity will have closed by the end of 2020.³⁶ However, the operating lives of nuclear power plants can be extended with the approval of the Office for Nuclear Regulation (ONR). The decision whether to seek to extend the scheduled closure date is a commercial one for the operators. These decisions will take into account such factors as plant safety and operating costs, as well as supply, demand and price expectations in the electricity market as a whole.
- 1.29. The UK's oldest operating nuclear power station at Wylfa in Anglesey has recently obtained an extension of operation until December 2015.³⁷
- 1.30. On December 4th 2012, EDF announced that it will undertake a programme of investment that will extend the expected operational life of two of its stations by seven years to 2023: Hinkley Point B and Hunterston B.³⁸ EDF has indicated that they will aim to obtain an average life extension of seven years for the rest of their Advanced Gas-cooled Reactor (AGR) nuclear fleet beyond their indicative closure dates, and for the Pressurised Water Reactor (PWR) at Sizewell to run for an additional 20 years.

³⁶ More information on the scheduled closure dates of the current nuclear fleet can be found at www.gov.uk/government/uploads/system/uploads/attachment_data/file/48353/2027-past-and-present-uk-nuclear-reactors.pdf

³⁷ Available from: news.onr.org.uk/2014/09/regulatory-support-for-wylfas-continued-operation/

³⁸ More information on the extension of Hinkley Point B and Hunterston B can be found at: www.nicongress.org/uploads/papers/speaker/Nigel%20Houlton%20NIC_LifetimeManagement_EDFenergy%20Pa-per%20Final.pdf

Following on from this EDF have stated the intention of extending the lifetime of its Dungeness station by 10 years to 2028.³⁹

Policy and Market Development

- 1.31. New policies are being implemented to bring forward new capacity. Market developments are already impacted by these new policies including the new plant pipeline. Below the report describes the key policies that are being implemented and the outlook for new generation.

Electricity Market Reform

- 1.32. The current market faces a number of unprecedented challenges:
- very rapid closure of existing capacity as older, more polluting plant go offline to comply with environmental legislation;
 - the generation mix needs to respond to the challenge of climate change and meet the UK's legally-binding carbon and renewable targets; and
 - there is uncertainty about future electricity demand as highlighted in this chapter. DECC expects demand to continue to grow over the coming decades as GB increasingly turns to electricity for heat and transport.
- 1.33. To address these challenges DECC designed the Electricity Market Reform (EMR). EMR is designed to help to incentivise the further investment GB needs over the coming decade, bring forward low-carbon generation and maintain security of supply at the least cost to the consumer.

The Capacity Market

- 1.34. In order to address concerns around a lack of investment in new reliable sources of capacity, DECC designed the CM. This is part of the Government's EMR package, and will ensure security of electricity supply in the medium to long term. The CM provides a payment for reliable sources of capacity, alongside their electricity revenues, to ensure they deliver energy when needed. This will encourage the investment GB needs to replace older power stations.
- 1.35. Capacity agreements will be offered to investors with existing and new capacity, four years (or one year) ahead of the year capacity must be delivered, giving them certainty over part of the future revenues they will receive. Capacity agreements will be allocated based on the outcome of CM auctions.

Reliability standard

- 1.36. Underpinning the CM is an enduring reliability standard which provides the acceptable level of security of supply for the GB system – bearing in mind the likely costs of providing that level of security. This is expressed as a loss of load expectation (LOLE) and set to 3 hours/year.⁴⁰ The Government will review the reliability standard as it considers appropriate.

³⁹ Available from: <http://newsroom.edfenergy.com/News-Releases/Update-on-Dungeness-B-graphite-bricks-2ab.aspx>

⁴⁰ i.e. The number of hours/periods per annum in which, over the long-term, it is statistically expected that supply will not meet demand, and which reflects the economically efficient level of capacity. This does not mean that we would have this level of blackouts in a particular year; in the vast majority of cases, loss of load would be managed without significant impacts on consumers.

Amount to auction and four year ahead auction

- 1.37. The reliability standard will guide how much capacity is auctioned in the CM. Each year, the System Operator (NG) will set out how much capacity is needed to meet the reliability standard and will provide a recommendation to Government on the amount of capacity needed to be procured for a particular capacity year, four years in advance.⁴¹ This will be based on NG's assessment of different scenarios for the level of electricity demand and the amount of capacity provided by power plants, which are not eligible for capacity payments, e.g. low carbon generation. The Government will ultimately take the final decision over how much capacity to procure for each capacity year.
- 1.38. The target capacity for the first four year ahead auction is 48.6GW, with 2.5GW for demand side response set aside for the first one year ahead auction. The first auction will be held in December 2014 for delivery of capacity from October 2018.

Transitional Arrangements

- 1.39. The transitional arrangements have been designed to help new DSR providers and small scale embedded generation or storage under 50MW that are not yet mature enough to compete against traditional generation in the main CM, and in so doing help grow these sectors. New providers will have an opportunity to participate in the transitional arrangements auctions from Q4 2015 and use that experience and learning in the main CM auctions.

Contracts for Difference

- 1.40. A further key instrument under Electricity Market Reform is the CfD that are designed to provide long-term price stabilisation to low carbon plant. CfDs aim to allow investment to come forward at a lower cost of capital and therefore at a lower cost to consumers. The design aims to ensure that strategically important technologies can be deployed and supply chains strengthened. Whilst the primary policy to ensure security of electricity supply is the CM, CfD will help promote a diverse and sustainable energy mix which will benefit energy security.⁴²

Electricity Balancing Significant Code Review

- 1.41. The Electricity Balancing Significant Code Review (EBSCR) aims to support electricity security of supply by ensuring that price signals accurately reflect the value of flexible electricity sources. Currently, the prices parties pay or receive for uncontracted electricity ('cash-out prices') do not accurately reflect the marginal cost of balancing the system or the value consumers assign to maintaining supply. This limits the ability for prices to rise to reflect scarcity, dampening incentives for investment in flexible capacity and reducing the chance of electricity flowing to GB over the interconnectors when needed.
- 1.42. The EBSCR Final Policy Decision, which was published in May 2014, proposes a range of measures that result in sharper, more cost-reflective cash-out prices. This complements the CM in delivering security of supply by improving prices as a signal of scarcity and better signalling the value consumers place on flexibility (such as DSR and storage). As the EBSCR reforms improve revenue expectations for flexible plant, they should also lead to lower clearing prices in the CM auctions.

⁴¹ NG has published auction guidelines for the first CM auction and the pre-qualification process is underway.

⁴² The Levy Control Framework (LCF) allows the Government to control public expenditure for all of DECC's low carbon electricity levy-funded policies until 2020/21. These comprise the Renewables Obligation (RO), small-scale Feed-in Tariffs and CfDs (including Investment Contracts). The annual cap in 2020/21 has been set at £7.6 billion.

- 1.43. The EBSCR includes four main proposals which are due to be introduced in three stages.⁴³ The first stage, proposed for this winter, involves an initial reduction in the number actions used to calculate the cash-out price and thereby a marginal sharpening of prices.⁴⁴ The second stage, intended for winter 2015/16, would involve all four proposals. However, in order to phase introduction to help the industry to adapt to the changes, prices would still not be 'fully sharpened'.⁴⁵ The final step, involving the fully marginal, cost-reflective cash-out price, is proposed for introduction before the first CM delivery year in winter 2018/19. The proposals are currently being assessed by industry through the code modification process, to agree final implementation details.

Gas and Coal-fired Generation

- 1.44. Approximately 16 GW of CCGT capacity (comprising 15 projects) has been granted consent although final investment decisions have not yet been made.⁴⁶ In addition, a further 5.8GW (8 projects) of gas fired capacity is awaiting planning consent. Carrington power station (880 MW CCGT)⁴⁷ is currently under construction and expected to be completed by the end of 2016.

Nuclear

- 1.45. The proposed new nuclear plant at Hinkley Point C (3.2GW) achieved planning consent and an agreement on key terms between the Government and EDF in 2013; first electricity generation is anticipated in 2023. In total, the UK's three nuclear consortia – NNB GenCo (EDF), Horizon Nuclear Power (Hitachi) and NuGen (Toshiba/GDF Suez) – plan development of up to 16 GW (including Hinkley Point C) of new nuclear power in the UK by 2030.

Renewables

- 1.46. There is approximately 4.3 GW of transmission connected renewable electricity generation under construction with a further 14.3 GW of projects having gained planning permission and awaiting construction. In addition nearly 18GW of capacity is currently seeking planning consent. Projects remain predominantly offshore and onshore wind, and biomass as shown in the summary table below.

⁴³ These are: making cash-out prices 'marginal' by calculating them from the top 1MWh of balancing actions in each period rather than an average of the top 500MWh; introducing a single, cost-reflective cash-out price that more accurately captures the value or cost of a market participant's imbalance to the system operator (SO); replacing the price of certain pre-contracted reserve actions in cash-out with a price which more accurately captures their real time value; and ensuring that the costs to consumers of Demand Control (the Value of lost Load which has been assessed at £6,000/MWh) are captured in the cash-out price if it occurs.

⁴⁴ Ofgem's final decision for this winter will be published shortly here: www.ofgem.gov.uk/licences-codes-and-standards/codes/electricity-codes/balancing-and-settlement-code-bsc

⁴⁵ Instead cash-out prices would be calculated using the top 50 MWh of actions, and the Value of Lost Load figure used to price Demand Control into cash-out would be £3,000 / MWh rather than £6,000 / MWh.

⁴⁶ Projects granted Section 36 consent or Development Consent Order.

⁴⁷ Consented capacity is 860 MW.

Table 1.2: Renewable Capacity in GW				
	Installed capacity end of 2013	Capacity Under-construction	Capacity Awaiting Construction	Capacity Awaiting Consent
Offshore	3.7	1.4	4.3	9.1
Onshore	7.3	1.5	5.1	6.5
Solar	2.7	0.6	1.5	1.4
Marine	0.6		0.2	0.3
Biomass	4.1	0.8	3.8	0.6
Hydro	1.7		0.1	
Total	20.1	4.3	15	17.9

Source: Delivering UK Energy Investment, July 2014⁴⁸

Electricity Networks

Current network reliability

- 1.47. There are three onshore transmission owners (TOs) in GB: NGET in England and Wales; Scottish Power Transmission Limited (SPTL) in south and central Scotland, and Scottish Hydro Electric Transmission plc. (SHET plc.) in the north of Scotland. In addition to onshore TOs, there are nine Offshore Transmission Owners (OFTOs) and 14 distribution network operators (DNOs) in GB.
- 1.48. Onshore TOs face statutory obligations and regulatory incentives to create an operating environment designed to reduce unsupplied electricity. The historic overall reliability of supply has been impressive. For instance, during the financial year 2012/13, overall reliability for the network stood at 99.99975%.⁴⁹
- 1.49. Offshore Transmission Owners (OFTOs) are incentivised to maintain availability of their offshore transmission systems. This ensures offshore generators are able to export energy with minimal disruption. For the financial year 2012/13 the average availability of offshore transmission systems was over 98%.⁵⁰
- 1.50. As part of the price control process, Ofgem set target and incentive rates for the number of customer interruptions and customer minutes lost for each DNO. The 'Interruptions Incentive Scheme' (IIS) incentivises DNOs to invest in and operate their networks to manage and reduce the frequency and duration of power cuts experienced by their customers. This amounts to 99.98% availability for year.
- 1.51. There are standards to encourage DNOs to meet certain expected levels of service and to provide payments to end customers in the event of individual standards not being

⁴⁸ Available from: www.gov.uk/government/publications/delivering-uk-energy-investment-2014

⁴⁹ Available from: www.nationalgrid.com/NR/rdonlyres/83A0A21D-4267-4983-8109-AA9A4E7B83FD/62630/NationalElectricityTransmissionSystemPerformanceReport20122013.pdf

⁵⁰ Offshore Transmission OFTO Revenue Report, December 2013: www.ofgem.gov.uk/ofgem-publications/85237/es822-offshore-ofto-revenue-report-1-web.pdf

met.⁵¹ The standards cover a range of activities, including restoring supply during an unplanned interruption and providing notice periods for planned interruptions.

Future Development of Electricity Networks

- 1.52. The electricity network in GB is undergoing a significant programme of investment. This includes expansion to accommodate forthcoming new generation projects, replacement of ageing assets and maintenance of assets to ensure continued network reliability. Ofgem's framework for carrying out Price Control Reviews, RIIO (Revenue = Incentives + Innovation + Outputs), aims to ensure that electricity network companies actively support the transition to a decarbonised electricity sector and GB's security of supply needs, whilst providing long term value for money for consumers.
- 1.53. The 2013 to 2021 transmission price control (RIIO-T1) started on 1 April 2013. Ofgem has approved funding of up to £21.5 billion (2009-2010 prices) for expanding, replacing and maintaining the GB transmission network for RIIO-T1.⁵²
- 1.54. In addition, the TOs provide quarterly updates on their major projects to the Electricity Networks Strategy Group (ENSG – a high level industry group chaired by DECC and Ofgem). The latest update shows that around 12.6 GW of network capacity is under construction for delivery by mid-2018.⁵³
- 1.55. Under the current Distribution Price Control (DPCR5) covering the years 2010 to 2015, up to £10.5 billion (2007/08 prices) of new capital is being invested in the distribution networks.⁵⁴
- 1.56. As part of preparation for the next electricity Distribution Price Control (RIIO-ED1), which starts on 1 April 2015, DNOs submitted initial business plans to the independent regulator Ofgem in July 2013. Following Ofgem's review and consultation, Ofgem fast tracked 4 of these business plans and requested revised business plans from the remaining DNOs. The non-fast tracked revised business plans were submitted to Ofgem in March 2014 and Ofgem published its draft determination in July 2014 with a final determination on baseline revenues expected in November 2014.⁵⁵
- 1.57. To safeguard minimum levels of performance and reliability of supply for all customers Ofgem is retaining the existing interruptions incentive scheme (IIS) and continuing the Electricity (Standards of Performance) Regulations, and enhancing particular ones. For the other reliability indices, health and load, Ofgem are creating more consistent methodology for assessment across the DNOs. Ofgem has decided to modify the existing health index by removing the criticality element and creating a separate criticality index. The health and criticality scores will be combined and consolidated into a new composite risk index. This is to allow DNOs to clearly demonstrate that actions taken by them during RIIO-ED1 to reduce network risk take account not only the probability that an asset fails, but also the expected impact of such failures.

⁵¹ As part of DPCR5 the "Electricity (Standards of Performance) Regulations 2010" (SI 2010/698) were updated.

⁵² Available from:

www.ofgem.gov.uk/Media/PressRel/Documents1/RIIO%20Controls%20Come%20into%20Effect.pdf

⁵³ Updates are available from: www.gov.uk/government/policy-advisory-groups/107

⁵⁴ Calculated from regulatory asset value additions from Ofgem's DPCR5.

⁵⁵ Available from: www.ofgem.gov.uk/publications-and-updates/riio-ed1-draft-determinations-consultation-slow-track-electricity-distribution-companies

Interconnection

- 1.58. GB currently has 4 GW of electricity interconnector capacity with mainland Europe and Ireland. This consists of a 2 GW link to France (IFA), a 500 MW link between Wales and Ireland (East-West), a 1 GW interconnector with the Netherlands (BritNed), and a nominally rated 500 MW link between Scotland and Northern Ireland (Moyle).
- 1.59. The Moyle interconnector continues to have a reduced technical capacity of 250MW due to a failure in one of the cables in 2012. However, availability of all other interconnectors has improved significantly from last year.⁵⁶ In December 2013, Government published "*More interconnection: improving energy security and lowering bills*"⁵⁷ setting out DECC's commitment to increasing GB electricity interconnection capacity and the steps underway to facilitate this.
- 1.60. In August 2014 significant progress was made to facilitate interconnector investment as Ofgem launched a new 'cap and floor' regulatory regime for investment in interconnector projects aiming for operation before 2021. The new regime aims to incentivise investment by providing a minimum return for project developers (the floor) whilst protecting consumers from excess revenues accruing to developers by limiting the maximum return (the cap). Ofgem is currently assessing the first round of projects to apply, and a second application window is expected in 2015. For its part, in September 2014 the Government published proposals to allow interconnected capacity to participate in the CM from 2015.⁵⁸
- 1.61. These developments have encouraged a strong pipeline of projects which could more than double GB's capacity by the 2020s. This includes around 6GW of projects – to France, Belgium, Norway and Ireland – which the UK supported to receive 'Project of Common Interest' (PCI) status. PCIs benefit from potentially faster planning and permitting procedures, and improved regulatory treatment, where appropriate. In particular circumstances it is possible for PCIs to access financial support under the Connecting Europe Facility.⁵⁹ The UK will continue to actively participate in the EU process for identifying priority cross-border projects every two years as set out in the 'TEN-E Regulation'.⁶⁰

Offshore Transmission

- 1.62. The offshore transmission regime, developed by DECC and Ofgem, uses competitive tendering for licensing offshore electricity transmission in a secure, timely and cost-effective manner. The interests of the consumer lie at the heart of the regime, which was specifically designed to bring competition into an area traditionally dominated by regulated monopolies in order to drive down costs. Ofgem recently consulted on a report by independent consultants that estimates that this approach has saved between £200

⁵⁶ For more information, see NG's Winter Consultation 2014/2015 report: www2.nationalgrid.com/UK/Industry-information/Future-of-Energy/FES/Winter-Outlook/

⁵⁷ Government announcement on Interconnection in Dec 2013: www.gov.uk/government/uploads/system/uploads/attachment_data/file/266460/More_interconnection_-_improving_energy_security_and_lowering_bills.pdf

⁵⁸ Available from: www.gov.uk/government/uploads/system/uploads/attachment_data/file/358461/CM_October_Condoc_FINAL.pdf

⁵⁹ See latest PCI list: ec.europa.eu/energy/infrastructure/pci/doc/2013_pci_projects_country.pdf

⁶⁰ TEN-E Regulation, 2013: www.gov.uk/government/uploads/system/uploads/attachment_data/file/311184/uk_manual_procedures_ten_e_regulation.pdf

and £400 million to date.⁶¹ Ofgem believes that further savings are possible for current and future tender rounds.

- 1.63. The offshore regime has had considerable success in delivering cost-effective investment, with new entrants and new sources of finance demonstrating interest in the sector. Almost £4 billion of investment appetite was attracted for the first £1.1 billion of assets. So far, nine OFTO licences have been granted, attracting over £1.4 billion of new investment into the UK transmission sector, and there has been a range of participants in bidder consortia. A further £1.5 billion of assets is currently being tendered.

Grid Access

- 1.64. To maintain security of electricity supply over the next decade, the transmission companies are to carry out essential projects helping to connect new generation to the grid. In August 2010, the enduring 'Connect and Manage' grid access regime was introduced by DECC. This enables new generation projects to connect to the network once their enabling works have been completed, whereas under the previous regime, 'Invest and Connect', new generation was only able to connect once wider network reinforcement had taken place.
- 1.65. Ofgem provides an annual monitoring report to the Secretary of State on the impacts of the Connect and Manage regime.⁶² To date 'Connect and Manage' has brought forward the connection timescales for around 191 renewable and non-renewable generation projects by an average of five years.⁶³

EU Network and Market Codes

- 1.66. The Third Energy Package (Third Package) creates common technical and commercial rules (network codes and guidelines) governing access to energy networks that provide the foundation for an integrated secure, competitive, low carbon European sector.⁶⁴ This new legal framework was in response to the European Commission's 2007 inquiry into competition in gas and electricity markets that found insufficient cross-border transmission capacity and different market designs were hampering market integration.⁶⁵ To realise this objective network codes and guidelines aim to:
- promote greater trade across Europe;
 - make it easier for companies to enter the market;
 - enhance cooperation and security of supply; and
 - facilitate the safe integration of more renewable generation into the energy mix.

⁶¹ Consultation on CEPA/BDO evaluation of Offshore Transmission Tender Round 1 benefits:

www.ofgem.gov.uk/publications-and-updates/consultation-cepabdo-evaluation-offshore-transmission-tender-round-1-benefits

⁶² The most recent report is available at: www.ofgem.gov.uk/ofgem-publications/84982/connectandmanagear2013final051213.pdf

⁶³ Connect and Manage Forecast and Actuals, 1st July 2014: www2.nationalgrid.com/UK/Services/Electricity-connections/Industry-products/connect-and-manage/

⁶⁴ The Third Energy Package consists of two Directives and three Regulations: Directive 2009/72/EC and 2009/73/EC concern the common rules for the internal market in electricity and gas respectively; Regulation (EC) No 714/2009 on conditions for access to the network for cross-border exchanges in electricity (governing ENTSO-E); Regulation (EC) No 715/2009 on conditions for access to the natural gas transmission networks (governing ENTSONG); Regulation (EC) No 713/2009 establishing an Agency for the Cooperation of Energy Regulators (ACER). ec.europa.eu/energy/gas_electricity/legislation/third_legislative_package_en.htm

⁶⁵ Available from: ec.europa.eu/competition/sectors/energy/inquiry/index.html

Network codes and guidelines promote the completion of an internal energy market by aligning or harmonising aspects of the existing rules. The process to develop these instruments is set out in law and both enter into force following a vote by Member States (via the comitology process). Once they enter into law both take the form of a European Regulation.

Market Functioning

- 1.67. Energy market firms buy and sell their electricity in the wholesale market. The wholesale market allows participants to trade in a range of products that enable them to meet their obligation to supply energy whilst also enabling them to mitigate risk. The degree of access to these products relates to the liquidity of the market: low levels of market liquidity can be indicative of an uncompetitive market.
- 1.68. Poor liquidity in the wholesale market can prevent consumers from fully realising the benefits that competition can deliver in terms of downward pressure on bills, better service and greater choice. It can also obscure or weaken price signals, inhibiting long term investment decisions in new generating plant with negative consequences for security of electricity supply.
- 1.69. Ofgem is concerned about the lack of liquidity of the wholesale electricity market. Ofgem's liquidity project has examined poor liquidity in the electricity wholesale market and the barriers that this poses to competition and entry in the market. After extensive consultation, Ofgem activated the 'Secure and Promote' licence condition on March 31st 2014, with the aim of ensuring that all parties can access the wholesale market effectively and that robust reference prices are available from the wholesale market. The project is now monitoring the success of the licence condition.

Conclusion

- 1.70. This chapter has set out the expected outlook for GB's electricity security of supply in the coming years; it covers many of the key drivers affecting supply and demand, both of which are subject to significant uncertainties. This analysis is to be read in conjunction with Ofgem's latest Electricity Capacity Assessment report which shows that, in the absence of new measures that have been introduced, the risks to security of supply have increased. Without the new measures being introduced, de-rated margins would be expected to fall over the next two winters as older power stations close, before improving after the mid-decade, primarily driven by a drop in demand and new plant coming online. However, in response to this, the introduction of new balancing services is expected to reduce the risk of customer disconnections in the short term.
- 1.71. Since the publication of Ofgem's Capacity Assessment report, uncertainty on the supply side has increased for the coming winter, with some plant confirmed to be unavailable for next winter and other plant due to return in the winter. As a response to these market developments, NG has tendered for SBR as a precautionary measure to help manage the uncertainty for winter 2014/15. NG is currently assessing the bids received during the SBR tender and will make a decision shortly on whether and how much SBR is required for the coming winter taking account of recent developments in the market.
- 1.72. In the long term, Government has put in place a CM to ensure security of electricity supply in an energy system where many older power plants are closing and the investment case for reliable capacity is increasingly uncertain. Government expects to run the first CM auction in December 2014, for delivery of capacity from the winter of 2018/19.

1.73. This chapter has also set out the outlook for the development of networks and the developments of the electricity markets. Ofgem's EBSCR is in the process of reforming the cash-out regime which aims to support electricity security of supply by ensuring that price signals accurately reflect the value of flexible electricity sources. The networks are currently undergoing a significant programme of investment and plans are in place to enable this to continue. Meanwhile, there are low levels of liquidity in the wholesale electricity market and this issue is being addressed through Ofgem's work on market liquidity in the wholesale electricity market.

2. Gas

Introduction

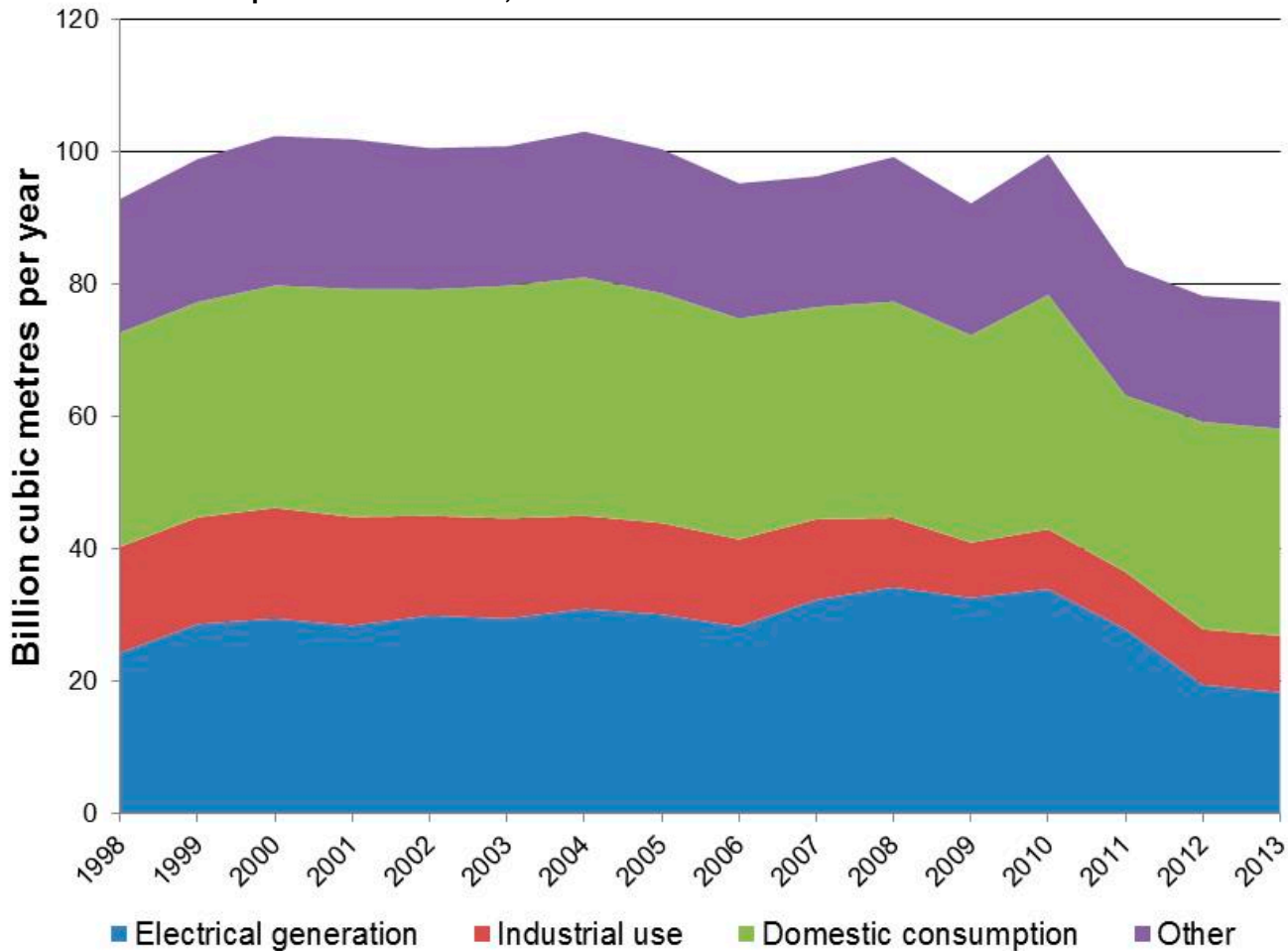
- 2.1. This chapter sets out the robustness of the current security of supply situation for gas in Great Britain (GB).⁶⁶ Many of this year's projections consider all four current scenarios from NG's Future Energy Scenarios 2014. These include two new scenarios alongside the updated 'Gone Green' (GG) and 'Slow Progression' (SP) scenarios, which have been used before. The new scenarios are 'Low Carbon Life' (LCL), which envisages similar levels of affordability to GG but with less sustainability, and 'No Progression' (NP), where there is less money available and sustainability ambition is low. This tests GB security against future uncertainties and concludes that security can be maintained under a range of different conditions.
- 2.2. This year's report highlights how the GB system has maintained security to date, including successfully delivering during the prolonged cold weather in March and April 2013. Temperature is particularly relevant as the main use of gas is for space heating. Looking to the future, political tensions between Russia and Ukraine, as well as disagreement in gas negotiations between the two countries, raise the possibility of a gas disruption in Europe along similar lines to that experienced in January 2009. Whilst it is impossible to predict how this geopolitical situation will develop, this report summarises some scenario-planning undertaken by DECC and National Grid (NG) and demonstrates that sufficient gas is likely to be physically available to the UK market in all scenarios, except unlikely combinations of full-scale disruption to Russian gas supplies to Europe and colder than average weather in the UK.
- 2.3. The analysis in this chapter draws upon work to ensure security of gas supply. This includes Ofgem's reform of the incentives on gas shippers to balance their positions, set out in the Significant Code Review (SCR), and the collective work being carried out by regulators, industry and the government to implement the EU Market and Network Codes, the detailed regulations that will help create a more co-ordinated European energy market.

Demand

- 2.4. Chart 2.1 shows annual gas usage by sector since 2000, with overall gas consumption continuing to fall in 2013. Significant reductions in gas used for power generation were notable but there was also an increase in gas use by the services sector and modest increases by domestic users.

⁶⁶ The statistics relied on in this document are GB stats as far as possible. However, in some cases where it is not possible to split the GB data out from the UK data, UK statistics have been used.

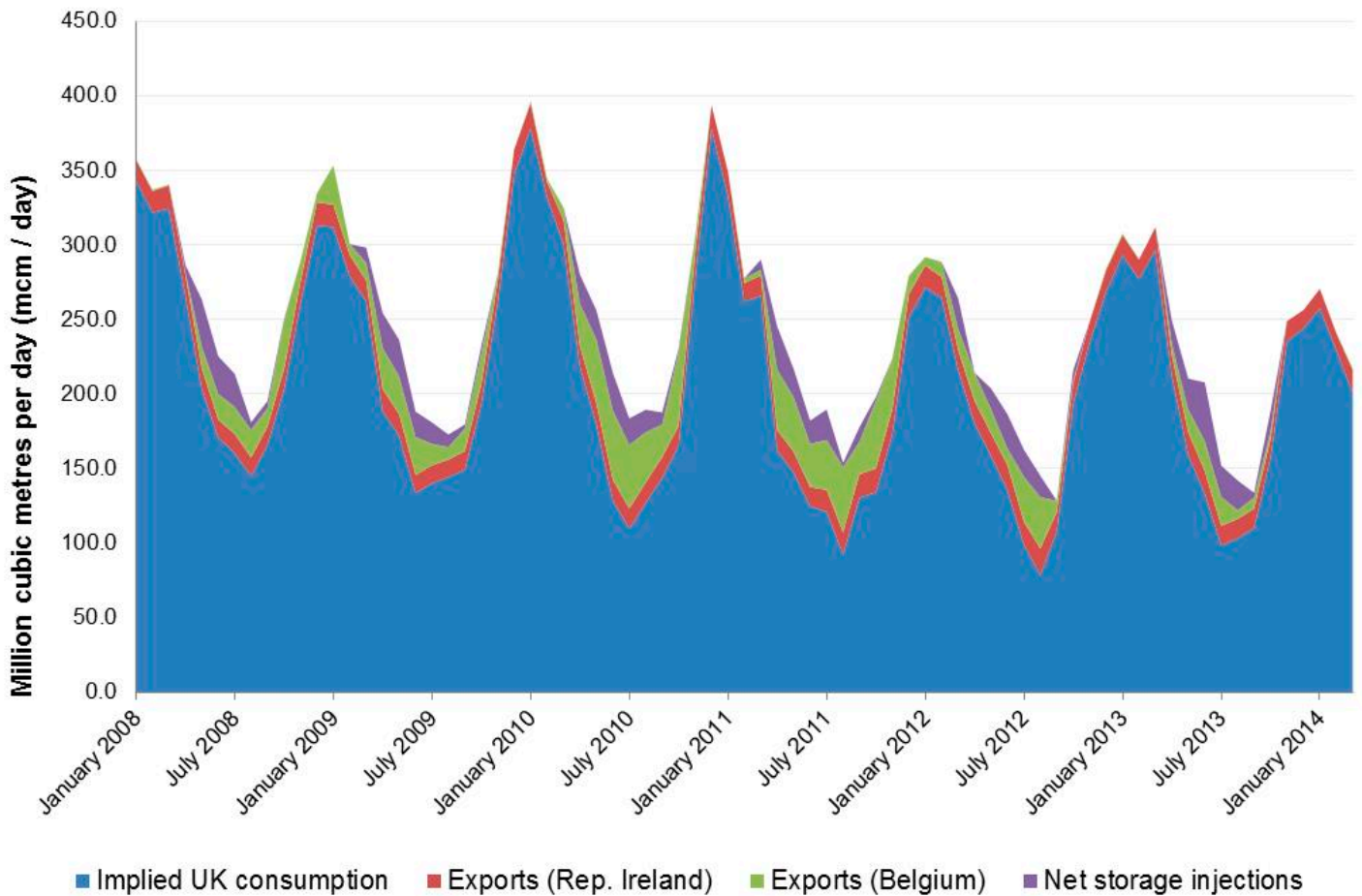
Chart 2.1: Consumption of Natural Gas, 1998 to 2013



Source: DUKES 2014

- 2.5. Reduced gas use in Q1 2014, compared to Q1 2013, was seen across all sectors, with electricity generation, domestic and other final use showing larger drops than industrial sectors. This reflects the greater impact of mild temperatures on these sectors, to which the industrial sector is less exposed. Gas demand decreased year-on-year since 2010. The rate of decline has slowed, with a 1% decrease between 2012 and 2013, versus a 5% decrease between 2011 and 2012 and a 17% decrease between 2010 and 2011. This decline was predominantly driven by a shift in electricity generation away from gas to coal, due to its relatively cheaper price.
- 2.6. Demand for gas varies on a daily basis and is notably higher in winter than in summer, as shown in Chart 2.2. A seasonal pattern is created by temperature levels, which generally determine how much gas households and businesses require for space heating. Gas demand for use in electricity generation and industrial purposes tends not to follow this seasonal pattern so closely, but is instead more heavily influenced by the price of gas relative to the price of other fuels and the price of electricity.

Chart 2.2: UK Monthly gas demand



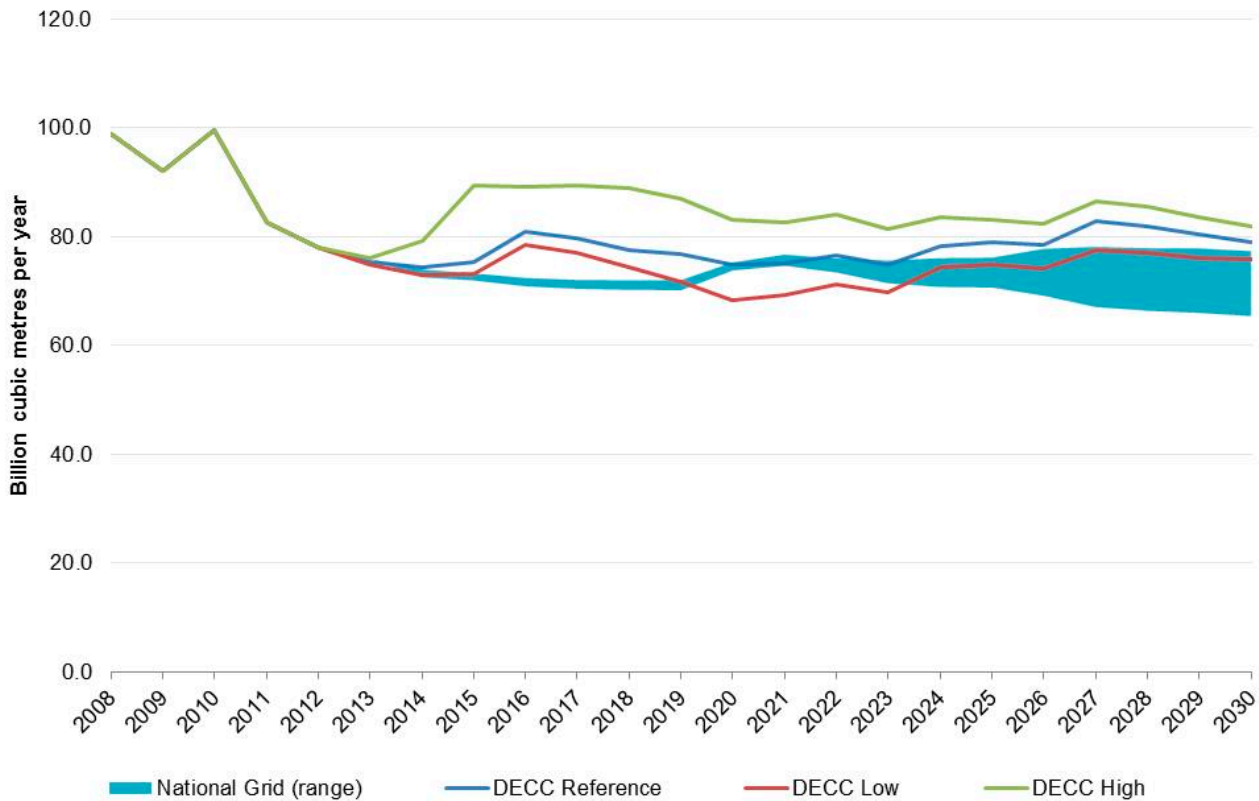
Source: DECC Energy Trends 2014

Exports to Ireland

- 2.7. The island of Ireland (Republic of Ireland and Northern Ireland) is 98% dependent on GB for its gas supply and, consequently, the British and Irish gas markets are coupled. As a result, the network operators work closely together and have arrangements in place in case of a supply emergency. In 2013, about 6 billion cubic metres (bcm) of gas flowed from GB to Ireland, accounting for 100% of Northern Irish demand and 96% of Irish demand.
- 2.8. This dependence will lessen for a period as the Republic of Ireland establishes new gas supplies through offshore production at the Corrib gas field. Gas production from Corrib, likely to commence in 2015, is expected to meet approximately 47% of Ireland's annual demand over the first two years of operation. However, Corrib has a short production profile and is expected to deplete within six years of its commencement. Whilst there are other potential supply options at planning stage, such as Shannon LNG terminal, it is likely that Ireland will remain dependent on gas imports from GB in the medium term.
- 2.9. Chart 2.3 shows projected annual gas consumption in five scenarios including NG's four Future Energy Scenarios, and DECC's Reference Scenario (DECC).
- 2.10. It should be noted that DECC and NG measure demand differently: demand projections provided by NG differ from DECC projections because they measure demand on the National Transmission System, so include exports to Ireland and gross exports to the Continent via the Interconnector (IUK), whilst the DECC demand projections consider end use within the UK. There are further differences between the scope of the

projections: DECC uses calendar years while NG uses “gas years”; and NG only looks at demand from the National Transmission System (NTS), excluding demand from major users who get their gas directly from offshore suppliers, while DECC measures total UK demand including these “directs”.

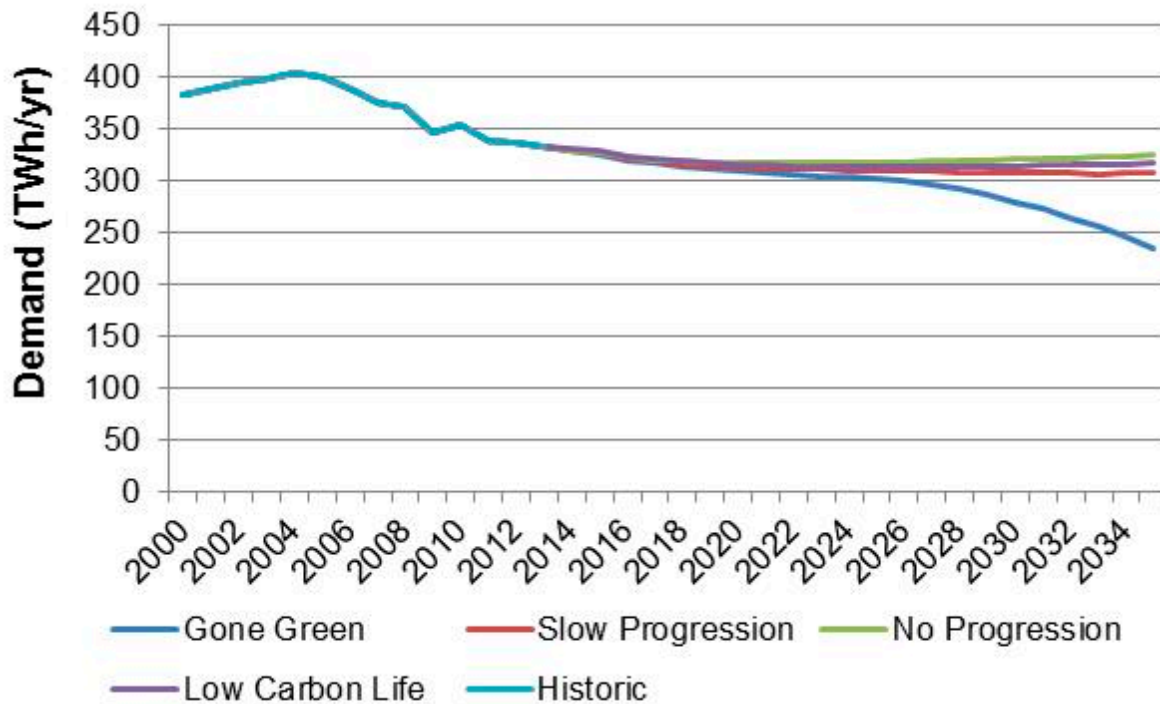
Chart 2.3: Annual gas demand sensitivity analysis



Source: DECC UEP 2013 and National Grid Future Energy Scenarios 2014

- 2.11. All scenarios still show a short-term increase in gas demand at varying points between now and the mid-2020s. Overall projections to 2030 are now showing slightly higher demand than was projected last year as reduced domestic use is offset by increased gas-fired power generation at the expense of coal and as a back-up to intermittent renewables.
- 2.12. In Chart 2.4 below, all of NG’s scenarios show reducing residential demand for gas for the rest of this decade. The level of demand then plateaus in the majority of scenarios except for GG, which envisages higher use of heat pumps in residential properties particularly from the mid-2020s, leading to gas demand dropping sharply throughout the 2020s and into the 2030s.

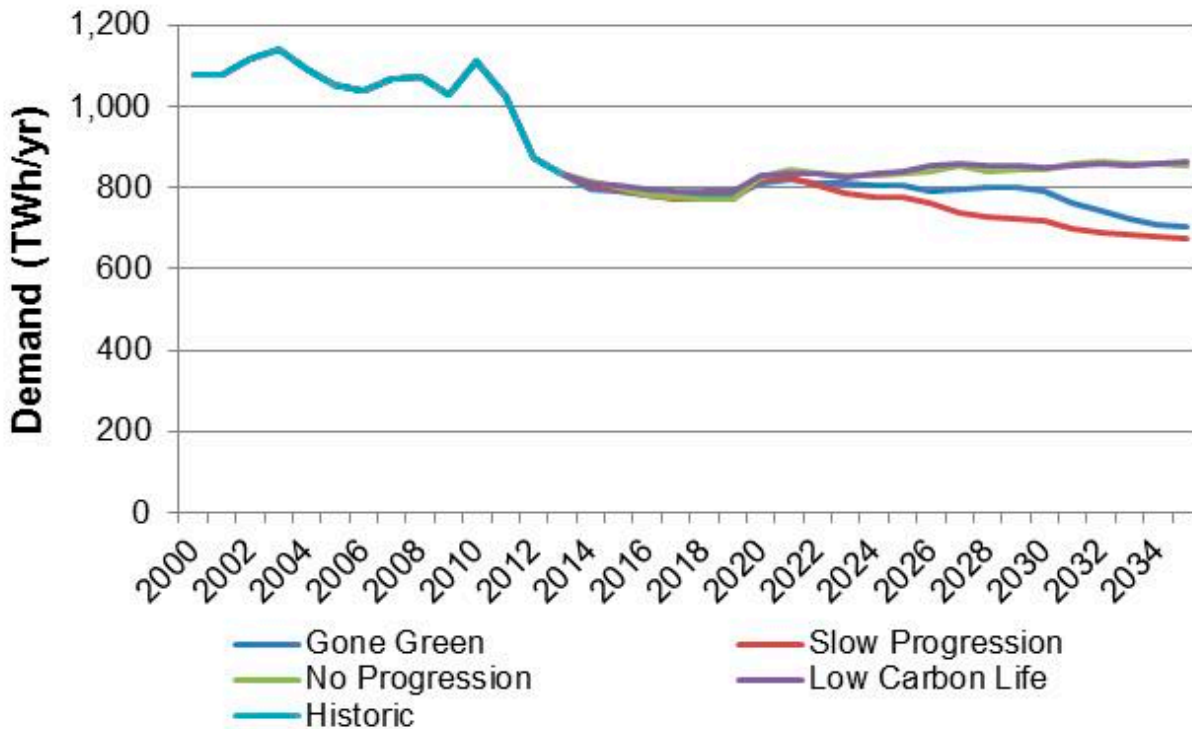
Chart 2.4: Residential gas demand



Source: National Grid Future Energy Scenarios 2014 (Figure 108)

- 2.13. Demand reduction is more pronounced in the industrial commercial sector with all of NG’s scenarios envisaging persistent demand reductions into the 2030s.
- 2.14. Gas for power generation is projected to increase up until 2025, after which demand is predicted to level out, although NG’s electricity generation projections to 2050 do show a significant switch towards gas-fired power generation. GG predictions for gas use in 2050 are now slightly higher than last year but with relatively lower carbon emissions. This sustained use of gas for power generation offsets reductions in residential use and means that, even in the GG scenario, there is a smaller decline in the total gas demand trend, shown in Chart 2.5 below.

Chart 2.5: Total gas demand



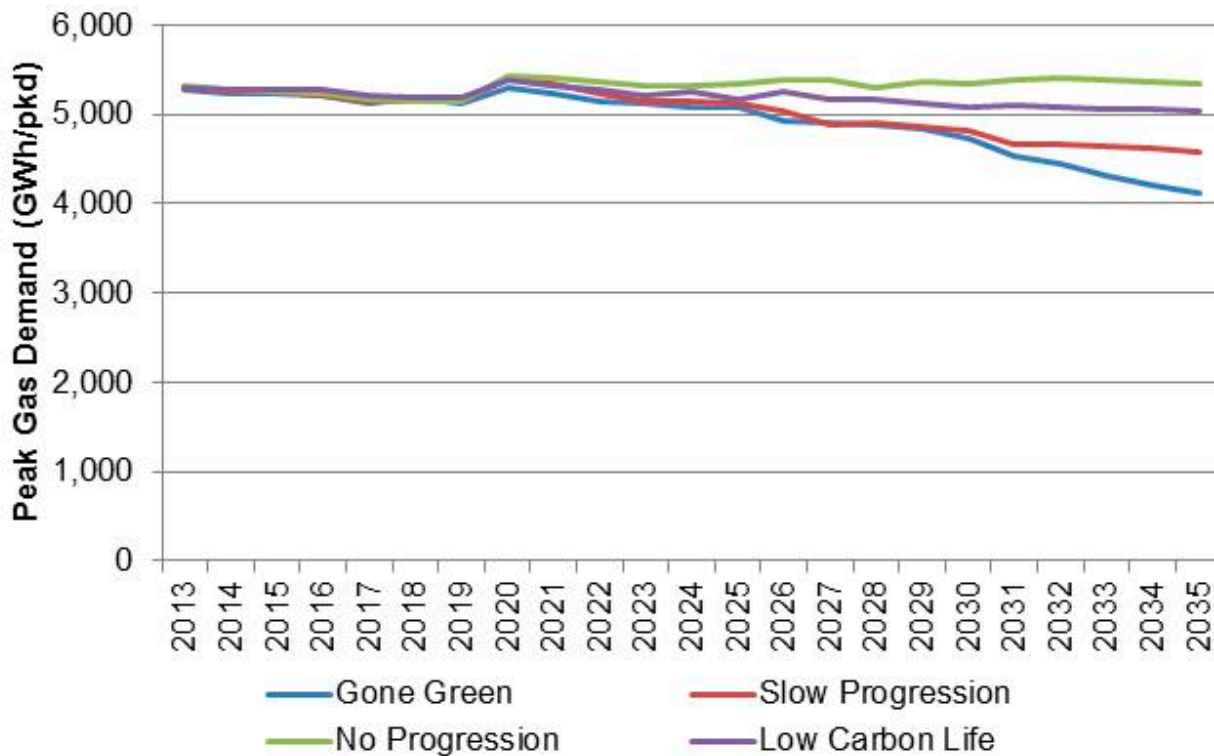
Source: National Grid Future Energy Scenarios 2014 (Figure 112)

Peak Demand

- 2.15. The peak winter day demand for 2013/14 was 327mcm, which was 138 mcm lower than the record winter peak day demand in December 2010.⁶⁷
- 2.16. In addition to meeting annual demand, the gas market’s ability to meet demand on a 1-in-20 peak day is important for security of supply. On a peak day, the grid has to deliver over double the average daily gas demand. Using 2013/14 figures average demand is forecast to be 238 mcm/d, whereas on a 1-in-20 peak day, demand could rise to 534mcm/d.
- 2.17. Gas market participants build redundancy into their supply arrangements, above the minimum amount to meet peaks, to manage the risk that other capacity may not be available.
- 2.18. Peak gas demand is projected in Chart 2.6 in the four NG scenarios, with 2014 peak demand estimated at around 494-500mcm/d. Both GG and SP show a net decline in peak diversified demand to around 484 mcm/d by 2019. Under GG, peak demand is projected to increase briefly in 2020/21 before declining steadily into the 2030s. Under SP, peak demand follows a similar path with a less marked decline from 2030. NP sees small declines from a peak around 2020, whilst LCL sees a gradual decline from 2020 onwards.

⁶⁷ Source: NG Data Item Explorer

Chart 2.6: Projected peak diversified demand to 2035



Source: National Grid Future Energy Scenarios 2014 (Figure 113)

2.19. The role of gas in the UK energy mix will impact on future peak demand. Increasing amounts of intermittent wind generation will increase the volatility of gas demand, as gas-fired generators are likely to have a role as back-up generation to balance this intermittency. In addition, the amount of nuclear capacity that is built will influence the extent to which gas generation is used to meet baseload demand. The amount of interconnection between GB’s electricity market and mainland Europe’s will also have an impact.⁶⁸ The gas system will need to respond to these challenges by becoming increasingly responsive to changes in both supply and demand, for example through greater demand-side response.

Demand Side Response (DSR)

2.20. DSR is a mechanism used to ensure that, in times of market tightness, supply and demand can be balanced through reducing gas demand, rather than increasing supply. The power generation sector provides an opportunity for switching demand away from gas to coal or oil generation, reducing overall gas demand. In recent years, however, this facility has been minimal as low coal prices have meant coal has been favoured over gas for electricity generation. More coal and oil generation capacity is due to close through the LCPD and the IED,⁶⁹ meaning this plant will no longer be available for switching.

2.21. Beyond power generation, good levels of liquidity in the GB gas market mean that non-domestic consumers can respond to price signals by either changing their demand

⁶⁸ This is expanded further in both the electricity chapter of this document and in the Electricity Capacity Assessment Report response, to be found at Annex A.

⁶⁹ The terms LCPD and IED are explained above in footnote 29 and in paragraphs 1.25 – 1.26 of the Electricity Chapter of this report.

profile or reducing demand altogether. Larger industrial consumers may also have the ability to switch to alternative fuels during times of high gas prices.

- 2.22. Ofgem's reform of the gas cash-out mechanism, the Gas Significant Code Review (SCR), will sharpen the incentives on gas market participants, to invest in measures to enhance security of supply.⁷⁰ Currently, in the event of a Gas Network Supply Emergency (GNSE) the cash-out price would be frozen, which could mean GB does not receive imported gas at precisely the time it is most needed, and the full economic value of lost gas supply to customers is not factored into the cash-out price. The Gas SCR which announced its conclusions on 23 September 2014, confirmed that the cash-out price would be unfrozen in an emergency and the value of lost load for domestic consumers would be applied at £14/therm if needed. This should provide a strong incentive to shippers to undertake actions which reduce the risk of a GNSE occurring, such as encouraging gas market participants to invest in new infrastructure.
- 2.23. Ofgem also decided to introduce a DSR mechanism to be developed by NG ahead of winter 15/16, subject to a successful trial. Such a mechanism should encourage greater participation by industrial and commercial gas consumers, enabling them to signal their willingness to be interrupted earlier in an emergency. This would allow NG to interrupt consumers in a more efficient way and provide an additional tool to prevent involuntary interruptions to supply.
- 2.24. Non-daily metered consumers, such as domestic consumers and small businesses, are not exposed to fluctuations in wholesale prices and, therefore, have no price signal to reduce demand. In the future, it is expected that smart meters will affect domestic consumer behaviour to the extent that providing real-time consumption and cost information will result in consumers using energy more efficiently, and will incentivise consumers to install energy efficiency measures. Cumulatively, smart meters are expected to reduce direct demand for gas by domestic and small business consumers, (under normal market conditions), by 1 bcm in 2020, remaining roughly constant out to 2030.⁷¹

Box 2.1 The mild winter 2013/14

Temperatures in the UK were significantly higher during the winter of 2013/14 in comparison to previous winters. According to Meteorological Office figures, mean temperatures across the UK were well above the long-term average for December to February with a mean winter temperature of 5.2°C, which is 1.5°C above the average and the equal-fifth highest since 1981.

Gas demand in Q1 2014 was 19% lower compared to Q1 2013. A reduction in gas use compared to Q1 2013 was seen across all sectors, with electricity generation, domestic and other final use showing larger drops ranging between approximately 20 - 25%. This was driven primarily by the warmer average temperatures driving demand down.

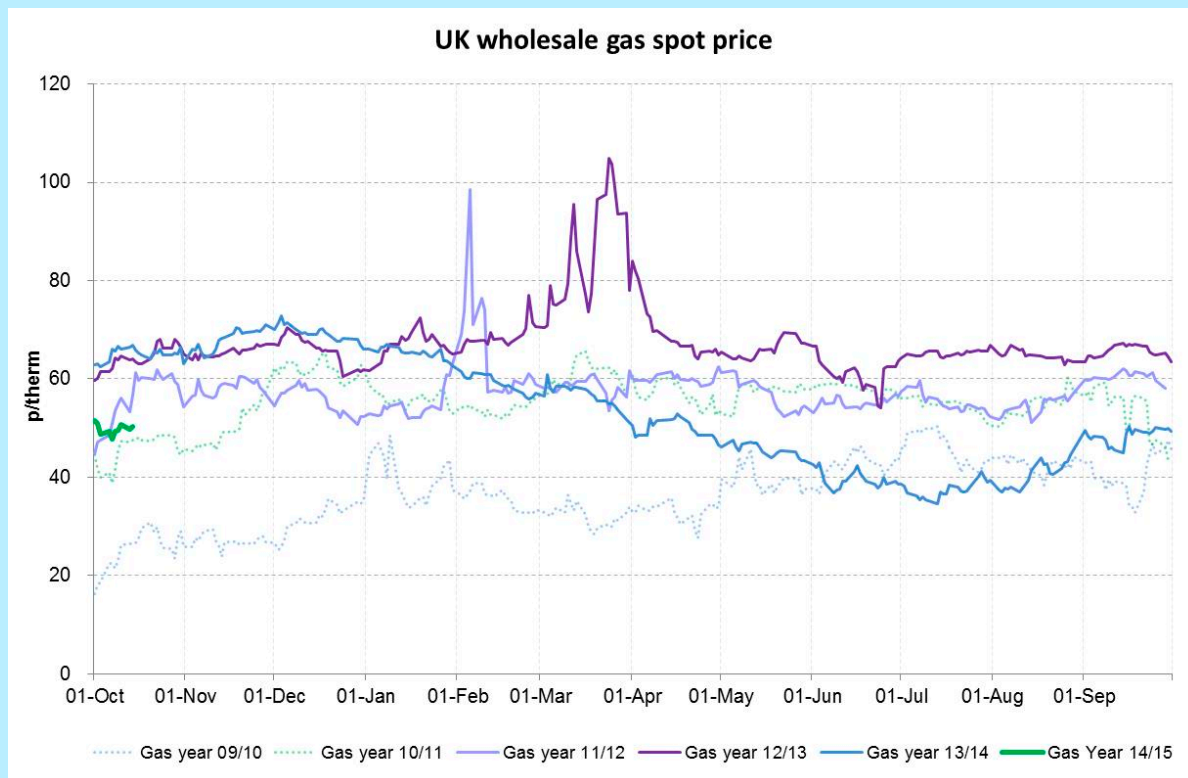
Demand for natural gas from the industrial sector also fell in Q1 2014 compared to Q1 2013, being 0.2% lower for the iron and steel industry and 5.8% lower for other

⁷⁰ Available at: www.ofgem.gov.uk/publications-and-updates/gas-security-supply-significant-code-review-conclusions

⁷¹ DECC, Impact Assessment: Smart meter roll-out for the domestic and small and medium non-domestic sectors (GB). (IA No: DECC0009).

industries.⁷² These smaller drops in gas demand reflect the industrial sector relying less on gas for space heating than other sectors.

With less demand for gas overall the price for wholesale gas continued to drop. Following the mild winter 2013/14, the spot price in April 2014 was the lowest April price since 2010. That fall continued reaching the lowest July price since 2009.



Reduced winter demand has also meant that UK storage entered the gas summer already 53.6% full on 1 April 2014, compared to 5.7% at the same time in 2013. Although the 2012 gas year started at similarly high levels of 59.8% full, both 2011 and 2010 saw levels of 33.5% and 17.3% respectively.

Furthermore, the first part of the 2014 summer injection season was productive: in mid-October storage levels stood at 98% full, a rise of 5% on the level the previous October and leaving the UK in a good position approaching winter 2014/15.

Whilst high levels of storage is reassuring going into winter the fluctuations over the last few years demonstrate the volatility within the gas market and the degree to which security of supply can be significantly affected by unforeseeable factors such as weather. This highlights the need for continued investment in robust infrastructure and varied supply sources.

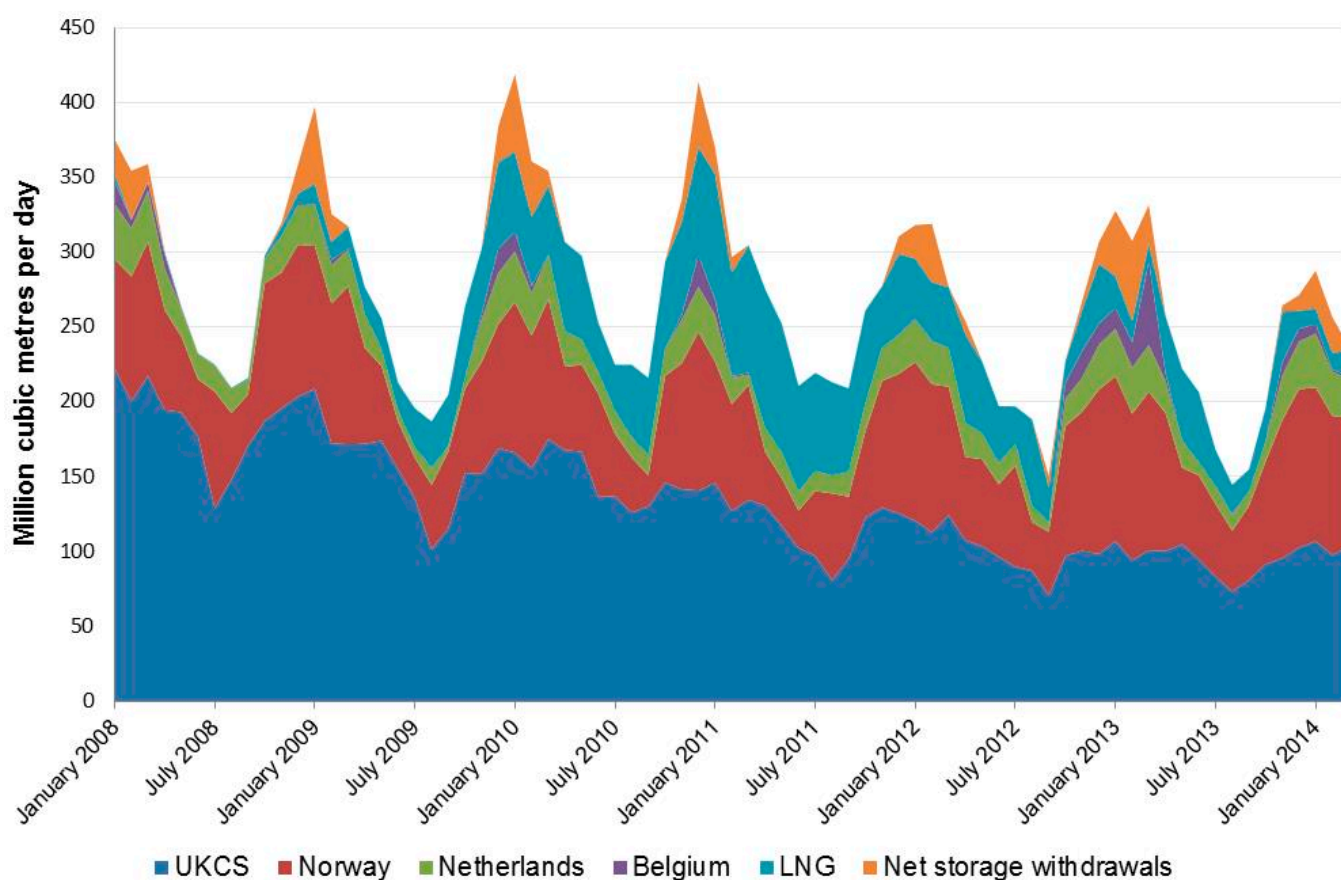
Supply

- 2.25. The UK already has a diverse range of sources of gas supply, including domestic production, pipeline imports from Norway and the Continent, liquefied natural gas (LNG) from global markets and storage.
- 2.26. Chart 2.7, showing UK monthly gas supply 2008-14, is notable for the mild winter of 2013/14, when lower demand led to the lowest overall supply levels in the last ten years. LNG supplies to the UK continued to reduce and there was a decline in supplies from

⁷² DECC Energy Trends 2014

Belgium by comparison to the previous colder winter. This demonstrates the UK gas market's ability to adjust gas supplies according to price signals and demand.

Chart 2.7: UK monthly Gas supply



Source: DECC Energy Trends 2014

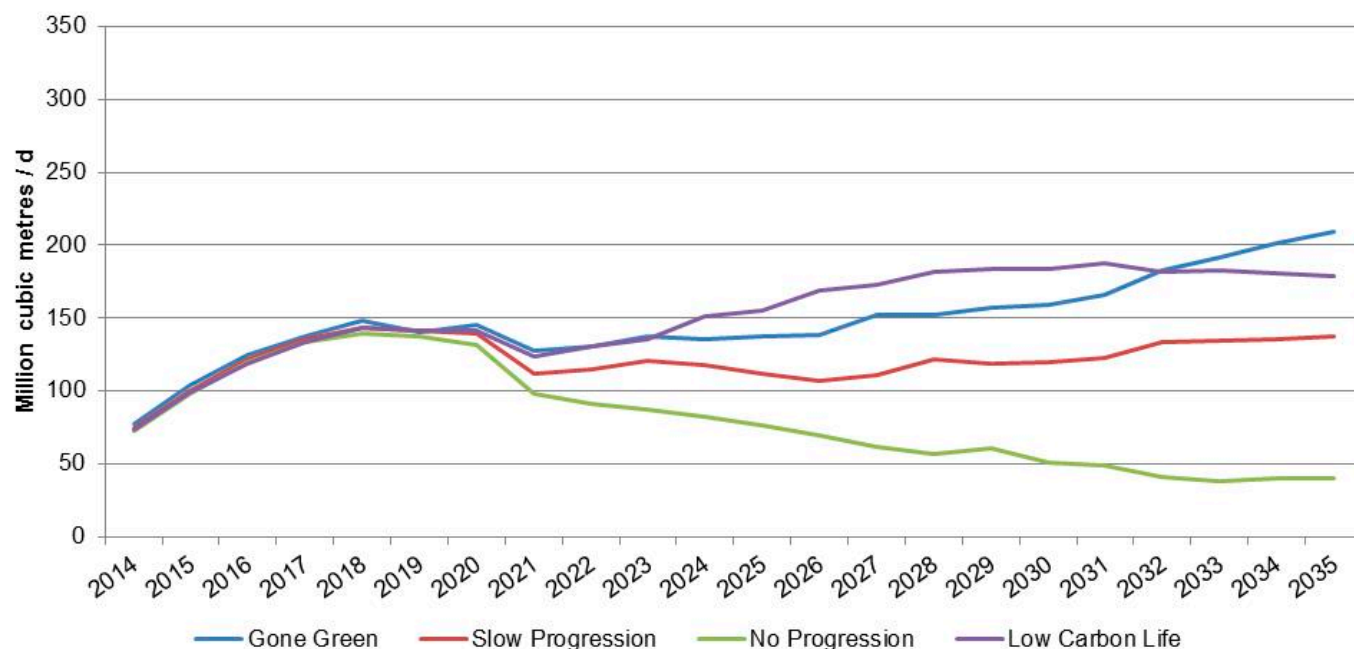
Peak Supply

- 2.27. The analysis in DECC's *Risk Assessment on Security of Gas Supply*, which was submitted to the European Commission in June 2014, found that, in the short to medium term, UK gas supply infrastructure is resilient to all but the most extreme and unlikely combinations of severe infrastructure and supply shocks. The UK n-1 calculation exceeds the target of 100% with a score of 112-13% and 109% including exports to Ireland.⁷³
- 2.28. Chart 2.8 shows that in all scenarios, maximum deliverability of gas infrastructure exceeds peak demand. For example in the NP scenario this is by 40 mcm/d in 2035 and in the other scenarios, deliverability is significantly more than peak demand. This supply capacity includes physical import pipeline capacities, peak storage deliverability and capacity of the UKCS to supply at 100% availability.
- 2.29. The chart shows each source delivering at maximum rate, assuming each component is at full capacity. While this shows the full potential of these components, peak supply is overstated, as not all components will necessarily provide supply at a given point in time

⁷³ The n-1 calculation is the formula indicating the proportion of gas demand that could be met in the event that a country loses supply from its single largest piece of gas infrastructure. The full risk assessment can be found here: www.gov.uk/government/publications/uk-risk-assessment-on-security-of-gas-supply

for technical or commercial reasons. For example, LNG deliverability may be restricted by limited stocks and, for storage sites operating later in winter, maximum deliverability may be restricted if stocks have been depleted.

Chart 2.8: Diversified peak margins



Source: National Grid Future Energy Scenarios 2014 (Figure 126)

UK Continental Shelf Production

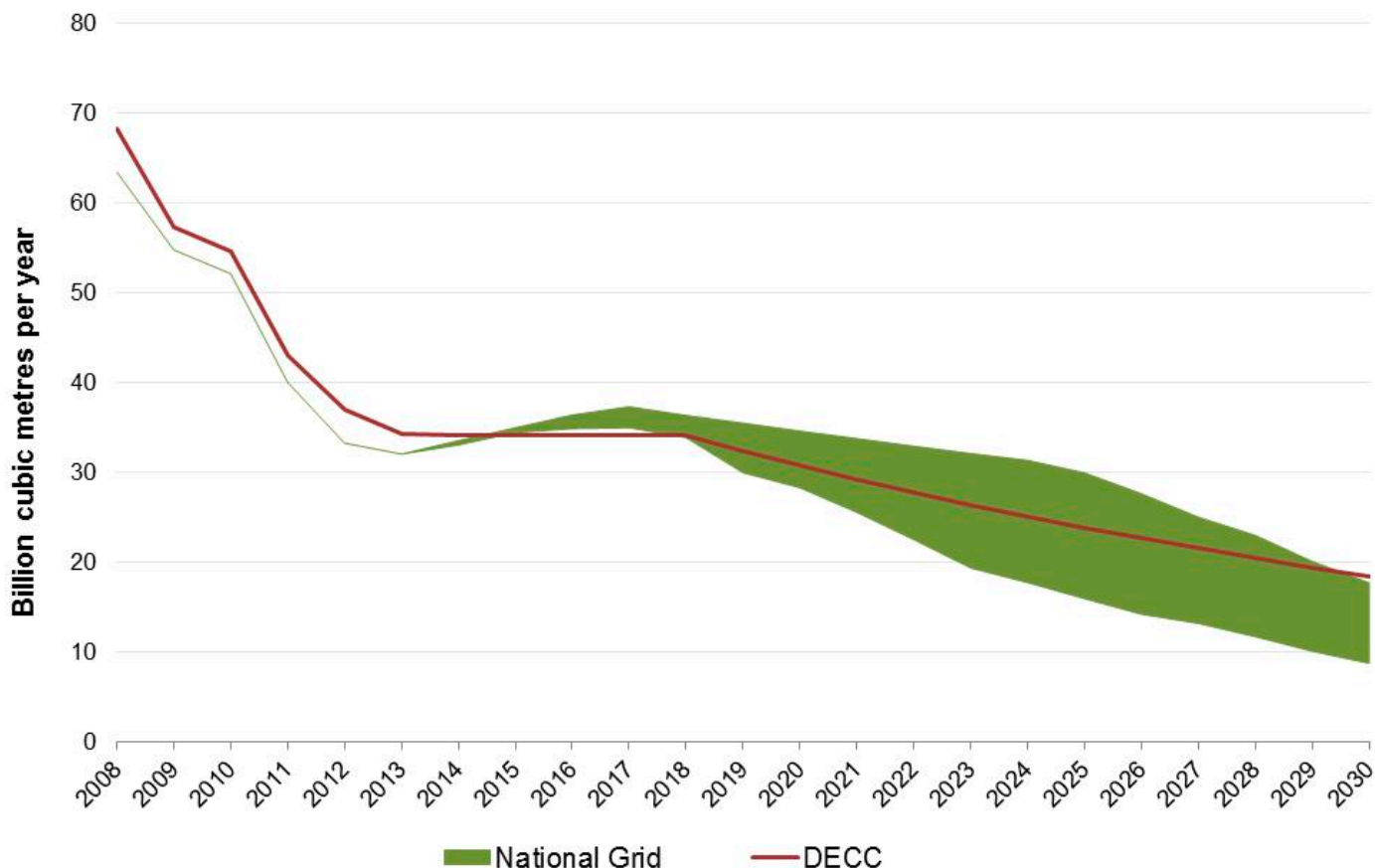
- 2.30. In 2013, around half of UK gas demand was supplied through UK production, but in the longer term that share is expected to fall.⁷⁴
- 2.31. Chart 2.9 shows projected production of gas from the UK Continental Shelf (UKCS) from 2008 to 2030. It shows the net decline over this period. It should be noted that there are inherent uncertainties involved and, therefore, the projections should be treated as indicative rather than definitive. Actual production levels in the future will be determined by the balance between the increases due to new or extended fields and the decreases due to declining or decommissioned older fields.⁷⁵
- 2.32. Seasonal variation in supply from UK production, termed 'swing supply', has reduced over time. This reduction reflects a greater share of production from associated gas fields, where producers are more reluctant to flex production, and less from dry gas fields. Furthermore, a declining share of production is sold under buyer-nomination contracts that allow production to be varied in line with demand.
- 2.33. The UKCS is one of the most mature basins in the world, albeit with some less developed areas, such as that to the west of the Shetland Islands. Exploration and appraisal activity in well-developed areas continues to be successful, although this work is costly and not without risk. Work is underway to upgrade infrastructure to help reverse

⁷⁴ Available from: www.gov.uk/oil-and-gas-uk-field-data

⁷⁵ Associated gas fields hold both oil and gas, and gas is produced as a joint-product with oil. Since oil is the higher value product, production tends to be governed by conditions in the oil market. Dry gas fields contain only natural gas and so their production is influenced but not determined by short term supply and demand conditions in the gas market.

the decline seen in production efficiency in existing fields in the last five years, and at the same time, fields previously considered not commercially viable are coming on stream.

Chart 2.9: UKCS Production



Source: National Grid Future Energy Scenarios 2014 and DECC Energy Trends 2014

Unconventional Gas Production in the UK

2.34. The British Geological Survey has conducted three estimates of potential shale gas and oil in place.

- The Bowland Basin in the North of England contains an estimated volume of shale gas of 1300 trillion cubic feet (TCF) of shale gas
- The Weald Basin in the South of England contains an estimated volume of 2.2-8.5 billion barrels of shale oil
- The Midland Valley of Scotland contains an estimated volume of 80 TCF of shale gas and 6 billion barrels of oil.

2.35. While this does not mean that this amount could be extracted for use, the report published gives industry and regulators an indication of how best to plan future exploratory drilling to determine how much of the gas may be commercially viable to recover. This will be substantially lower than the total amount of gas in place because of technical limitations and commercial viability.

2.36. Shale gas is an important domestic energy resource that could bolster GB's energy security, create jobs, increase tax revenue and provide a bridge to a greener future. The UK has a strong regulatory system which provides a comprehensive and fit for purpose regime for exploratory activities, but DECC wants to continuously improve it. The Office for Unconventional Gas and Oil (OUGO) will work closely with the relevant regulators

and industry to ensure that it is as streamlined as possible, whilst remaining robust enough to safeguard public safety and protect the environment. Government also promotes the production of biogas through the anaerobic digestion of organic waste material, such as domestic and industrial food waste, manure and slurry. This gas can be burned to generate electricity or heat but, for maximum efficiency, it can be converted into biomethane to be injected into the National Gas Transmission system.

- 2.37. At present, this only occurs at a small number of UK plants but plans are in place for more than 20 such plants over coming years. ReFood's new biomethane-to-grid plant in Widnes will supply around 17mcm of gas every year, enough for more than 10,000 average homes.
- 2.38. The amount of 'green gas' that can be made in the UK ultimately depends on the availability of suitable waste feedstocks. Estimates for the potential of biomethane to green the gas grid vary widely but it could play an important role in decarbonising heat and transport in the future.

Imports

- 2.39. Since 2004, the UK has been a net importer of gas. In 2013, total imports reduced slightly in comparison to 2012, although a more severe decline in exports meant that the figure for net imports increased by around 1.9bcm. Recent years have seen a reduction in LNG imports, offset by increased flows from Belgium, the Netherlands, and Norway. Table 2.1 shows gas imports and exports over the last five years.⁷⁶

Table 2.1 Natural Gas Imports and Exports, bcm					
	2009	2010	2011	2012	2013
Imports					
<i>by pipeline from</i>					
Belgium	0.7	1.2	0.4	1.3	3.3
The Netherlands	6.5	8.2	6.5	7.3	7.6
Norway	23.5	25.0	21.2	26.8	27.9
LNG	10.2	18.9	25.2	13.8	9.4
of which:					
Algeria	1.8	1.1	0.2	0.1	0.4
Australia	0.1	-	-	-	-
Egypt	0.5	0.1	0.1	0.01	0.07
Nigeria	-	0.3	1.2	0.04	-

⁷⁶ The historical figures for LNG imports in this table show a slight increase on figures previously published. This is because of a change in the way the figure is calculated, which now includes an estimate of gas used at the LNG terminals from January 2008. The terminals' use of gas is estimated to be 1.5% of gas entering the National Transmission System (NTS) from the LNG terminals.

Table 2.1 Natural Gas Imports and Exports, bcm

	2009	2010	2011	2012	2013
Norway	0.2	0.8	0.9	0.2	0.1
Qatar	5.7	14.8	21.5	13.5	8.7
Trinidad & Tobago	2.0	1.5	0.5	-	0.1
USA	-	-	0.1	-	-
Yemen	-	0.2	0.6	-	-
Total Imports	41.0	53.3	53.2	49.3	48.2
Exports to:					
Belgium	5.7	8.8	9.3	4.6	2.5
The Netherlands	1.2	1.3	1.3	2.1	1.6
Norway	0.03	0.02	0.01	0.004	0.002
Republic of Ireland	4.9	5.1	5.3	5.3	4.9
Total Exports	11.9	15.2	16.0	12.0	9.0
Net Imports	29.1	38.0	37.3	37.3	39.2

Source: DUKES 2014

Import Capacity

- 2.40. The UK has a diverse range of sources of gas supply, including domestic production, pipeline imports from Norway and mainland EU, LNG from global markets and storage. GB's gas supply infrastructure is able to deliver approximately 700 mcm/d.⁷⁷
- 2.41. Chart 2.10 shows that currently GB has an import deliverability of 53.7 bcm/y from pipelines connecting to Norway, 46.4 bcm/y from capacity connected to the Continent and 53.1 bcm/y from LNG import terminals. It also shows that a further import capacity has been proposed. It is important to note, however, that capacity is not a measure of utilisation.
- 2.42. Ofgem's Gas Security of Supply Report 2012 highlights the risks associated with the closure of critical LNG shipping lanes and makes the point that the destination of LNG cargoes can go against price signals.⁷⁸ The report also notes that in a normal winter the GB gas market would have to lose 50% of non-storage supplies for there to be an

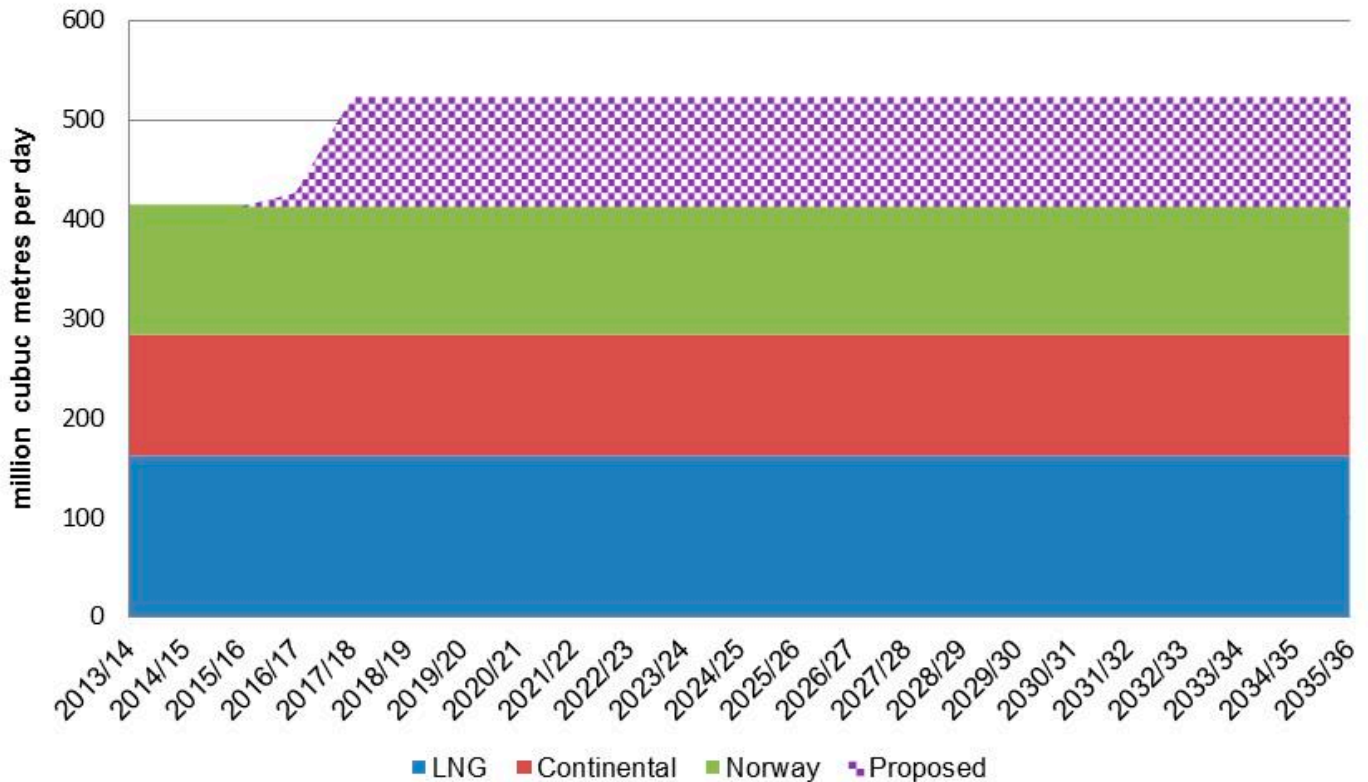
⁷⁷ Available from:

www.gov.uk/government/uploads/system/uploads/attachment_data/file/295223/Physical_gas_flows.pdf

⁷⁸ Available from: www.ofgem.gov.uk/publications-and-updates/gas-security-supply-report

interruption to gas supplies to large industrial users and/or the power sector. Between 60 and 70% of all gas sources would have to be lost for there to be an interruption of supplies to domestic customers: equivalent to losing all LNG supply, all imports from the Continent and 50% of indigenous production at the same time. Going forward, it is important that market arrangements properly reflect the importance of security of supply and its value to consumers.

Chart 2.10: Possible Evolution of UK Gas imports (Peak)



Source: National Grid Analysis 2014

Norway

- 2.43. Norway is a crucial gas supplier to GB, supplying around 36% of total gas demand in 2013. Norwegian supplies, in part, replaced declines in LNG imports attracted to higher-priced Asian markets.
- 2.44. Norway currently has the infrastructure capacity to export 53.7 bcm/y to GB. Infrastructure built to supply the UK includes: the 13.1 bcm/y Vesterled pipeline supplying gas to St Fergus; the 25.3 bcm/y Langeled pipeline supplying gas to Easington; and the 9.1 bcm/y Tampen link and the 6.2 bcm/y Gjoa link, both of which feed into the FLAGS pipeline. Total Norwegian production is currently about 108 bcm/y; forecasts for this decade range from unchanged from today to a 20% increase. There is uncertainty surrounding future Norwegian production beyond 2020 due to lack of knowledge about the extent of gas resources in the Barents and Norwegian Seas.
- 2.45. In 2012, Norwegian authorities decided to focus on optimising existing gas infrastructure, including further development of the Polarled pipeline project, which will connect gas fields in the Norwegian Sea to the existing Norwegian network serving the UK and Continent. Gassco, Norway's gas transport company, published a report in June 2014 exploring options for further infrastructure development including a new pipeline. Connecting Norway's new northern gas reserves to existing infrastructure is in the long-term security of supply interest of the UK.

Mainland Europe Imports and EU Network Codes

- 2.46. GB has gas interconnectors with Belgium and the Netherlands. During Winter 2013/14, these import pipelines played a significant role in meeting the UK's gas demand, supplying 14% of the UK's gas supply over the winter period. They are increasingly taking a role in flexing supply by responding to price signals, which ensures the system balances. The pipeline with the Netherlands (BBL) accounted for over 5.3 bcm of the UK's gas supply in winter 2013/14, around 0.1bcm less than previous year. The interconnector with Belgium (IUK) accounted for over 3.3bcm of the UK's gas supply in winter 2013/14, around 0.7bcm less than the previous year.
- 2.47. Ofgem, in conjunction with the Belgian and Dutch regulators, undertook analysis on the price responsiveness of flows through the gas interconnectors to continental Europe. This explored whether gas flows to the UK from either Belgium or the Netherlands when the GB price is higher than on the continent and vice versa. In July 2013, Ofgem published an open letter jointly with the Dutch and Belgian regulators on their findings.⁷⁹ These indicated that GB's interconnector with Belgium (IUK) responds to price signals, but that there are some barriers to flows of gas, in part due to GB transmission charges. On the contrary Ofgem found that the interconnector with the Netherlands (BBL) does not respond to price signals as one would expect. Ofgem and the Dutch Authority for Consumers & Markets (ACM) are looking at ways to improve transparency.
- 2.48. The EU Third Energy Package set out provisions for the establishment of a number of EU Gas Network Codes.⁸⁰ The aim of the Network Codes is to increase competition in the EU gas market and remove barriers to gas trading between Member States. The Commission assesses that this will place downward pressure on the EU's collective gas bill, benefiting both domestic and non-domestic consumers and tackling some of the causes of the inefficiencies discussed above.

Table 2.2: Description of the various gas codes including implementation dates

Gas Network Code	Implementation
<u>Capacity Allocation Mechanism (CAM)</u> – sets rules for how transmission capacity at interconnection points between markets is offered for sale.	1 November 2015
<u>Congestion Management Procedure (CMP)</u> – aims to create an efficient use of booked capacity by bringing unused capacity back to the market. CMP applies to BBL (GB-Netherlands), IUK (GB-Belgium), IC1 and IC2 (GB-Ireland), SNIP (GB-Northern Ireland), and to the two parts of NG Gas's network that link these interconnectors: Moffat and Bacton.	1 October 2013 for three of the four procedures, with the remaining procedure being optional until 2016
<u>Gas Balancing (BAL)</u> – aims to develop non-discriminatory and transparent balancing systems, which are particularly important for new market entrants.	1 October 2015

⁷⁹ Available from: www.ofgem.gov.uk/publications-and-updates/further-analysis-and-next-steps-review-gas-interconnectors-between-great-britain-and-belgian-and-dutch-markets

⁸⁰ Directive 2009/73/EC and Regulation (EC) No 715/2009

Table 2.2: Description of the various gas codes including implementation dates

<u>Interoperability and Data Exchange Code</u> – aims to introduce a number of harmonised principles and common rules to Transmission System Operators (TSOs) to ensure that technical and communications operations cannot pose a barrier to cross-border gas trade.	1 April 2016
<u>Tariffs</u> – sets out the rules that must be adhered to when setting the auction reserve prices, prices shippers must pay to use the gas transmission network, and any revenue recovery mechanisms. ⁸¹	October 2017

2.49. On balance, increased interconnection with the Continent is thought to improve the UK's energy security of supply, with the positives of access to gas from a larger pool outweighing the negatives of increasing exposure to supply disruptions on the Continent.

Imports from the rest of the world

2.50. Imports from outside of Europe to GB are largely via Liquefied Natural Gas (LNG). From 2011 to 2013, there was a decline in LNG imports from around 47% of UK gas imports to around 19.5%, as LNG cargoes were diverted away from the European market and towards higher priced markets in Asia.⁸² In particular, Japan's continued high gas demands following the Fukushima incident continued to ensure higher gas prices in their market. Gas prices in Northeast Asia are expected to remain higher than those in Europe for at least the short term. However, LNG is one of a number of flexible sources of supply in the UK and the former position occupied by LNG in the UK market, for a comparatively short period, has been met by higher deliveries through the Continental and Norwegian pipelines. The UK retains its LNG infrastructure should price signals dictate that this source of gas is required.

2.51. Global gas markets have traditionally been regional with three loosely interconnected markets: North America, Europe and Asia. However, as the global gas market continues to develop and the LNG market continues to grow, these markets will increasingly interact and influence each other's prices.⁸³ This interaction is being aided by market liberalisation, especially in Continental Europe. New or increased LNG production is also expected in a range of countries, such as Australia, Canada, the USA, Mozambique, and Tanzania.

2.52. The International Energy Agency (IEA) estimates that the remaining technically recoverable resources of conventional natural gas worldwide,⁸⁴ including proven reserves, and undiscovered resources, are just over 460 tcm, while the remaining technically recoverable resources of unconventional gas worldwide are estimated at 328

⁸¹ This code has not yet been agreed; the contents of the code and the timings for implementation could change.

⁸² DECC Energy Trends, September 2013, Table 4.3

⁸³ The IEA forecast inter-regional trade (excluding trade with regions such as Europe) will grow from 21% of global demand to 23% between 2008 and 2020, with LNG making up an increasing proportion. Source: IEA WEO 2010 (p.193)

⁸⁴ World Energy Outlook 2012 (p 134)

tcm. Taken together, these resources would last more than 230 years at current production rates.

- 2.53. However, the prospects for unconventional gas production are subject to some uncertainty:
- whether the US shale gas experience will be replicated elsewhere in the world, and if so, when this will happen;
 - while there is shale potential particularly in Australia and China, the extent, timing and costs of production remain subject to considerable uncertainty; and
 - the IEA consider it unlikely that significant production of unconventional gas will occur in Europe in this decade.
- 2.54. According to the IEA, in 2035 global use of gas will have risen by more than 50% from 2010 levels and account for more than one-quarter of global energy demand. However, it also strikes a cautious note on the climate benefits of such an expansion, noting that an increased share of gas in the global energy mix is far from enough on its own to put the world on a carbon emissions path consistent with a global temperature rise of no more than 2°C.

Box 2.2: Russian gas supplies to Europe

Background

The ongoing crisis between Russia and Ukraine includes a dispute on gas debt and historic and future gas prices. This led on 16 June to the suspension of gas supplies from Russia to Ukraine, although gas continued to transit Ukraine to EU markets.

Whilst Russian gas supplies to EU markets continued to flow until the time of writing, gas supply to Ukraine has not yet resumed. Negotiations over gas debts and future prices continued over the summer, facilitated by the European Commission.

There was not a significant impact on the UK market in summer 2014 while there was a small risk premium on the winter contract and minor intermittent increases in the spot price, connected to escalations in tension. Despite the dispute, the summer 2014 NBP spot price was at its lowest level for four years for much of the period.

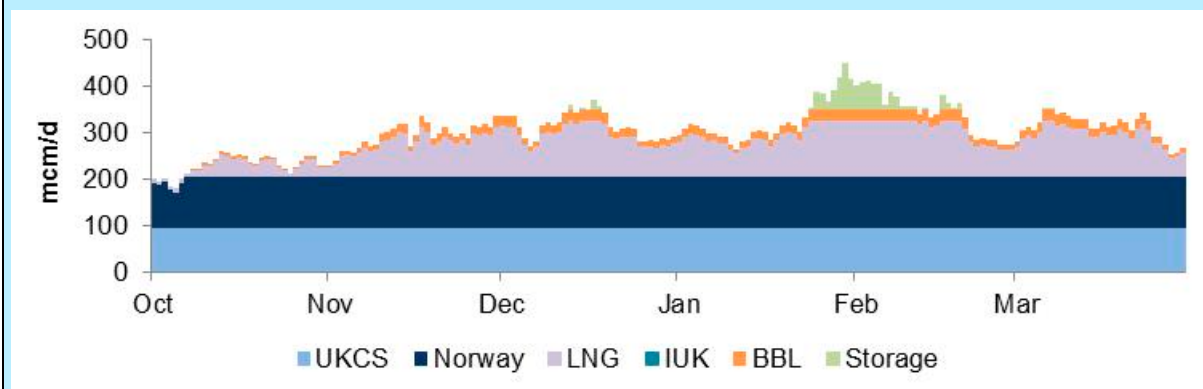
Stress Test analysis

The UK is one of the EU Member States most insulated against the Russia/Ukraine situation through the UK's location at the opposite end of Europe, indigenous production, and wide variety of gas sources and suppliers. However, due to GB's interconnectivity with Continental European markets, disruption in mainland Europe could have consequences for the UK market.

Government, in conjunction with NG as TSO, undertook analysis of particular scenarios associated with the continuation and escalation of gas supply disruption associated with the situation in Ukraine over winter 2014/15. This analysis was undertaken at the request of the European Commission as part of an EU-wide exercise. The modelled scenarios varied in terms of length of disruption, severity of import reduction into Europe, and average and severe weather conditions. The UK shared the results with neighbouring Member States and put questions to UK industry through NG's Winter Outlook consultation process to inform the findings.

The Stress Test analysis suggested that there is unlikely to be any disruption to gas supplies to any customer segment in scenarios up to and including full cessation of Russian gas supplies into Europe for an entire winter under average weather conditions. Government does not think this scenario likely, but wanted to cover the

full range of possible scenarios regardless of plausibility. The chart below shows a graphical representation of possible UK supply sources in a less extreme scenario of disruption to gas supplied to the EU via pipelines transiting Russian gas through Ukraine over winter 2014/15 with average weather conditions.



UK gas supplies with Ukraine disruption under average weather conditions

Under cold weather conditions with a statistical probability of 1-in-14, gas supplies were forecast to be available to every customer segment with Ukraine disruption. However, there was some unmet demand in the scenario of full Russian disruption with cold weather. This unmet demand situation would likely be addressed by market-based action on both the supply and demand side and, otherwise be managed in accordance with the procedures laid out in DECC's Gas National Emergency Plan.

Volumes of unmet demand were comparatively small and supplies of gas to 'protected demand' segments, such as households, SMEs, and hospitals, were not affected in the modelling. This shortfall could be met through reductions in gas flows to major users.

These Stress Tests are scenarios, not predictions, and rest on a number of assumptions. Whilst these assumptions are based on informed analysis and consultation with stakeholders, they are not infallible. Any impact of disruption to Russian gas to the EU will depend on global supply and demand fundamentals which are impossible to assess with certainty.

Next steps

Government is working closely with G7 and EU partners to monitor the situation, provide support to Ukraine, and prepare appropriate mitigating actions as the situation develops.

Storage

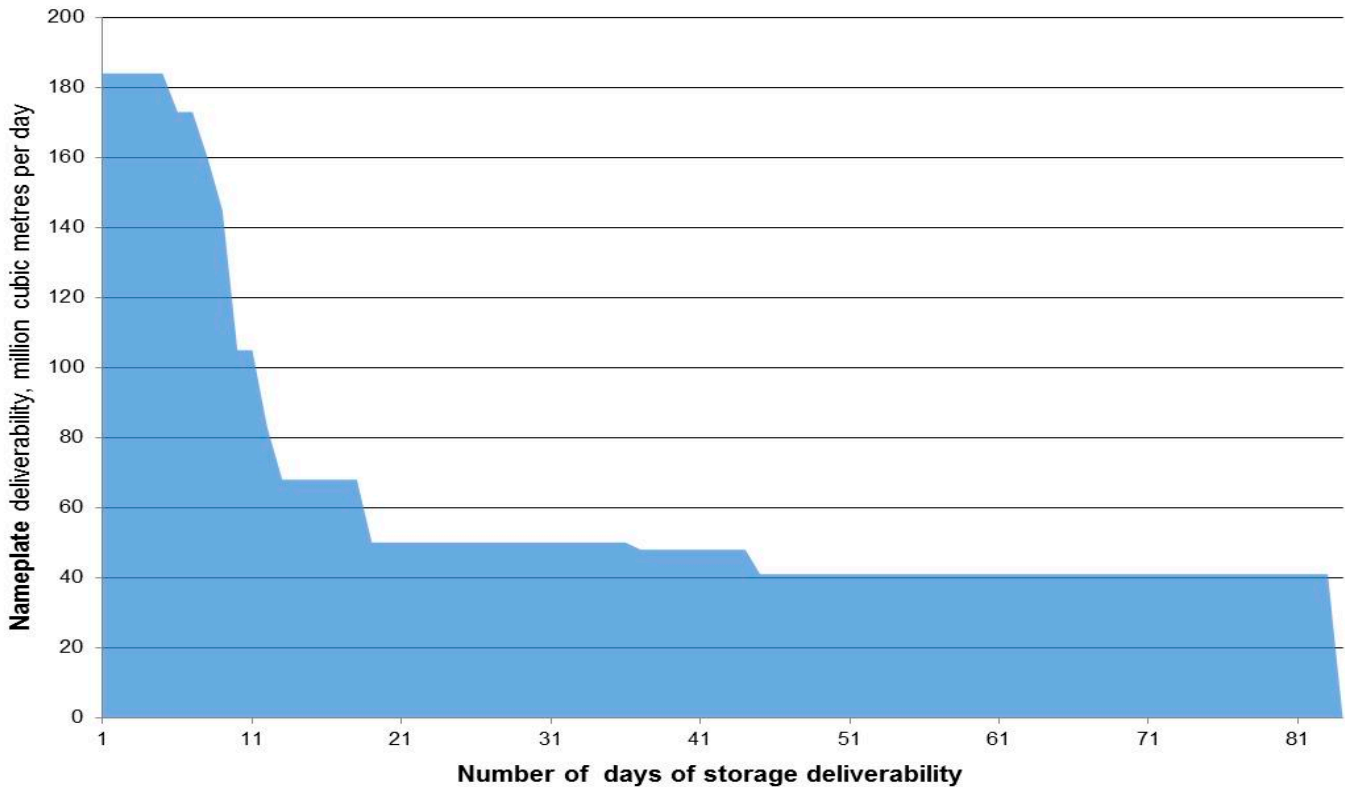
2.55. Storage facilities are another source of flexibility available to GB market participants. Characterising gas supply simply in terms of how many days of supply remain in storage can be misleading but storage is a useful means to mitigate supply disruptions and, alongside diverse supply sources, storage contributes to energy security. Broadly, there are two types of storage facility:

- Seasonal storage which is filled during summer months (when gas is cheaper) and withdrawn in winter to meet increased demand (when prices are generally higher). Seasonal storage may be partially refilled during periods of relatively low demand during the winter.

- Fast-cycle storage, which is filled and refilled throughout the year in response to short term variations in price and demand.

2.56. Chart 2.11 shows the aggregate storage deliverability. The chart excludes some storage sites: Stublach, which started commercial operation at the beginning of September 2014; and Hill Top Farm which is under construction.

Chart 2.11: Aggregate Storage deliverability



Source: National Grid 2014 and DECC analysis⁸⁵

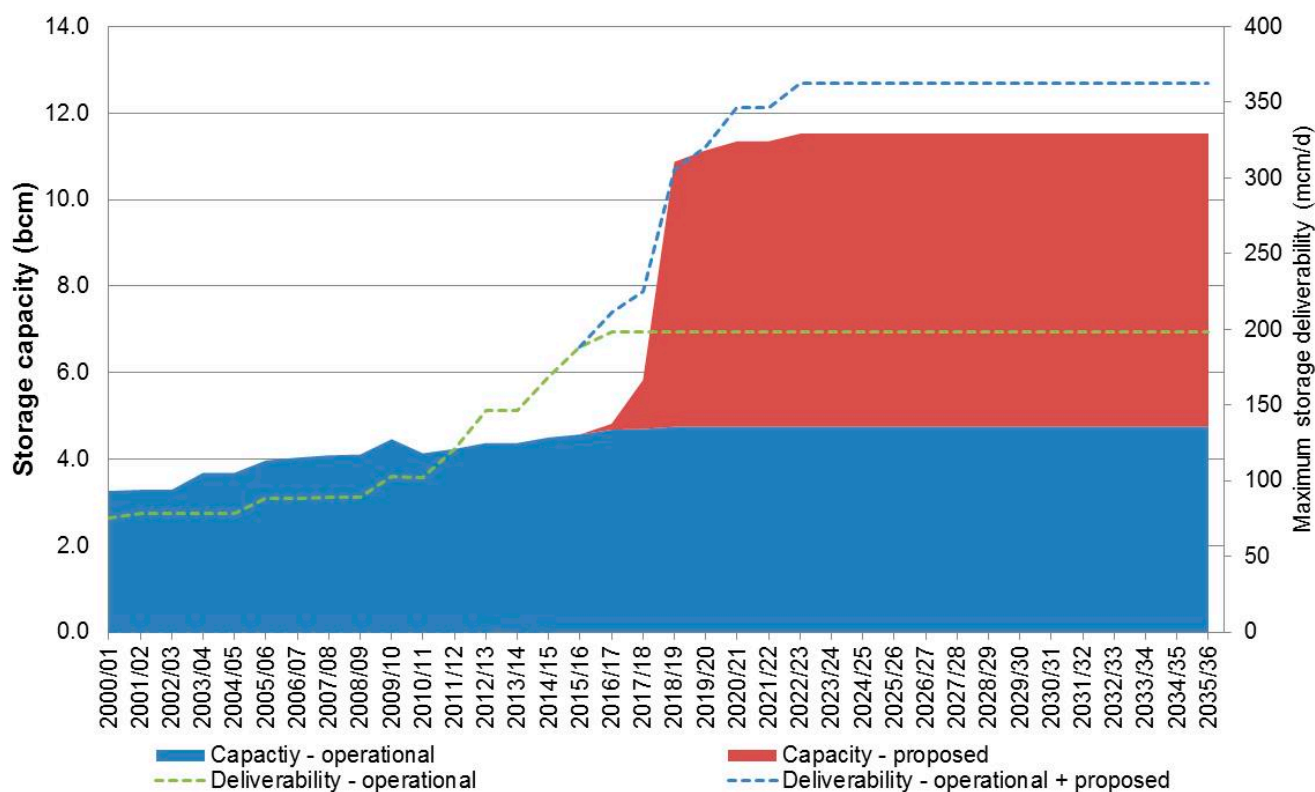
- 2.57. In the early part of 2013, media reporting suggested that the GB gas market was close to failing to deliver. In fact, analysis has shown that the GB market responded well to the prolonged cold weather and, as gas prices rose, the market increased flows from Rough and Holford storage, followed by flows from the Dragon LNG terminal. As a result, supply matched demand without requiring a Margins Notice from the system operator NG. Gas storage meets demand in combination with other supply sources and gas can also be re-injected into fast-cycle storage facilities even during the winter months, so characterising gas supply simply in terms of how many days supply remain in storage can be misleading.
- 2.58. Maximum deliverability for 2013/14 has increased to 154 mcm/day as the storage facilities at Aldbrough and Holford came online.⁸⁶ Chart 2.12 shows current and proposed gas storage capacity. The proposed capacities shown represent the storage developers' views and, in reality, actual capacity is uncertain. The market is currently delivering new fast-cycle storage: Hill Top Farm is currently under construction with Stublach Phase 1 recently starting operation, adding 30mcm/d to deliverability, or increasing storage deliverability by 29%. There are 11 further storage projects with

⁸⁵ It should be noted that this is showing maximum deliverability for all sites (nameplate capacity); as storage sites empty deliverability rates fall; this chart is not an accurate representation of the way in which storage sites send out gas. This chart is therefore for illustrative purposes.

⁸⁶ NG, Gas Ten Year Statement.

planning consent for more than double the current storage capacity, although the number of proposed storage sites that will become operational is uncertain.

Chart 2.12: Storage Development (Space)



Source: National Grid Future Energy Scenarios 2014

Network Reliability

2.59. The UK gas transmission network achieved 100% reliability in 2013/14. System reliability is assessed as no supply losses to firm supply points. During winter 2013/14, there was no requirement to interrupt any customers supplied directly from the NTS on any occasion. No other transporter or emergency interruption to customers supplied directly from the NTS was required.

2.60. In the future, the network will need to be able to react to the complications of greater gas demand volatility as gas is used as a back-up fuel for increased wind-power generation capacity. Ofgem is facilitating more network flexibility; RIIO-T1 allowed £26.4 million of ex ante expenditure so that National Grid Gas maintains the 1-20 obligation in Scotland and allows the possibility of further funding for network flexibility if Ofgem deems it appropriate.

Market Functioning

2.61. The UK gas market is one of the most liquid and developed markets in the world. The NBP is by far one of Europe’s largest traded gas markets, with only the Netherland’s comparable in size, a position which has developed over recent years. In the 12 months prior to May 2014, 27,400TWh of gas were traded in Europe, of which 11,714TWh (43%) was traded at the UK’s NBP.⁸⁷

⁸⁷ European Commission, Quarterly Report on European Gas Markets, p.10.

- 2.62. Liquidity is enhanced in the UK market by the presence of a large number of buyers and sellers: there are over 200 companies holding a shipper license within the UK, with around 130 participating regularly in the market in 2013/14.⁸⁸ The number of active market participants in the UK has been slowly increasing over the last five years. Furthermore, market concentration is at healthy levels, indicating competition between participants: the 20 largest shippers were responsible for around 73% of market activity.
- 2.63. This liquidity is evidenced by high churn rates at the NBP, the number of times a unit of gas is traded between extraction and consumption (one indicator of liquidity). Although churn rates vary with seasonality, the NBP churn in 2013/14 ranged from 10.5 to 18.1,⁸⁹ and a number in excess of 10 is taken by industry commentators to indicate gas hub maturity.⁹⁰ This churn rate was notably higher than gas hubs on Continental Europe with the exception of the Dutch TTF. High liquidity benefits security of supply as it provides international gas producers with effective markets where they can bring gas, and also the means by which gas consumers can indicate their willingness to buy.
- 2.64. NG, as system operator, has an important role in balancing the system within the gas day by trading on the On-the-Day Commodity Market (OCM). In 2013/14, NG activity on the OCM represented only 0.5% of total delivered gas volumes, which could be taken as evidence of the effectiveness of shippers in balancing the system and delivering security of supply.⁹¹

Conclusion

- 2.65. Analysis shows that the UK gas market has enough capacity and deliverability to meet demand; this was particularly evident during the prolonged GB winter of 2012/13. The mild winter experienced in 2013/14 also reminds us that the gas market has to cope with a range of supply/demand scenarios and that the market itself is best placed to allocate risk and weigh up the 'correct' level of capacity redundancy which delivers the best value for consumers.
- 2.66. There is continued awareness and action around the uncertainty of future levels of gas supply and demand at both the GB and global levels. These are affected by factors such as the impact of government policy, changes in consumer behaviour, economic growth and the future profile of the UK energy mix. The Government sees the potential for a bigger role for unconventional gas in the UK energy mix, and is ensuring that the regulatory framework facilitates exploration activity while focussing on safety and the environment. It is still too early to predict the extent to which production will be commercially viable.
- 2.67. Cross border and international relationships continue, with gas coming into GB from around the globe via LNG shipments, interconnectors with mainland Europe, pipelines from Norway and the UKCS. These varied sources work to enhance gas security. Ofgem's revision to the cash-out scheme to sharpen the incentives on gas market participants to match demand and supply are intended to encourage investment in measures to enhance security of supply. The implementation of EU Network Codes additionally strengthens the GB position.

⁸⁸ Ofgem data, available at: www.ofgem.gov.uk/publications-and-updates/list-all-gas-licensees-registered-or-service-addresses

⁸⁹ Based on data from the Medium-Term Gas Market Report © OECD/IEA 2014, IEA Publishing, p. 197.

⁹⁰ Heather, P., The Evolution and Functioning of the Traded Gas Market in Britain, p.6.

⁹¹ NG, National Grid Procurement Guidelines Report 1 April 2013- 31 March 2014, p.27.

3. Oil

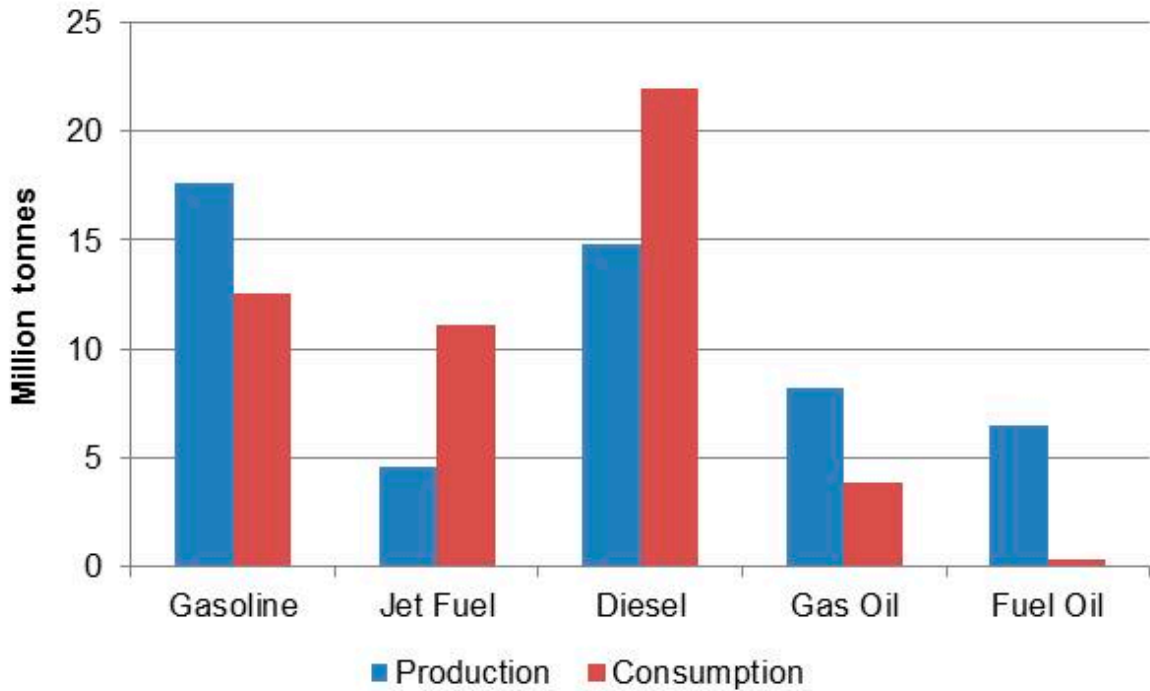
Introduction

- 3.1. This chapter sets out a summary of key facts on UK oil demand, UK oil production and global supply. Historic data is provided as well as, where possible, forecasts out to 2030. The document has been compiled using DECC data. As with all scenarios, a wide margin of uncertainty is inherent in the projections and future supply and demand will depend on a range of factors. Oil demand is expected to stay relatively constant in the short to medium term.

UK Demand

- 3.2. Oil currently meets around a third of primary energy demand and is the main energy source for transport, meeting virtually all of the UK's needs. Whilst the use of oil for transport is significant – equal to around 70% of total demand - the remaining volumes are used for a number of different purposes, including electricity generation, industrial processes, domestic heating and as feedstock for petrochemical, industrial and construction products and processes. Demand for oil in the UK is set to decrease further in the long term in order for the UK to meet its 2050 climate change objectives and rebalance the economy towards more sustainable and secure energy supplies. Oil from the UK Continental Shelf could meet nearly two thirds of current refinery demand; however GB exports and imports crude oil and refined products to take advantage of market efficiencies.
- 3.3. The UK demand for oil products has changed over the last 10 to 15 years. Factors such as increased vehicle efficiency and reduced use of oil for power generation have seen aggregate demand fall (from 81 million tonnes in 2005 to 66 million tonnes in 2013). Growth in the aviation sector and an increased proportion of diesel vehicles in the car fleet have contributed to a significant shift in the mix of products consumed. Although the use of oil for heating will continue to be important, it will decline due to consumers switching to electric heating; and schemes such as the Renewable Heat Incentive.
- 3.4. This means overall that UK refineries are producing more petrol than needed for the UK, but not producing enough diesel or aviation fuel. In 2013, UK refinery production was 27% petrol, 23% diesel and 7% aviation fuel, with the remaining 43% primarily being other light and heavy distillates. Chart 3.1 shows the mismatch between refinery production and consumption in the UK. Approximately 41% of fuel produced by UK refineries in 2013 was exported, of which 39% was petrol and 17% fuel oil. Re-aligning refinery output to better match UK demand would require substantial investment in new processing/conversion units.

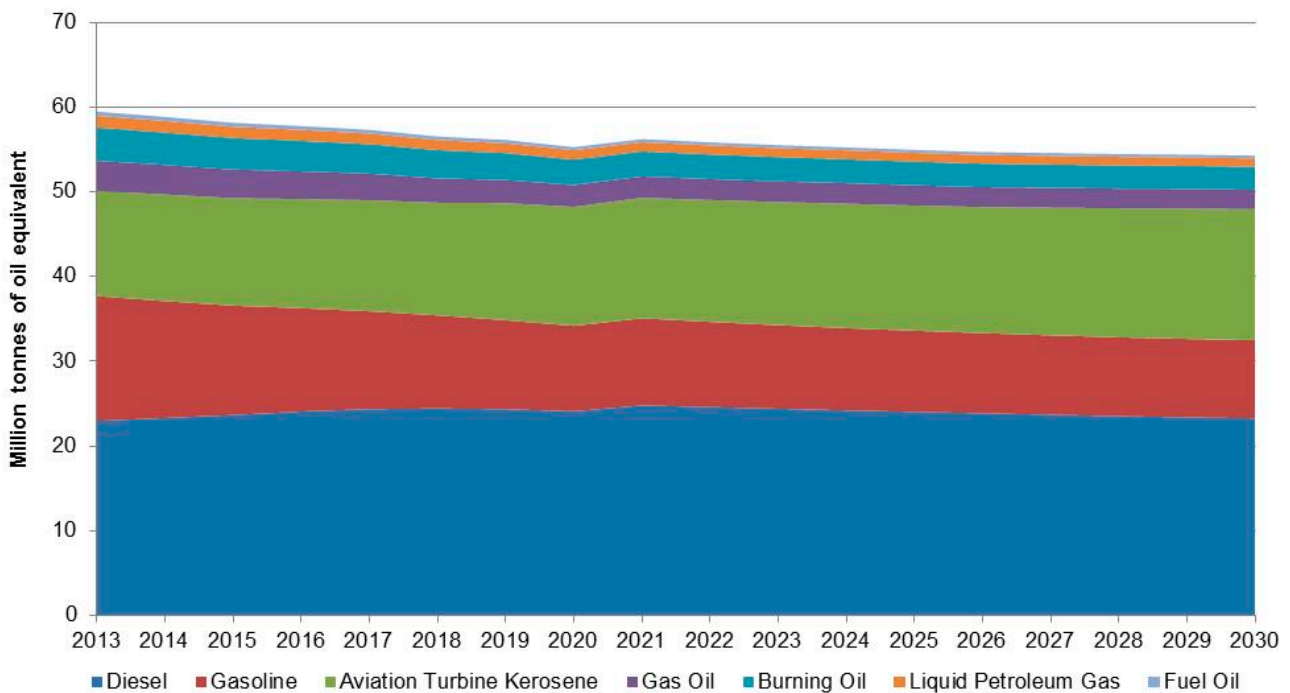
Chart 3.1: Production and Consumption of Key Petroleum products 2013



Source: DUKES 2014

3.5. The UK is increasingly reliant on importing diesel road fuel and jet fuel to meet demand. In 2013, the UK became a net importer of petroleum product for first time since 1984. As Chart 3.2 shows, the demand for aviation turbine fuel and diesel are forecast to increase up to 2030, whereas the demand for gasoline is forecast to fall, reflecting the continuing dieselisation and increasing development of renewable solutions in the motoring industry. This will likely increase the net imports of petroleum products into the UK.

Chart 3.2: Forecast UK oil demand by petroleum product type



Source: DECC Energy Trends 2014

Refining Review

- 3.6. This product/demand mismatch, along with global commercial factors, continue to affect the refining market in the UK and the EU more broadly, and further closures across the continent are likely in the future. While there is scope for further rationalisation of UK production capacity to take place without damaging supplies to consumers, if this trend continues over time the UK market risks a less diverse range of supply sources and a less flexible sector in the face of future supply disruptions. In light of the challenges facing the sector, DECC conducted a cross-government review of the role of the refining sector in a resilient downstream oil supply chain, and on 9th April 2014 published its review of the Refining and Fuel Import Sectors in the UK.⁹²
- 3.7. DECC assessed the midstream supply chain against three broad criteria; resilience, economic, and social and environmental impact. 'Resilience' included considering whether there is sufficient capacity in the supply system to meet demand, allowing for fuel to be provided to UK consumers at a globally competitive price.
- 3.8. The fuel supply sector, as currently structured in the UK, performs well against these criteria. Refiners have access to crude markets and provide a source of product within the UK itself, while importers help mitigate the supply-demand imbalance for diesel and aviation fuel and are able to provide a rapid and flexible response to supply disruptions. Wholesale UK road fuel costs are among the lowest in Europe demonstrating the efficiency of the supply chain.
- 3.9. This does not mean that the current balance between refiners and importers will be or must be preserved to maintain fuel resilience; the market will continue to drive changes in the supply sector. Government, however, recognises the benefit of ensuring that a mix of domestic refining and imports remains viable in the UK, so far as market conditions allow. The review concluded that resilience and security of supply is supported by retaining a mix of domestic refining and imported product – a view that is consistent with the government's Energy Security Strategy published on 29 November 2012, which recognises the benefits of supply diversity.⁹³
- 3.10. In response to the review, DECC has developed a package of actions which taken together could help improve the operating environment for the refining and import sectors. These actions are across three themes: a partnership approach with industry; addressing market distortions; and considering regulatory burden.
- 3.11. Key to the partnership approach has been the establishment of a new joint government and industry Midstream Oil Task Force. This will provide a strategic and collaborative way for government and industry to work together and to deliver the actions from the review. The task force is independently chaired and has drawn its members from across the midstream oil sector.
- 3.12. In addition, the government is continuing to consider measures to support fuel supply resilience. This further work includes considering the means to address other market distortions, analysing the case for supporting infrastructure development to build more resilience, as well as evaluating the oil stocking levels on UK companies to ensure they continue to be applied fairly and appropriately.

⁹² Review of the Refining and Fuel Import Sectors in the UK:

https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/302172/Refining_and_fuel_imports_in_the_UK_FINAL_VERSION.pdf

⁹³ DECC Energy Security Strategy published 29 November 2012:

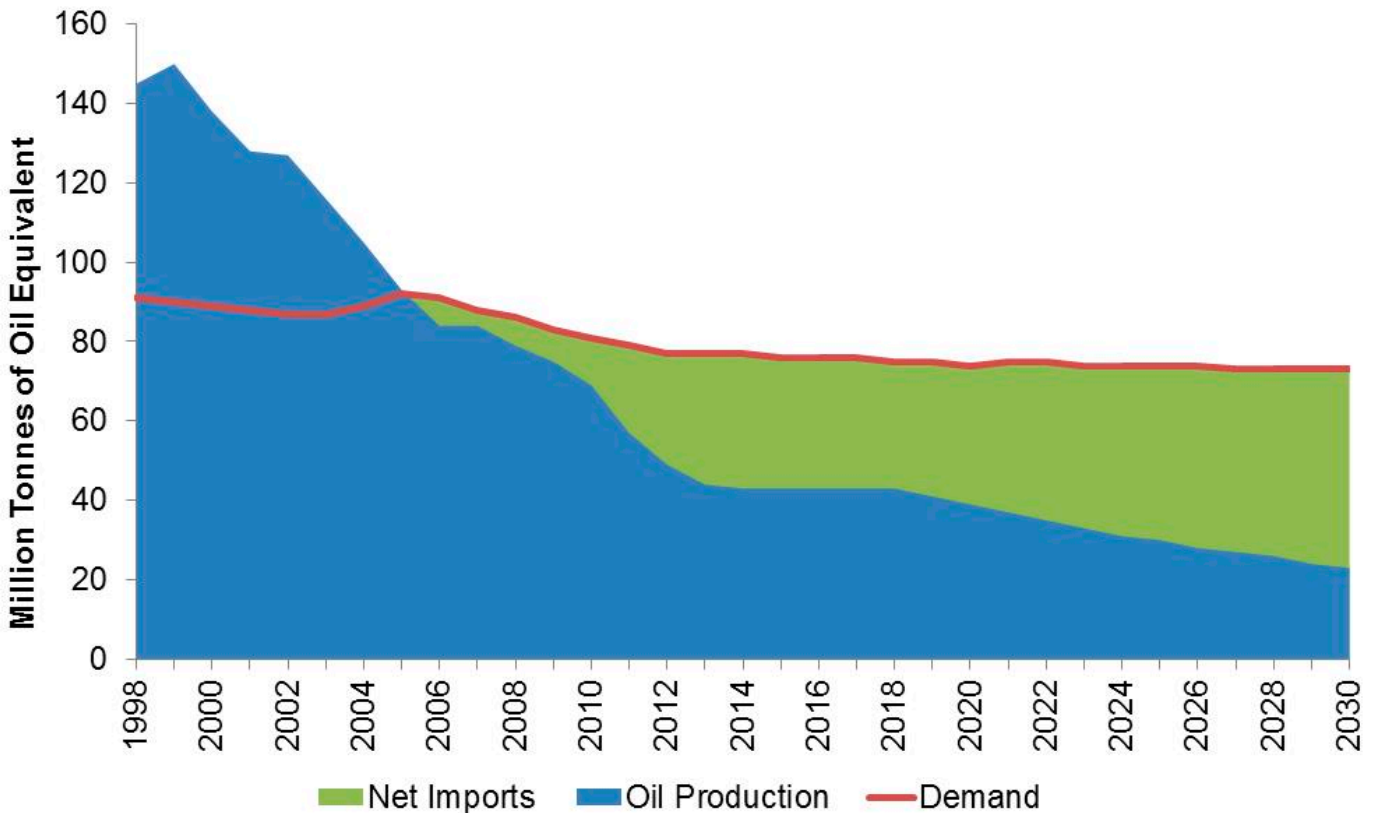
<https://www.gov.uk/government/publications/energy-security-strategy>

Supply

UK Oil Production

- 3.13. Oil production from the UK Continental Shelf (UKCS) peaked in 1999 and declined at an average rate of around 7% per year until 2010. In the last couple of years a number of unexpected slowdowns in oil production resulted in an increased rate of decline in UKCS production. These unexpected shutdowns included maintenance of the Buzzard field and production restraints in the Elgin area because of a gas leak from March 2012. Consequently, there was a reduction in oil production of 18% in 2011 followed by a further reduction of 14% in 2012. Production in 2013 showed an 8.8% reduction on 2012 and is now just under 30% of 1999 production.
- 3.14. DECC's latest central projections indicate UK production (including Natural Gas Liquids) will be 43 million tonnes of oil equivalent in 2018, similar to the 44 million tonnes of oil equivalent in 2013, though there is a wide margin of uncertainty with such projections. The actual rate of future decline will depend on the level of investment and the success of further exploration. Chart 3.3 shows the declining production profile and how net imports will be increasingly important in meeting a broadly flat demand profile.

Chart 3.3: UK Oil Demand, Production & Imports



Source: DUKES 2014 and DECC Energy Trends 2014

- 3.15. The government is committed to maximising economic recovery of UK oil and gas; the 2014 review of UK offshore oil and gas recovery led by Sir Ian Wood estimated that 12 to 24bn barrels of oil equivalent could be produced from the UK's offshore resources. In order to capitalise on these resources, The Wood Review recommended that a new independent regulator, to be called the Oil and Gas Authority (OGA), be established and should adopt a tripartite approach with HM Treasury and industry to develop and commit to a new, shared strategy of Maximising Economic Recovery for the UK's oil and gas

(MER UK). This will require licence holders, upstream infrastructure owners and operators to act in a manner best calculated to give rise to the recovery of the maximum amount of petroleum from UK reserves as a whole, not just that recoverable under their own licences. A requirement to establish the MER UK strategy has been introduced to legislation via the 4th Session Infrastructure Bill, along with a levy making power. The additional powers recommended in The Wood Review will be taken in a further bill in due course. It is intended that the OGA will commence operations in shadow form before being fully established in the form of a new arms-length body in 2016.

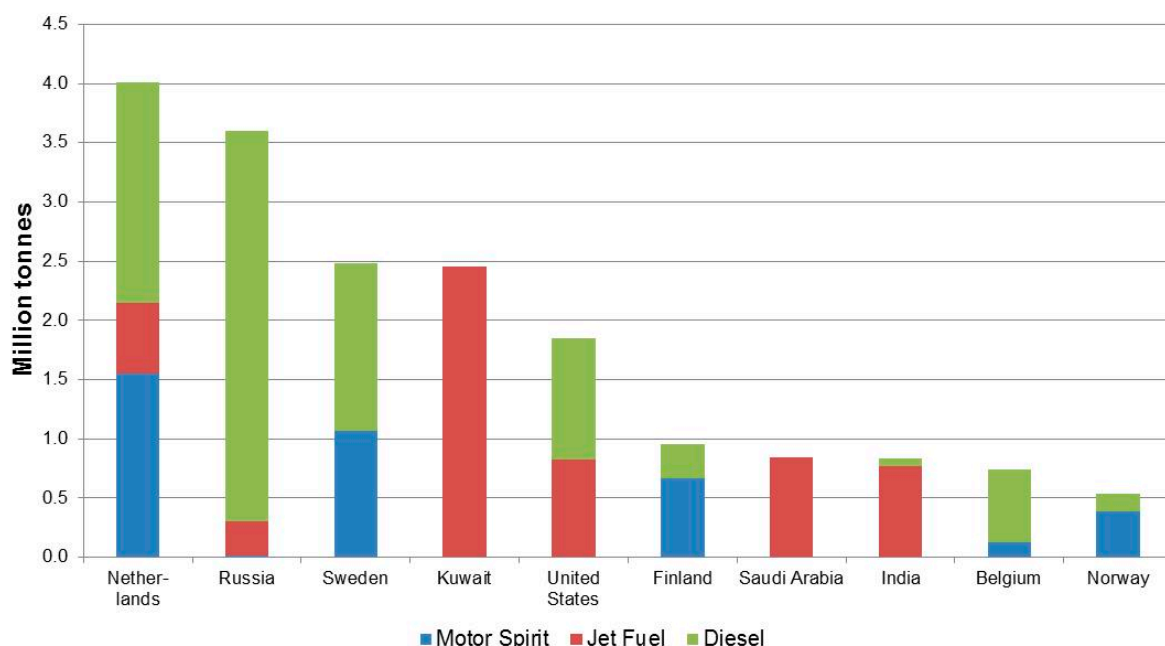
Crude oil imports

- 3.16. The UK's production of crude oil would be sufficient to meet over 60% of UK refinery demand. However, there is active trade in oil and in 2013 less than 20% of UK crude oil production was used by UK refineries. The UK both imports and exports crude oil, and the direction of this trade is dependent on the prevailing market conditions.
- 3.17. Historically, around 65% of the UK's crude imports have come from Norway, given not only its proximity to the UK, but also because Norwegian crude oil is similar to the UK's in being low in sulphur. However, this decreased to 40% in 2013 due to declining reserves in Norway, resulting in imports from the OPEC countries increasing significantly, in particular from Algeria and Saudi Arabia. This increases the diversity of sources coming into the UK and would reduce the impact of a disruption to any one source of supply on the UK.

Refined oil imports

- 3.18. The UK has a well-developed infrastructure for the trade of both crude oil and petroleum products, and, as Chart 3.4 illustrates, sources its petroleum products from a diverse range of countries. Around a fifth of the products come via the Netherlands, but, as with imports from other EU Member States, the fuel may have originated from elsewhere in Europe or beyond. Imports from European countries are mainly transport diesel whilst imports from the Middle East are predominantly jet fuel.

Chart 3.4: UK Oil Product Imports

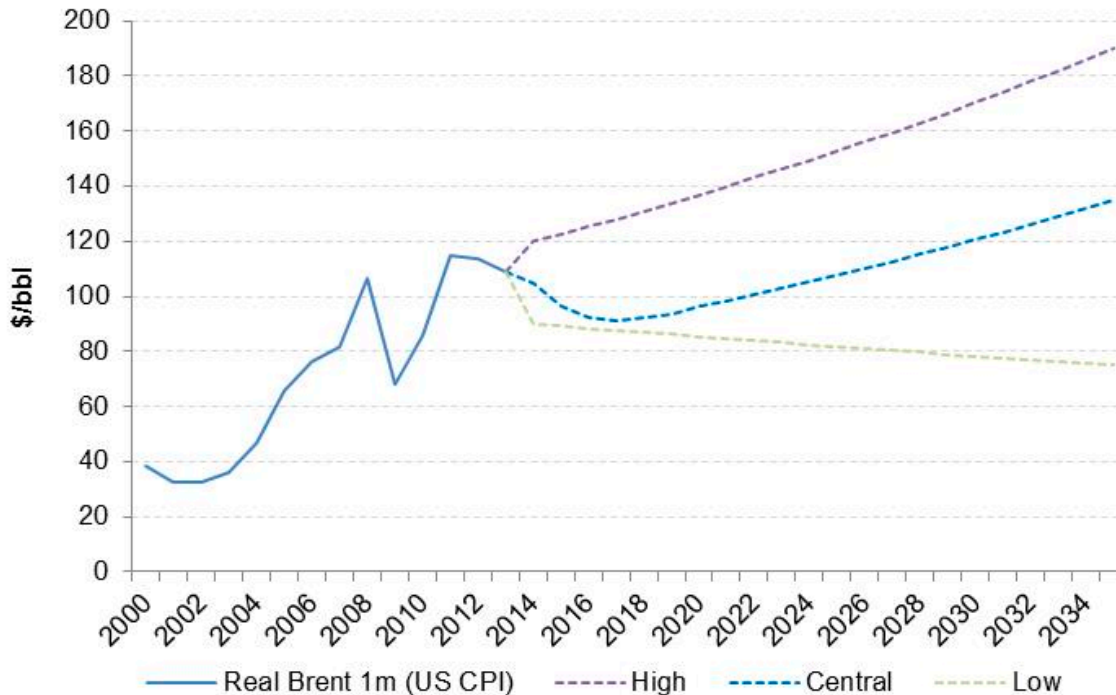


Source: DUKES 2014

Global oil issues

3.19. Global oil demand is projected to increase by around 16% by 2035 compared to 2012 levels, driven by emerging economies.⁹⁴ The historical oil price, and DECC's oil price projections, are illustrated in Chart 3.5; the price of crude increased in the 2000s due to growing demand specifically from Asian economies. The financial crisis in 2008 saw a collapse of the price, which has subsequently recovered.

Chart 3.5: Brent oil price 2000 onwards & DECC fossil fuel projections, \$ per barrel. (2014 prices)



Source: Adapted from Bloomberg and DECC fossil fuel price projections

- 3.20. Higher crude oil prices make affordable energy harder to achieve and have negative implications for economic growth. Whilst there are considerable uncertainties with such forecasts, the central estimate is for an initial decrease in per barrel prices over the next 3 years followed by a steady rise until 2035, as shown by chart 3.5.
- 3.21. The low scenario 2035 price is based on an assessment of the long-run marginal cost-curve for oil, based primarily on IEA estimates, choosing a level at which the majority of sources of unconventional oil will remain economic. The central scenario is based on an average of projections from external organisations between 2015 and 2020. The balance of supply and demand side factors are expected to weigh in on prices resulting in a downward pressure in the short/medium term, followed by a rise over the longer term.
- 3.22. Over the medium term the consensus expectation of key institutions and market analysts is that supply of light tight oil (LTO) is set to drive the increase in non-OPEC supply over the next few years, outweighing demand growth over this period, though there remains uncertainty surrounding future volumes. Adding to the uncertainty, on-going security concerns in Middle Eastern and North African oil producers lend the potential for unplanned supply disruptions and associated impacts on prices. On the demand side, the main uncertainties stem from economic growth and associated oil demand, with the main upside resting in the hands of emerging markets.

⁹⁴ Demand projections based on central scenario from IEA World Energy Outlook 2013.

- 3.23. Over the long term, demand growth is expected to outstrip supply growth and push prices up. A key factor underlying the trend rise in these projections of the oil price is economic growth in the emerging economies increasing the demand for oil. The IEA also identify the scale of the investment required to meet future demand and the constraints, including the availability of skilled personnel, on the industry's ability to bring forward that production. In the high scenario, prices increase throughout the projection period and this is illustrative of a "zero supply growth" scenario.
- 3.24. Key drivers for price volatility this year have been strong demand, growth in emerging economies, and concern over developments in Russia/Ukraine and the MENA (Middle-East and North Africa) region, including Libya and the insurgency in Iraq.

Emergency Oil Stocks

- 3.25. The UK is required to hold several million tonnes of oil stocks as part of international obligations arising from membership of both the EU and the International Energy Agency (IEA). These emergency stocks can be released onto the market to maintain supply in the event of a significant disruption to global oil supplies.
- 3.26. The EU Directive 2009/119/EC, which came into force from the start of 2013, requires all member states to hold stocks equivalent to either 90 days of net imports (in line with the IEA methodology) or 61 days of final inland consumption, depending on which of the two is largest. As a major producing nation, the UK is obliged to hold 61 days of final consumption as its EU obligation. The UK meets this by obligating companies that are substantial suppliers of oil products to the UK to hold stocks toward the obligation.
- 3.27. The UK held just under 12 million tonnes of petroleum products towards its obligation at the end of 2013; this was similar to the level of stock held in 2012.
- 3.28. In 2013 DECC launched a consultation on the future management of the compulsory oil stocking obligation. In April 2014, government published its response to the consultation which set out that an industry owned and operated Central Stocking Entity should be established in the UK, subject to a roadmap for this being prepared by obligated companies and presented to government. If this is acceptable the government will look to legislate for a Central Stocking Entity as soon as parliamentary time allows.

Conclusion

- 3.29. The UK relies on oil products to meet a considerable portion of its energy needs. Oil demand is expected to stay relatively constant in the UK in the short to medium term, which is at least to 2030, according to the current projection. Over time, technology changes, including electric vehicles and the generation of more heat from renewables, together with Government energy efficiency policies such as seeking to encourage greater use of public transport, should reduce demand for oil. The timing and scale of these demand decreases is uncertain.
- 3.30. Globally, oil demand is anticipated to increase in the run up to 2035, driven by emerging economies. Global production is expected to become more challenging during this timeframe, and the UK will become ever more exposed to global oil markets, as its requirements for imports increase. In order to respond to this the UK works to promote efficiency and transparency in the world market while diversifying domestic energy supply.
- 3.31. The UK is still the largest oil producer in the EU, although the UK's production of crude oil and natural gas liquids is decreasing. Production in 2013 showed an 8.8% reduction on 2012 and is now just under 30 % of 1999 production. This long term trend will

continue, but with a slower rate of decline in production over the next 20 years, as government has put in place a range of measure to maximise UK production following record investment in the UK continental shelf in 2012/13.

- 3.32. In 2013, less than 20% of UK crude oil production was used by UK refineries. Around 65% of the UK's crude imports have, until recently, come from Norway. This decreased to 40% in 2013, due to the declining reserves there, resulting in a significant increase in imports from the OPEC countries.
- 3.33. The UK remains a significant producer of refined products, producing more gasoline, fuel oil and gas oil than it needs but insufficient quantities of diesel road fuel and jet fuel. The UK is a net exporter of petroleum products.

Annex A

Secretary of State's Response to Ofgem's Electricity Capacity Assessment Report of June 2014

Context

- A.1 The Electricity Act 1989 was amended by the Energy Act 2011 to oblige Ofgem to provide the Secretary of State with a report assessing demand for, and supply of, electricity in Great Britain (GB), including an assessment of the different possible capacity margins for that supply and the degree of protection that each would provide against the risk of shortfalls in supply.⁹⁵ Ofgem published its third annual report in June 2014 ("Ofgem's Electricity Capacity Assessment"). The report covers the period from winter 2014/15 to winter 2018/19.
- A.2 Regulations 1(4) and 88 of the Electricity Capacity Regulations repeal Section 47ZA of the Electricity Act 1989. This comes into force on 1st January 2015. Following this repeal and the establishment of a GB Reliability Standard, Ofgem is no longer obliged to deliver a Capacity Assessment report to the Secretary of State by September 1st of every year; consequently this will be the last Secretary of State response.
- A.3 Ofgem's report can be found online at: www.ofgem.gov.uk/ofgem-publications/88523/electricitycapacityassessment2014-fullreportfinalforpublication.pdf
- A.4 This annex fulfils the obligation on the Secretary of State, as set out under Section 172 of the Energy Act 2004, to make an assessment of the amount of capacity required to meet the demands of electricity consumers including a spare margin to account for unexpected demand or unexpected loss of capacity for each of the periods.

Executive Summary

- A.5 Ofgem's Electricity Capacity Assessment is broadly consistent with DECC's own analysis of the security of supply outlook. Both sets of analysis point to a strong likelihood that de-rated capacity margins would fall over the next two winters, before they improve thereafter.⁹⁶
- A.6 Although there are some differences between the two organisations' projections of measures reflecting the state of the security of electricity supply, loss of load expectation (LOLE), these are principally due to reasonable differences in assumptions on the future outlook for electricity demand and interconnection.⁹⁷

⁹⁵ The terms "the Authority" and "Ofgem" are used interchangeably in this annex. The Authority is the Gas and Electricity Markets Authority. Ofgem is the Office of the Gas and Electricity Markets.

⁹⁶ The de-rated capacity margin is defined as the average excess of available generation capacity over peak demand expressed in percentage terms. Available generation capacity is the part of the installed capacity that can in principle be accessible in reasonable operational timelines, i.e. it is not decommissioned or offline due to maintenance or forced outage.

⁹⁷ The loss of load expectation is defined as the number of hours in a typical year that the system operator (NG) would be statistically estimated to intervene in the market i.e. where supply and demand will not meet. It is important to note that loss of load does not automatically mean that customer blackouts will occur; most periods of loss of load are managed without significant impact on consumers.

- A.7 As part of the EMR Delivery Plan, Government has legislated a confirmed Reliability Standard for the GB electricity system that is a target intended to reflect the optimal trade-off between the costs of additional security of supply as a result of additional capacity, and the benefits as a result of reduced lost load. This Reliability Standard is expressed in terms of loss of load expectation and is set at 3 hours of lost load per year.⁹⁸
- A.8 In light of the uncertain outlook to security of supply during the middle of the decade DECC, National Grid (NG) and Ofgem have announced additional safeguards for consumers in the form of new balancing services that will allow NG to balance the system in the event of margins tightening.⁹⁹
- A.9 DECC has legislated for the Capacity Market (CM), with the first capacity auction due to be run in December 2014, for delivery of capacity in the year beginning in the winter of 2018/19. Separate auctions will also be held for the delivery of Demand Side Response (DSR) and small scale storage in the period 2016-18.

Summary of Ofgem Analysis

- A.10 Ofgem's Electricity Capacity Assessment 2014 gives an assessment of the outlook for security of electricity supply for the following five winters. This focuses on the de-rated margins and LOLEs that could be delivered by the market over the next five winters and the risks to security of supply associated with these.
- A.11 The analysis shows that absent new measures introduced by the Government, Ofgem and NG, the outlook for security of supply would be broadly the same as seen in the 2013 report. However, the introduction of new measures means that the risk of customer disconnections in the coming winters has reduced compared to last year's report.¹⁰⁰
- A.12 Ofgem's assessment is based on NG's four Future Energy Scenarios that provide different views of the outlook for security of supply. Ofgem has also modelled a range of sensitivities around NG's scenarios. These sensitivities capture uncertainties in key variables, such as the future level of peak demand, the commercial decisions of generators and the level of interconnector flows with mainland Europe, among other factors. Ofgem's analysis shows the range of risks implied by NG's FES and a broader range of risks resulting from the sensitivities developed by Ofgem.
- A.13 Ofgem's 2014 assessment suggests that the risks to security of supply are broadly similar to those estimated in the 2013 assessment. Risks are expected to increase over the next two winters due to deterioration on the supply side outlook with a drop in the available capacity. From 2015/16 the supply side outlook improves, with available capacity increasing due to new generation coming on to the grid.
- A.14 Ofgem's assessment presents the risks to security of supply using the "Loss of Load Expectation" or LOLE - this represents the average number of hours per year where NG

⁹⁸ This is comparable to other reliability standards such as Ireland targeting 8 hours of lost load and The Netherlands with a 4 hour target per year. Reliability Standard Methodology available from: www.gov.uk/government/uploads/system/uploads/attachment_data/file/267613/Annex_C_-_reliability_standard_methodology.pdf

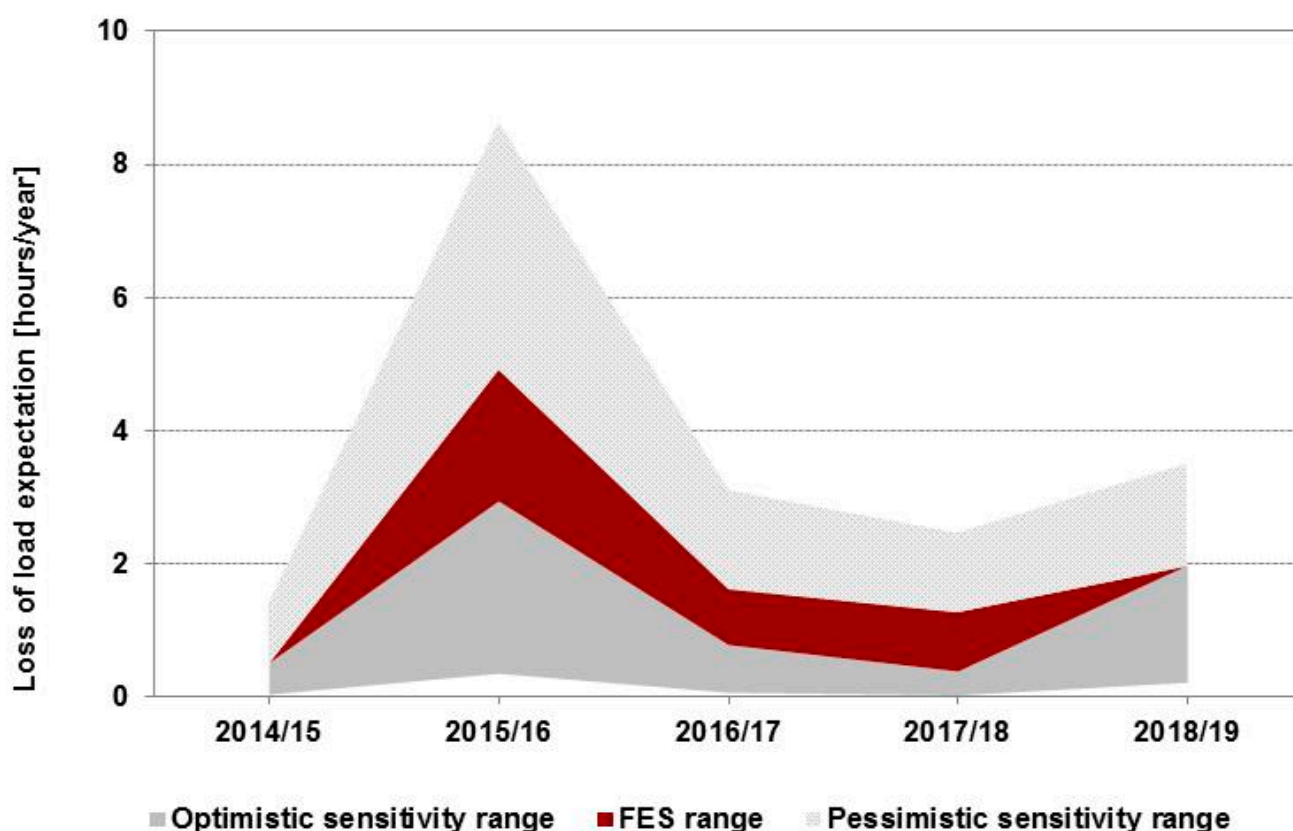
⁹⁹ NG press release available from: www2.nationalgrid.com/Media/UK-Press-releases/2014/National-Grid-to-contract-for-new-balancing-services/

¹⁰⁰ In the short-term NG can use new tools (the new balancing services) to help balance the system when margins are tight. The government has also set out firm plans to introduce the Capacity Market to reduce risks to security of supply in the medium term and beyond.

may need to take action, as the System Operator, that goes beyond normal market operations.

- A.15 In the Future Energy Scenarios, Ofgem estimates an increase in LOLE from less than 1 hour per year in winter 2014/15 to between 3 and 5 hours per year in 2015/16 as old and polluting plants close. LOLEs are estimated to drop beyond 2015/16, primarily due to a projected drop in peak demand and an improvement of the supply outlook.
- A.16 The sensitivity analysis modelled by Ofgem implies a wider range of risks. For the pessimistic range the LOLE is projected to increase to a maximum of around 9 hours in 2015/16, before it drops to a maximum of around 3 hours for the last three winters of the analysis. For the optimistic range the LOLE remains approximately at a level of zero for the entire period. The change in LOLE illustrates that variation such as an increase in electricity demand or a small reduction in capacity margins from current levels would result in a significant increase in the risks to security of supply.

Chart A.1: Ofgem Estimates of LOLE



Source: Ofgem Electricity Capacity Assessment Report, June 2014

- A.17 Ofgem also estimates the risk to customer disconnections before and after the implementation of the new balancing services. Controlled disconnections of customers - involving industrial and commercial sites before households - would only happen after all mitigation actions available to the System Operator have been exhausted, including voltage control and emergency interconnection services (2 GW in NG's FES). These services are not taken into account in the de-rated margins and LOLE estimations.
- A.18 Before taking into account the new balancing services, the chance of an event occurring that would require the controlled disconnection of customers in NG's most pessimistic scenario, would be around 1 in 4 years in 2015/16. The new balancing services give NG an extra way to balance the system before using these mitigating actions. This further lowers the probability of controlled disconnections. For NG's most pessimistic scenario

the probability of customer disconnections, with the additional measures will reduce the risk of disconnections to 1 in 31 years in 2015/16, if NG procured the maximum volume it has indicated.¹⁰¹ This is lower than the probability of controlled disconnections that corresponds to the Reliability Standard (which is 1-in-8 years in winter 2015/16), and within the range of the risks Ofgem has estimated in recent years.

DECC Analysis¹⁰²

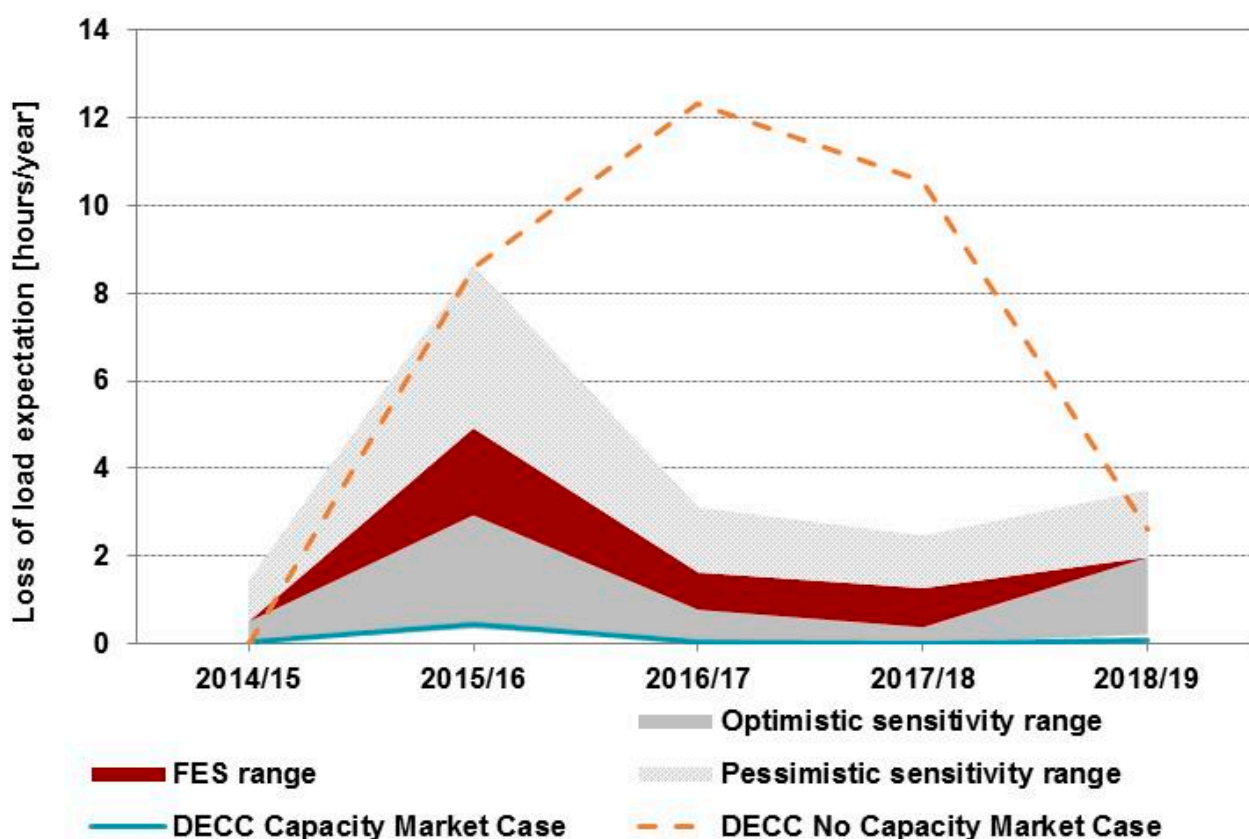
- A.19 DECC uses its Dynamic Dispatch Model (DDM) to make projections of future developments in the electricity sector including future capacity margins reflecting a set of assumptions on fossil fuel and carbon prices and costs. More details on the DDM and how it models the electricity market can be found here in Annex A of the latest EMR delivery plan update (March 2014): www.gov.uk/government/uploads/system/uploads/attachment_data/file/288463/final_delivery_plan_ia.pdf
- A.20 No matter what modelling approach is taken, the future outlook for electricity security of supply is very difficult to project with full confidence because marginal changes in input assumptions which affect either supply or demand can have large impacts on de-rated capacity margins. Key assumptions include:
- future electricity demand;
 - retirement decisions and new build;
 - contribution of interconnection; and
 - availabilities (or de-rating factors) of different technologies.
- A.21 DECC has modelled the security of supply outlook. The full analysis goes out to 2030, but only the outputs to winter 2018/19 are shown below to mirror the scope of the Ofgem Electricity Capacity Assessment. The LOLE from these scenarios are shown in Figure 2 below along with the FES scenarios Ofgem has analysed.
- A.22 The LOLE measure is utilised throughout this analysis as it is a more robust measure, used as a basis for the Reliability Standard and also used internationally in other CMs. The de-rated capacity margin is the average or mean; it does not give an indication of the variation around this average value. The use of de-rated capacity margins as a security of supply measure is less indicative of the state of the security of electricity supply, as the introduction of more intermittent generation increases the variability of the de-rated capacity margin around the mean.
- A.23 As can be seen in chart A.2, while the FES scenarios analysed by Ofgem and the DECC CM Case (with inclusion of the CM) do not mirror each other exactly, they do present a broadly similar trend. That is, increasing in the period up to 2015/16, continuing on a downward trend over the consecutive two winters. Beyond 2016/17, Ofgem's analysis and the DECC CM Case project that LOLE will reduce from 2016/17 onwards, before rising slightly in 2018/19. It should be noted that small differences in the supply or demand backgrounds can be exacerbated when looking at differences in LOLE given its sensitive nature as capacity margins get tight.

¹⁰¹ A tender in June 2014 for up to 330MW Demand Side Balancing Reserve (DSBR) to pilot the new service for winter 2014/15 which has led to 319 MW (136 MW de-rated capacity) being procured in DSBR. Tenders will run in autumn 2014 and in early 2015 for a total of up to 1,800MW of both DSBR and Supplemental Balancing Reserve (SBR) for winter 2015/16.

¹⁰² DECC's analysis in this document is consistent with the analysis for the Capacity Market Impact Assessment published in October 2013: www.gov.uk/government/consultations/proposals-for-implementation-of-electricity-market-reform

A.24 DECC and Ofgem share the same view on some of the input assumptions in their respective analysis on security of electricity supply. For example, DECC and Ofgem assume that the same level of reserve is held back to cover the single largest loss on the system and also that the de-rating factors for different domestic generation technologies are the same. However, not all assumptions align and there are differences in projected de-rated capacity margins, driven by separate views on the evolution of electricity demand, differing assumptions on interconnection flows and inclusion of the impact of policy. As such, these differences as well as the sensitive and asymmetric relationship between LOLEs and de-rated capacity margins cause DECC's CM Case LOLE estimates to be significantly lower. However both DECC and Ofgem acknowledge the wide range of uncertainty around these values, as can be seen by the DECC No CM case.¹⁰³

Chart A.2: DECC and Ofgem estimates of LOLE



Source: Ofgem Electricity Capacity Assessment Report, June 2014 plus DECC DDM modelling

A.25 The key differences between the Future Energy scenarios used by Ofgem and the DECC Base Case are as follows:

Demand: The DECC CM Case use demand figures based on DECC's Updated Energy Projections published in September 2014,¹⁰⁴ whereas Ofgem's analysis is based on NG's 2014 FES's projections.¹⁰⁵

¹⁰³ No Capacity Market Case LOLEs are higher due to the greater amount of plant retirement which has been modelled in the DDM in the absence of the CM; these plant retirement decisions have a wide range of uncertainty around them.

¹⁰⁴ Available from: www.gov.uk/government/publications/updated-energy-and-emissions-projections-2013

¹⁰⁵ Available from: www2.nationalgrid.com/uk/industry-information/future-of-energy/future-energy-scenarios/

The DDM derives peak demand from these annual demand figures which are calibrated to reflect the actual reported figures from last winter. DECC projects a greater reduction in expected peak demand than in the NG's FES scenarios used by Ofgem. This is largely as a result of more optimistic assumptions around energy efficiency, as well as underlying differences in the growth and use of embedded generation.

Supply: DECC's CM Case was established in September, and reflects some of the latest market developments since Ofgem's capacity assessment was published in June.

Contribution of interconnection: The DECC CM Case assumes that GB's interconnectors are importing 1.5 GW at times of system stress through the interconnectors in the winter season; the FES scenarios used by Ofgem assumes interconnectors are neither importing nor exporting during the winter season.¹⁰⁶ This is a key area of uncertainty, which Ofgem acknowledge in their sensitivity analysis. In general, Ofgem expect that interconnectors will be helpful for security of supply as they assume that GB would be able to call on around 2GW (in the Reference Scenario) of emergency services from the interconnectors before any customer disconnections would take place.

Capacity Market: Ofgem's assessment only considers policies that were already in place at the time of publication. Since then, DECC has laid final secondary legislation on implementing the CM and so DECC's analysis assumes the CM begins delivering in 2018/19, which also has an impact in the interim years up until 2018/19, as some generation decides not to retire given increased certainty of future revenues from the CM. Ofgem did not account for an impact from the CM. This also has an impact in the interim years up until 2018/19, as some generation decides not to retire given increased certainty of future revenues from the CM.

Potential impacts in 2015/16

- A.26 DECC's analysis is consistent with that in the 2013 Statutory Security of Supply Report, which identified that 2015/16 is likely to present the most severe near-term challenge to security of electricity supply. While DECC presents the expected risks in 2015/16, other years in Ofgem and DECC's analysis could potentially present a challenge to security of electricity supply.
- A.27 In Ofgem's analysis, it is likely that any energy unserved would be associated with small, occasional shortfalls which could be dealt with by NG through mitigation action such as voltage reduction ("brownouts"), with little or no impact on customers. Involuntary disconnection of some customers ("blackouts") would be likely to occur in a small minority of years.

¹⁰⁶ Both the Ofgem Reference Case and the DECC Base case assume that the Irish Interconnectors, representing around 0.75 GW of capacity will be fully exporting at winter peak. The differences are due to our different assumptions on continental interconnector flows. DECC assume that we will be importing around 2.33 GW from the continent at times of system peak. The Ofgem analysis considers the contribution of interconnectors during the winter season. FES assumes that interconnectors will be importing just enough to offset exports to Ireland (0.75) meaning that net flow will be 0GW.

A.28 Table A1 sets out the potential impacts to security of electricity supply in 2015/16 from DECC's CM scenario, no CM scenario and four credible scenarios.

Table A1: security of electricity supply in 2015/16			
	De-rated capacity margin (%)	Expected amount of energy unserved (GWh)	Loss of load expectation (hours per year)
DECC CM case	7.6	~0.2	~0.3
DECC No CM scenario	1.5	~10.6	~8.6
Lower bound of FES (SP)	3.6	3.2	2.9
Upper bound of FES (LCL)	2.5	5.7	4.9
Ofgem High Demand scenario	1.4	10.4	8.3
Ofgem Low Demand scenario	4.8	1.6	1.6

Note: ~ information in cells containing this symbol has not been estimated from DECC modelling but has been inferred from similar results in Ofgem's modelling.

Note: The likelihood of some customer disconnections gives the probability of some customers facing disconnection after the system operator has made full use of the mitigating measures available to it, including the provision of emergency services from Britain's interconnectors. Industrial customers would likely be disconnected before households.

Additional Capacity

- A.29 Section 172 of the Energy Act 2004 was amended by the Energy Act 2011 to oblige the Secretary of State to make an assessment of the amount of capacity required to meet the demands of electricity consumers including a spare margin to account for unexpectedly higher demand or an unexpected loss of capacity.
- A.30 In the EMR Delivery Plan, Government has confirmed a Reliability Standard for the GB electricity system. This Reliability Standard, expressed in terms of loss of load expectation, is set at 3 hours of lost load per year. This is the same Reliability Standard that is used by RTE (the French System Operator) to guide their assessment of whether additional capacity is required.
- A.31 As shown in chart A.2, DECC's Reference case suggests the reliability standard is met in all years up to 2018/19. However, DECC recognises that several uncertainties exist as reflected in Ofgem's analysis.
- A.32 In recognition of these uncertainties, NG has taken the view that it would be prudent to procure some Supplemental Balancing Reserve (SBR) capacity for the coming winter in order to provide further reassurance that the system is secure. This is in addition to the Demand Side Balancing Reserve (DSBR) capacity that NG announced it was seeking to procure in June. This measure is fully supported by Government as a sensible and prudent step in order to provide a high degree of certainty that the system will remain secure.

Conclusion

- A.33 Ofgem's Electricity Capacity Assessment is broadly consistent with DECC's own analysis of the security of supply outlook.
- A.34 New balancing services should be utilised first to fulfil short-term tightened capacity margins. The CM provides a medium–long term solution to capacity shortage risks.
- A.35 The analysis suggests that significant uncertainties exist around the outlook for both electricity supply and demand. This underpins the views expressed by DECC, NG and Ofgem that it is prudent to introduce additional safeguards in the form of new balancing services aimed at reducing risks of consumer disconnections. NG are taking steps to procure balancing services should capacity margins tighten.
- A.36 Given the likelihood of LOLE rising over the coming years and the need to tackle the underlying failures in the electricity market to bring forward sufficient investment, the Government has decided to run the first capacity auction in December 2014 with capacity being in place for 2018/19.

Annex B

Secretary of State's Update of the Energy Security Indicators

Introduction

- B.1 In November 2012 Government published its Energy Security Strategy in which it committed to updating the Energy Security Indicators. Government is continuing to implement the policy actions set out in the Energy Security Strategy; more detail can be found in the Annual Energy Statement. The Government also continues to monitor the energy security situation, using the three complimentary approaches set out in Annex A of the Strategy:
- horizon scanning for risk;
 - assessing the characteristics of the energy system; and
 - stress testing the energy systems.
- B.2 The indicators initially published in the *Energy Security Strategy*, carry out the second of these approaches in assessing the characteristics of the energy system and are updated below.¹⁰⁷ These indicators remain under review to keep them relevant and robust. When considered alongside each other, and in the context of the risks identified and the stress tests undertaken, they illustrate the UK's current energy security situation.
- B.3 Published here, they provide an aid to stakeholders in assessing the UK's energy security. The Government engages with stakeholders regularly to hear their views on energy security and invites comment on the energy security situation conveyed by these indicators.

Indicator Definitions

- B.4 As explained in the Strategy, electricity, gas and oil are each considered against the same four high level indicators; capacity, diversity, reliability and demand side response. The illustration of each of these characteristics differs by fuel but they have the same overarching definitions as follows:
- **Capacity:** the difference between the expected / likely volume that can be supplied within the UK, against the likely maximum demand.
 - **Diversity:** covers the mix of fuel types. This can include their place of origin, the amount and nature of the energy supply infrastructure, the number of companies involved and their market shares. Diversity reduces the system's exposure to any single risk, so reducing the impact on the system if any single risk is realised.
 - **Reliability:** the certainty with which an aspect of the supply chain will fulfil its function, taking account of the reliability of sources, infrastructure and delivery networks. Reliability indicates the risk that an aspect of the system will fail to deliver. Flexibility of components in the supply chain is also an important aspect of reliability.

¹⁰⁷ Available from: www.gov.uk/government/publications/energy-security-strategy

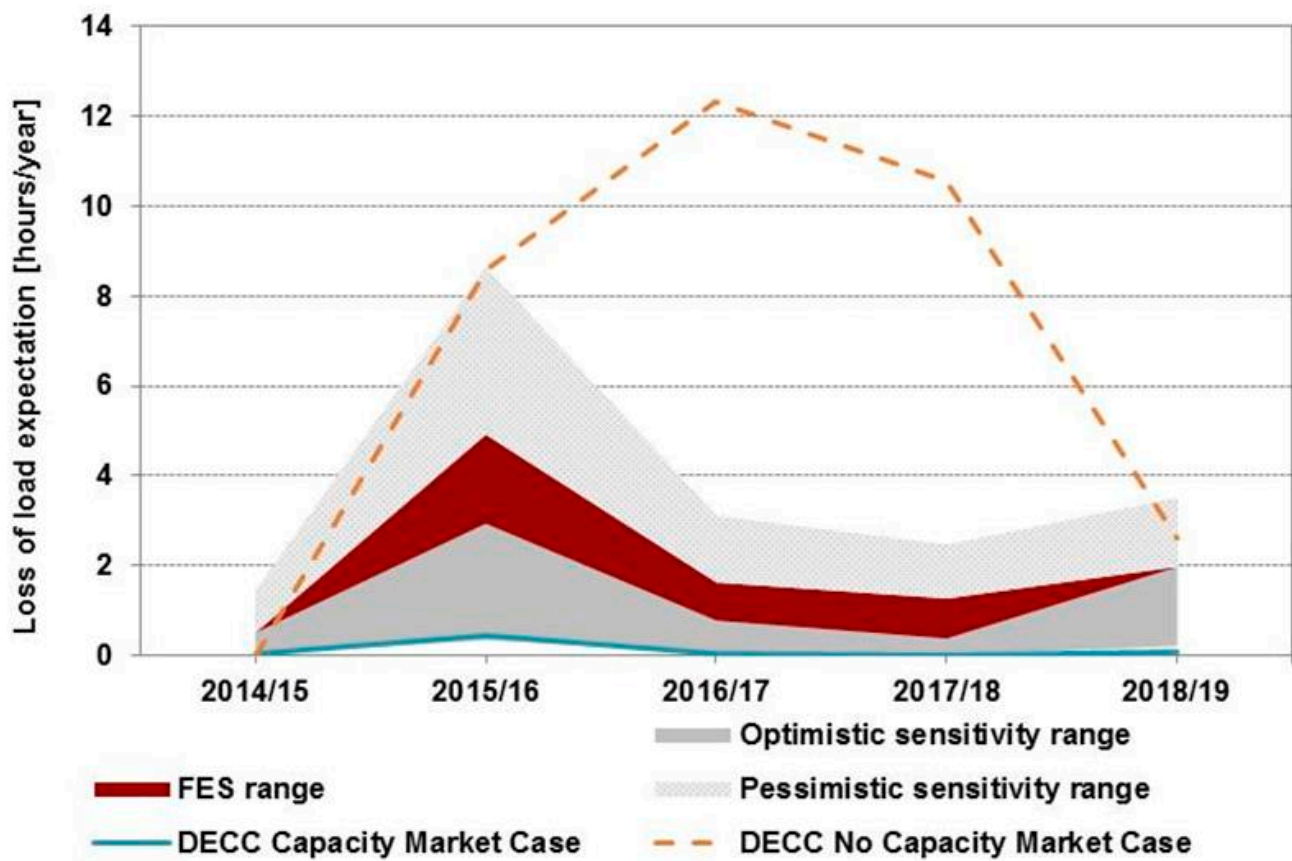
- **Demand Side Response:** the degree to which demand can adjust to accommodate any changes in supply. The availability of demand side response indicates the ability of the system to absorb any supply shortages.

Electricity

Indicator I: Electricity Capacity

- B.5 In previous years, DECC has used capacity margins as the measure for this indicator. De-rated capacity margins measure the amount of excess supply above peak demand. De-rating means that the supply is adjusted to take account of the availability of plant; de-rating is specific to each type of generation technology. It reflects the proportion of an electricity source which is likely to be technically available to generate at times of peak demand. For example, in Ofgem's Electricity Capacity Assessment, a combined cycle gas turbine (CCGT) plant is assumed to be available 85% of the time.
- B.6 While de-rated margins illustrate trends in the market, they are not a measure of the risk to security of supply. DECC now presents the risks to security of supply using "Loss of Load Expectation" or LOLE - this represents the number of hours per year in which supply is expected to be lower than demand before any intervention (eg. voltage reduction) by the System Operator. It is important to note that LOLE is not directly indicative of likely controlled power outages; in most cases, loss of load would be managed without significant impacts on consumers.
- B.7 For the Capacity Market (CM), a reliability standard has been established which is 3 hrs LOLE. The reliability standard is based on LOLE as it is a more robust measure and also used internationally in other CMs. A change to LOLE allows you to better illustrate that small changes in margins result in significant changes in the level of risk to security of supply.
- B.8 The de-rated margin was an appropriate indicator when intermittent generation was not significant and the proportion of each type of generation in the fleet was roughly constant year on year. However, the increasing penetration of intermittent generation such as wind power is likely to make this issue more significant in the future. This is because DECC expects the variability of the de-rated capacity margin around the mean to increase. DECC therefore does not expect the de-rated capacity margin to remain a good metric of security of supply.
- B.9 The chart shows both Ofgem's and DECC estimates of LOLE, including Ofgem's analysis of NG's Future Energy Scenarios. While they do not mirror each other exactly, due to different input assumptions (e.g. the DECC reference scenario models the influence of the CM, whereas Ofgem's analysis does not), they do present a broadly similar trend; increasing in the period up to 2016/17, continuing on a downward trend over the consecutive two winters. Beyond 2016/17, Ofgem's analysis and the DECC CM Case project that LOLE will reduce from 2016/17 onwards, before rising slightly in 2018/19. However both DECC and Ofgem acknowledge the wide range of uncertainty around these values, as can be seen by the DECC No CM case. For more detail on this please see **Annex A**.

Chart B.1: DECC and Ofgem's estimates of LOLE

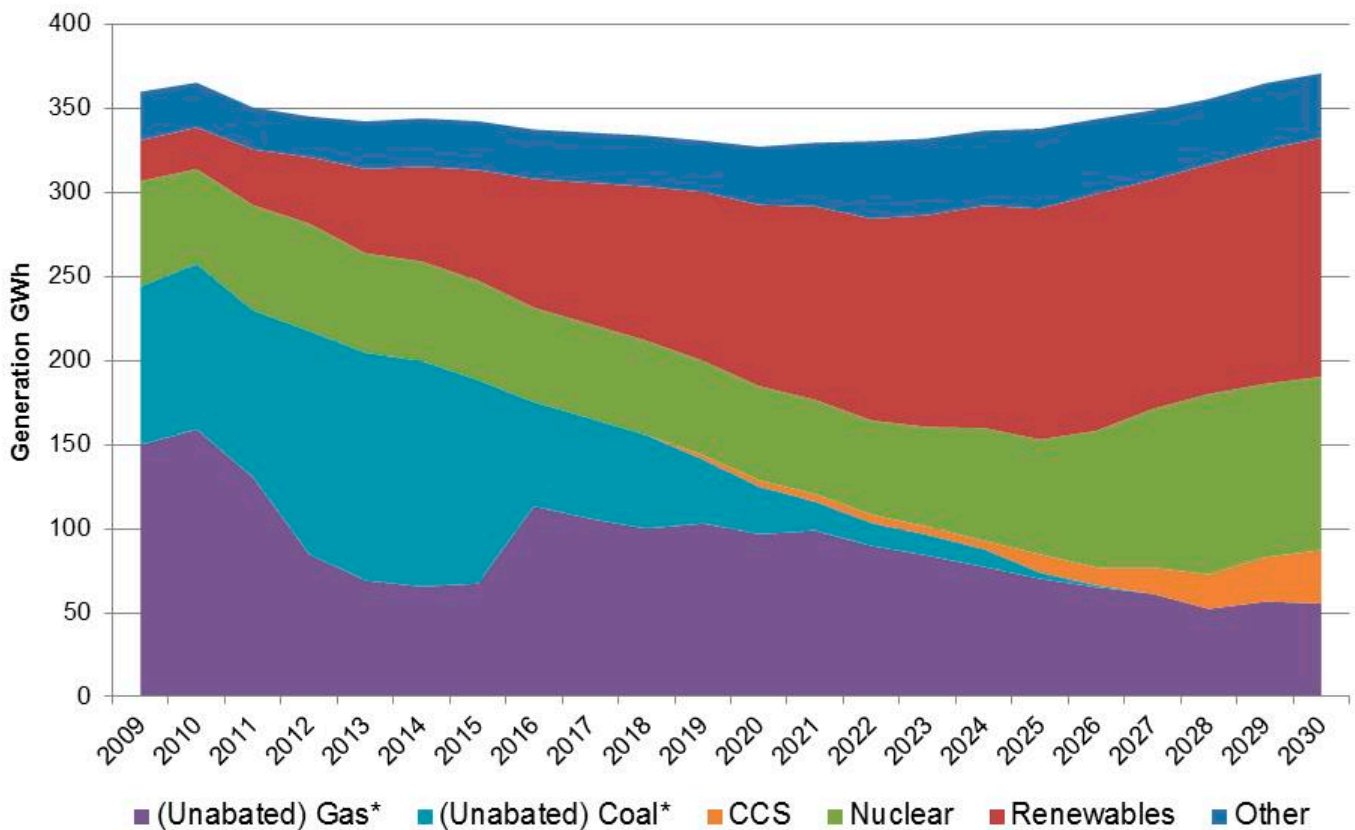


Source: Ofgem's Electricity Capacity Assessment Report, July 2014 plus DECC's own analysis

Indicator II: Electricity Diversity

B.11 B.9 How the electricity generation mix changes over time is indicative of the diversity of fuel sources in the electricity market. This chart provides an illustrative generation mix consistent with an emissions intensity of 100gCO₂e/kWh in 2030. The EMR Delivery Plan considered a number of different scenarios for the 2020s, including different rates of decarbonisation, fossil fuel prices, levels of demand and different technology mixes.¹⁰⁸

Chart B.2: Historic and projected generation mix



Source: DECC Dynamic Dispatch Model analysis plus DUKES 2014

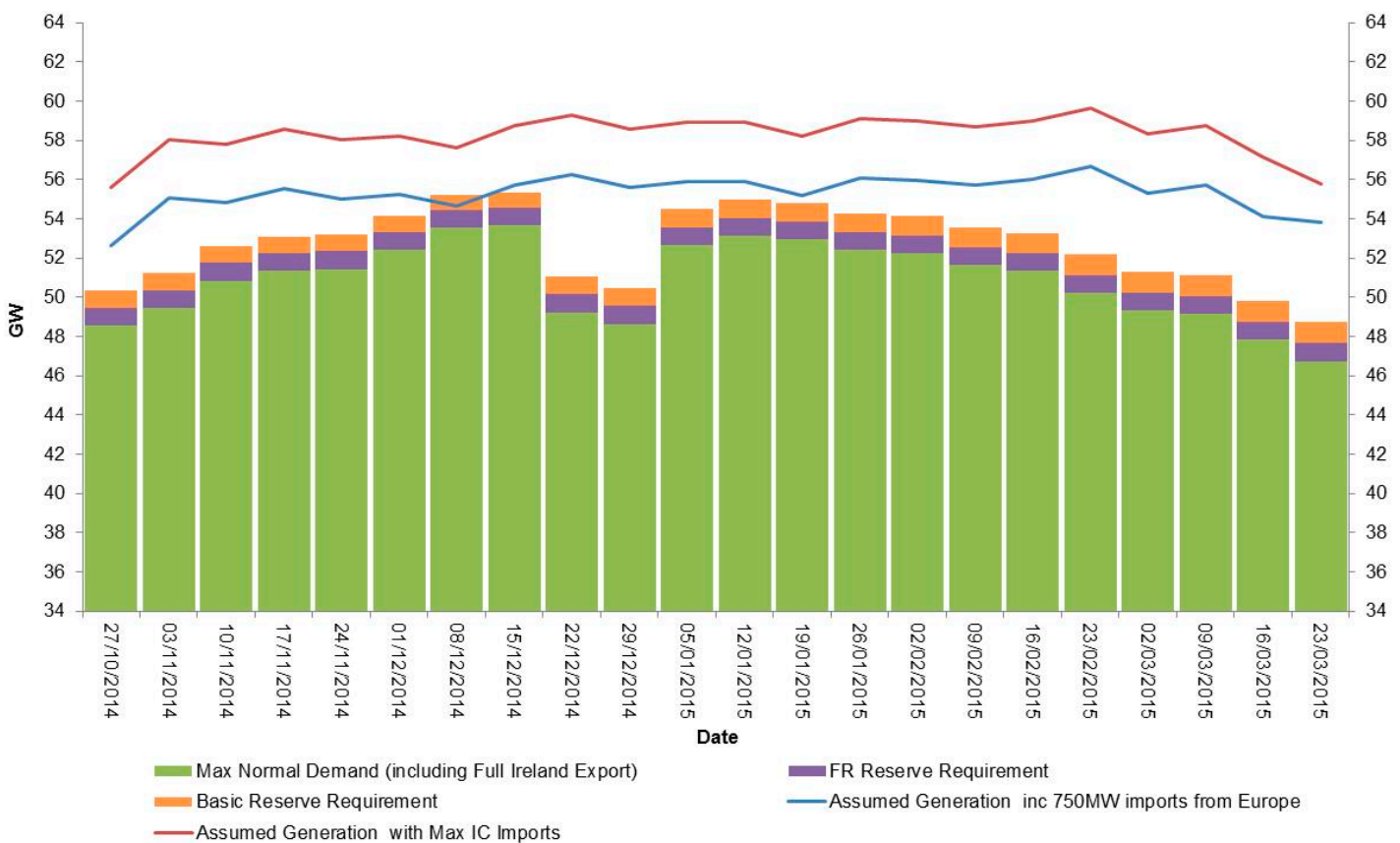
¹⁰⁸ Available from:

www.gov.uk/government/uploads/system/uploads/attachment_data/file/268221/181213_2013_EMR_Delivery_Plan_FINAL.pdf

Indicator III: Electricity Reliability – Short Term Electricity Resilience

- B.12 DECC uses NG’s assessment of short term resilience for the forthcoming winter to consider whether, in the very short term, there is sufficient generation capacity to meet forecast demand. The chart shows forecast demand and the reserve requirements needed by NG to operate the system. The Frequency Response Reserve and Basic Reserve requirements are NG’s buffer of generating capacity, in place to guard against unexpected changes in supply or demand.
- B.13 There is a risk of system warnings once the assumed capacity falls below *both* the Frequency Response Requirement and the Basic Reserve Requirement. Thus the chart shows that in the week commencing 8th December in the Central Forecast, where assumed capacity falls into the Frequency Response Requirement, a risk of system warnings is not expected. The procurement of additional reserve capacity through new balancing services contracts this winter will further mitigate the risk of customer disconnections.

Chart B.3: NG’s central forecast demand and notified generation availability

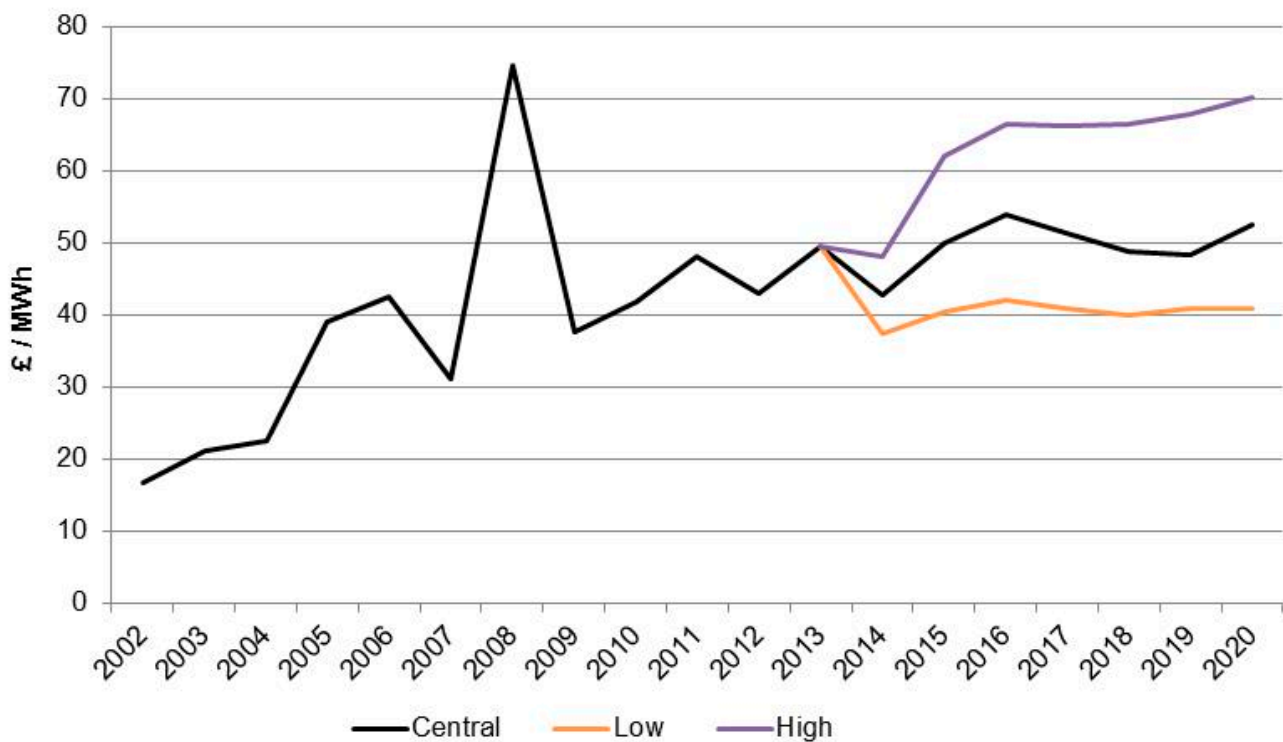


Source: Figure 24, National Grid Winter Outlook Report 2014 (as at 20th October)

Indicator IV: Electricity Reliability - DECC wholesale market price forecasts (£/MWh)

- B.14 DECC considers the trends in average annual wholesale electricity prices past and future to assess the incentives on market participants to balance their position within the market. The graph illustrates historic price trends, based on average annual day ahead price data (for base load electricity) from Marex Spectron. Future projections are based on DECC Dynamic Dispatch Modelling. Wholesale electricity price projections are the product of supply and demand expectations. As generation plant running on coal or gas will set the price for electricity in most periods of the projection, electricity price projections will reflect coal and gas price projections.
- B.15 The high and low electricity price scenarios shown in the graph are estimated using DECC's high and low fossil fuel price projection scenarios and illustrate the influence relative and estimated coal and gas prices can have on electricity prices.

Chart B.4: Wholesale market price forecasts

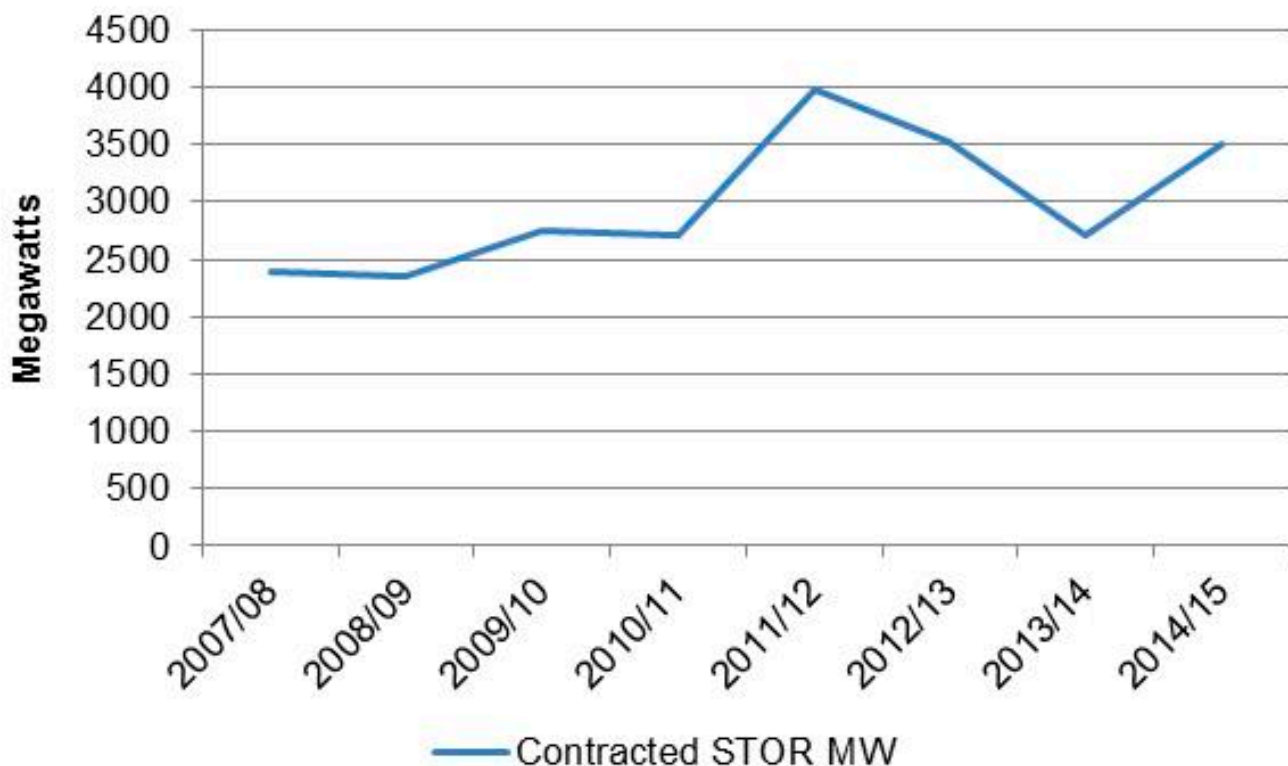


Source: Marex Spectron historical data plus DECC analysis

Indicator V: Electricity Demand Side Response

- B.16 As discussed in the main body of this report, DSR in the electricity market is provided through 'customers responding to a signal to change the amount of energy they consume from the grid at a particular time'. This can be by actively reducing load, moving load to another time or through embedded generation (generation which is not connected to the transmission system and so is seen as load reduction).
- B.17 Triad avoidance also adds to DSR provision whereby large consumers try to reduce their system charges by reducing their power demand on days which might be the 'peakiest' over the winter. Triad days are not known in advance so typically triad avoiders would reduce many times over the winter. Triad avoidance has risen in recent years but can only be assessed retrospectively.
- B.18 The chart shows NG's Short Term Operating Reserve (STOR), including all STOR providers. This is made up of approximately 1500MW of balancing mechanism providers and approximately 1900MW of non-balancing mechanism providers.

Chart B.5: NG's Contracted STOR



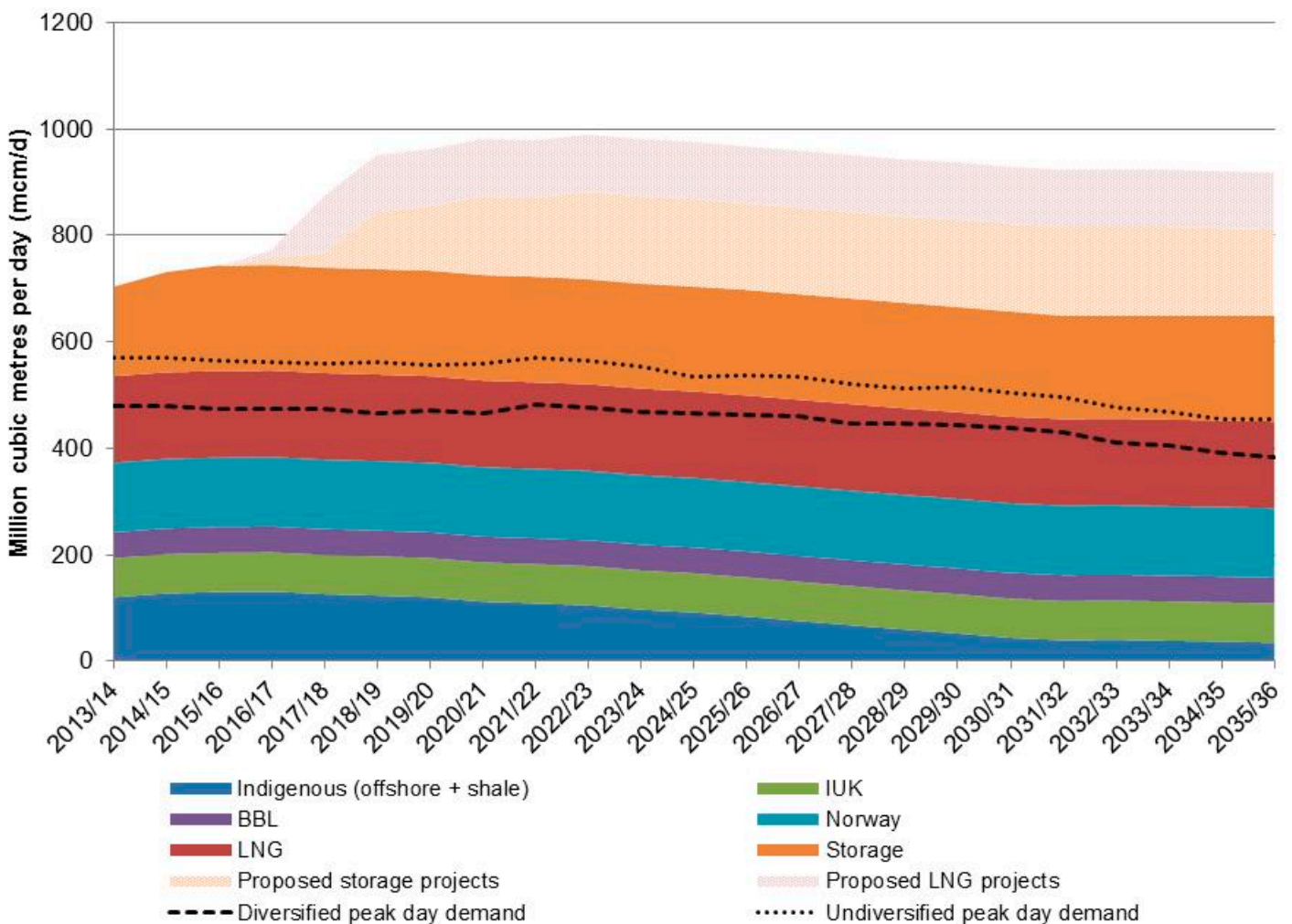
Source: NG 2014

Gas

Indicator VI: Gas Capacity

- B.19 This chart sourced from NG's Ten Year Statement combined with NG's Future Energy Scenarios, when considered alongside the load duration curve and level of storage fullness, indicates the ability of the UK to meet peak demand. The infrastructure capacity has been 'de-rated' using assumptions from NG on utilisation.
- B.20 It is a European requirement to report the UK's ability to meet demand by calculating n-1 (the ability of infrastructure to meet peak day demand, minus the largest piece of infrastructure). Without the Felindre Pipeline (86 mcm/day) which is the largest piece of gas infrastructure, N-1 for Great Britain & Northern Ireland in 2014 is 112 – 113% depending on the scenario. This indicates that GB would still have sufficient capacity to supply gas to consumers in the UK. Because the following chart is based on NG's GG scenario only, it presents only one possible state of the world. Other scenarios might show a different picture.

Chart B.6: Gas capacity

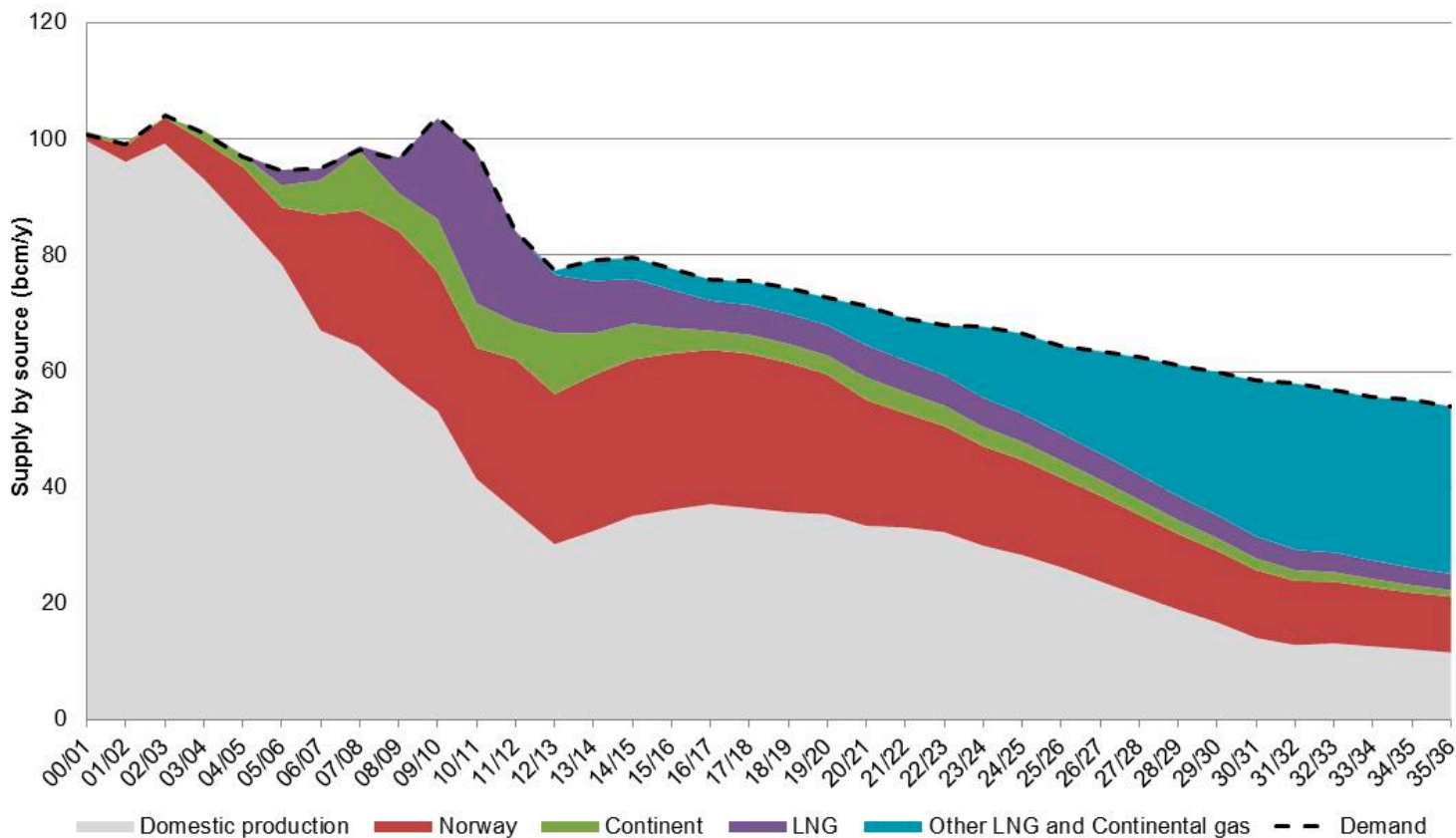


Source: National Grid Ten Year Statement combined with National Grid's Future Energy Scenarios

Indicator VII: Gas Diversity

B.21 The chart illustrates historic and projected supply sources using NG's 'Gone Green scenario'. Domestic production sits below the imports and is included here for completeness. The 'Gone Green Scenario' is one of several scenarios developed for the Future Energy Scenarios published by NG annually.

Chart B.7: Annual Gas imports (Gone Green Scenario)



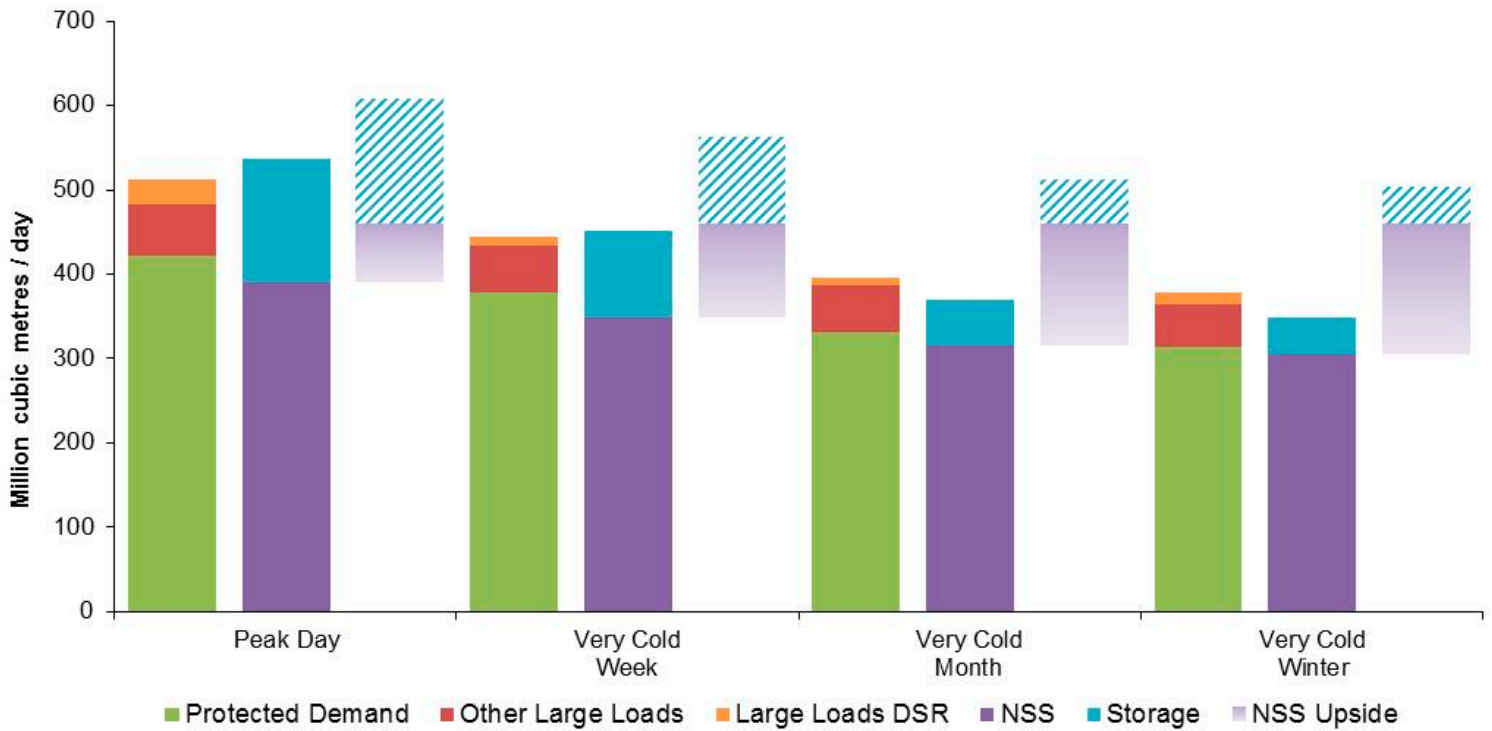
Source: National Grid Future Energy Scenarios

Indicator VIII: Gas Reliability - National Grid Cold Spell analysis, Winter 2014/15 (severe winter conditions)

B.22 This indicator, taken from NG’s winter outlook, illustrates the ability of the gas system to meet demand over a range of scenarios; peak day, a cold week, a cold month and a cold winter.

B.23 The chart shows that under all scenarios protected demand can be met through non storage supply.

Chart B.8: Cold Spell Analysis for winter 2014/15



Source: National Grid 2014

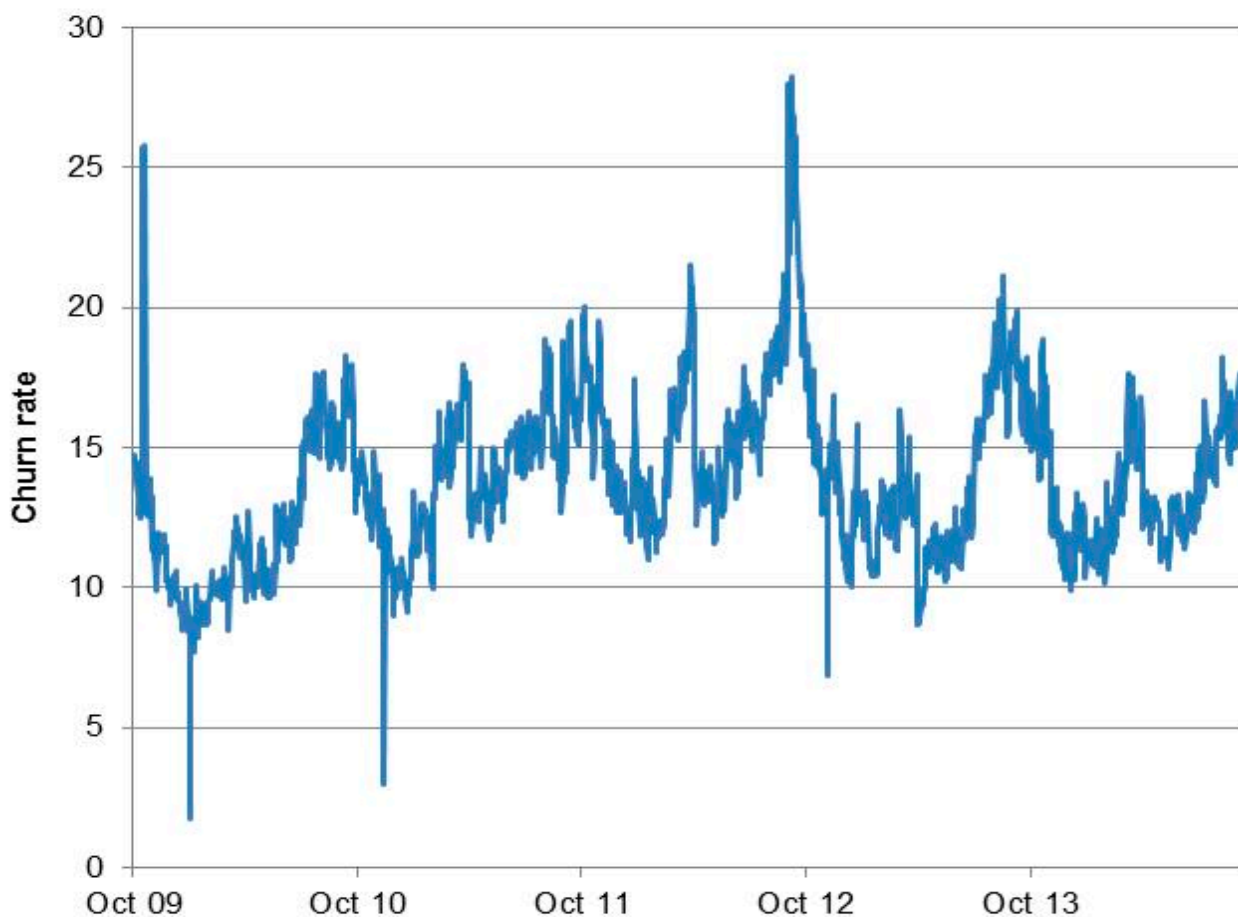
Indicator IX: Gas reliability - Market Liquidity

B.24 Market liquidity aids security of supply by:

- encouraging the optimal allocation of gas to where it is valued most,
- reducing investment risk,
- encouraging new entries and diversity; and
- allocating price and quantity risk efficiently.

B.25 In general terms, greater liquidity leads to greater market reliability. Liquidity is measured here by the churn rate; the number of times a unit of natural gas is traded and re-traded before reaching the final consumer. Churn rates of greater than ten tend to characterise mature markets with high levels of liquidity. A churn rate of less than ten is therefore undesirable. Current churn rates continue to imply adequate levels of liquidity in the gas wholesale market as shown below.¹⁰⁹ The churn rate on the spot market is a key performance indicator, although it is only one part of the market, this is further explored in Ofgem's assessment of UK gas market liquidity report.¹¹⁰

Chart B.9: Gas market churn rate



Source: National Grid Data Explorer

¹⁰⁹ Data may not include total traded volumes for GB.

¹¹⁰ Available from: www.ofgem.gov.uk/ofgem-publications/40515/liquidity-gb-wholesale-energy-markets.pdf

Indicator X: Gas Demand Side Response - Coal plant available to contribute to Gas DSR

B.26 Currently NG estimate demand side response, including DSR provided by the power sector, industry and domestic sectors, could make up approximately 6% of total gas demand on a peak day (severe winter conditions). However, demand side response is inherently difficult to estimate and the market could respond differently in response to shocks dependent upon the range of conditions on the day and the severity of situation.

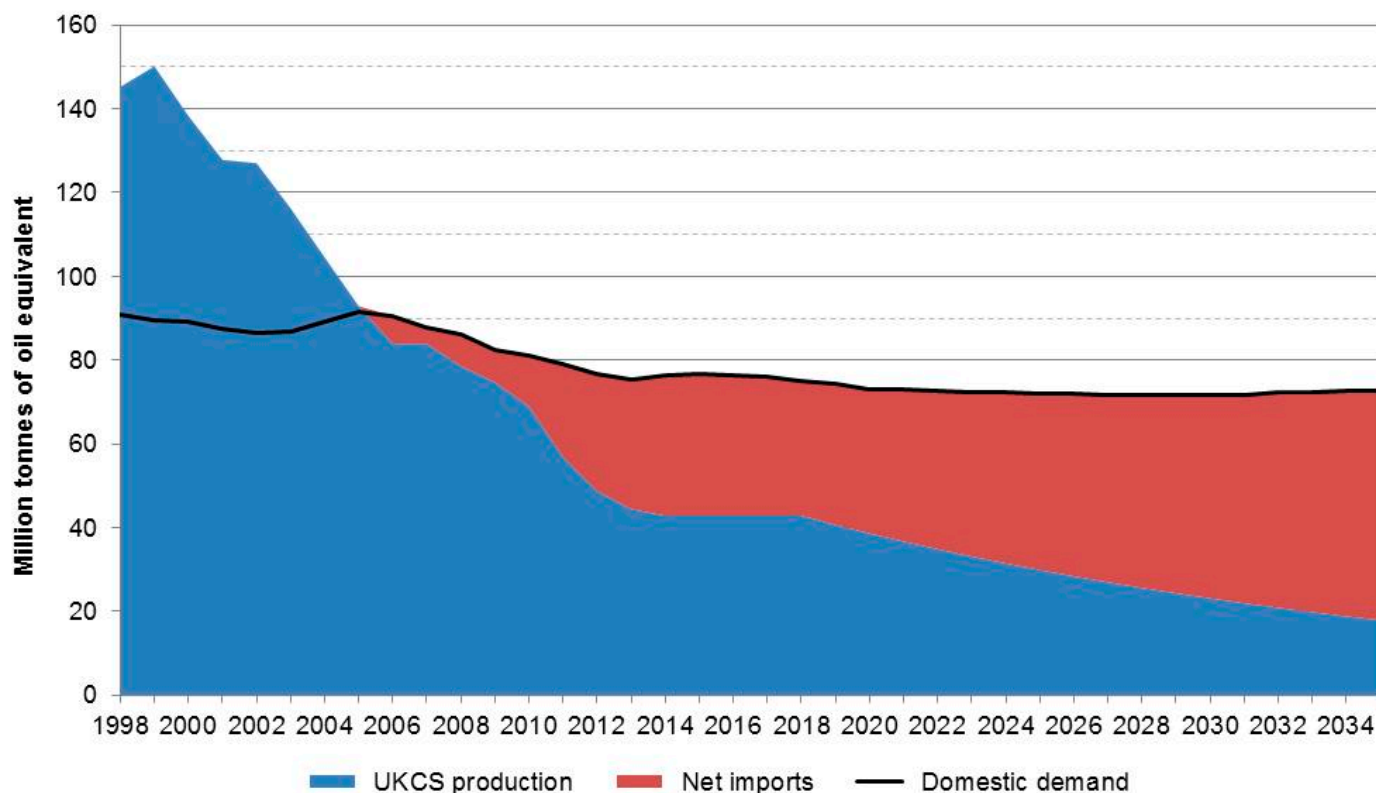
Oil

Indicator XI: Oil Capacity - UK Continental Shelf (UKCS) production, UK consumption and implied net imports of oil

B.27 DECC considers how much of UK demand could be met by UK production and how much will therefore need to be met by imports.

B.28 The chart shows DECC's latest published UK Oil Production and Demand Projections (February and September 2014, respectively). DECC's latest central projections indicate UK production (including Natural Gas Liquids) will be broadly flat at 43 million tonnes of oil equivalent (mtoe) out to 2019, similar to the 44 mtoe in 2013, but then continue to decline albeit at a slower rate than in recent years, though there is a wide margin of uncertainty with such projections. The actual rate of future decline will depend on the level of investment and the success of further exploration. The chart shows the declining production profile and how net imports will be increasingly important in meeting a broadly flat demand profile.

Chart B.10: UKCS production, UK consumption and implied imports



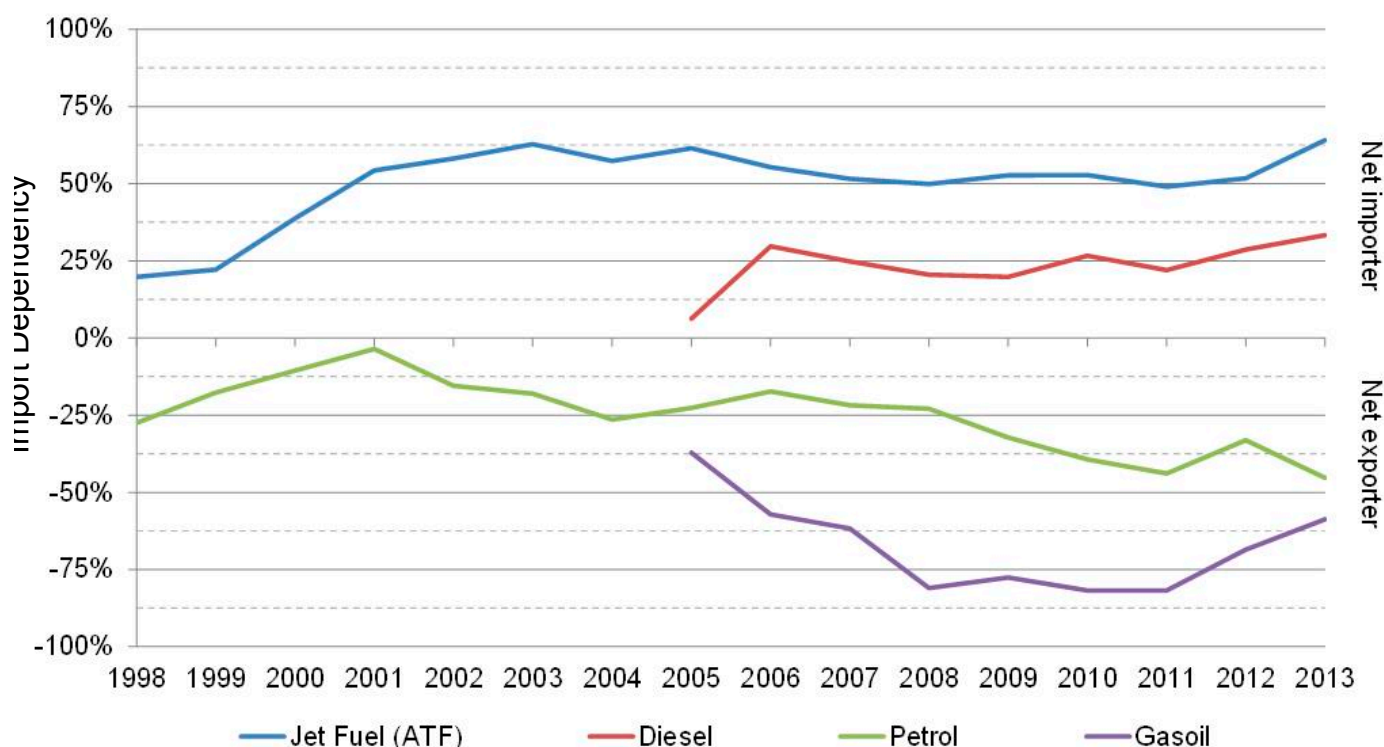
Source: DUKES 2014 and DECC Energy Trends 2014

Indicator XII: Oil Capacity - UK import dependency of key petroleum products

B.29 Similarly here, DECC looks at GB's import dependency for key petroleum products which gives us an indication of refinery capacity for the products the UK is using. Import dependency for jet fuel (also known as aviation turbine fuel), diesel, petrol and gasoil is displayed below. The UK is a net importer of jet fuel and diesel; import dependence for jet fuel has been declining slightly due to weak demand; import dependence for diesel has increased to 2006 levels, following an increase in demand.

B.30 Import dependency is calculated using net imports as a percentage of total UK demand. Future projections for import dependency have not been included.

Chart B.11: UK import dependency for oil products



Source: DUKES 2014

Indicator XIII: Oil Diversity - Diversity and stability of UK oil and oil product supply

B.31 The charts below provide an indication of the diversity of supply sources for crude oil and oil products.

B.32 The UK makes use of a diverse range of sources in order to meet its demand for oil – for example, Norwegian supply now meets a greater percentage of UK crude oil demand than UKCS production, whilst the UK still meets the majority of diesel demand using the UK's own production. Imports account for a greater percentage of jet fuel, consistent with Indicator XII.

B.33 UK exports are not included in these charts as they do not form part of the supply base. These indicators cannot be projected forward as the market determines sources of supply.

Chart B.12: Supply of crude oil in the UK

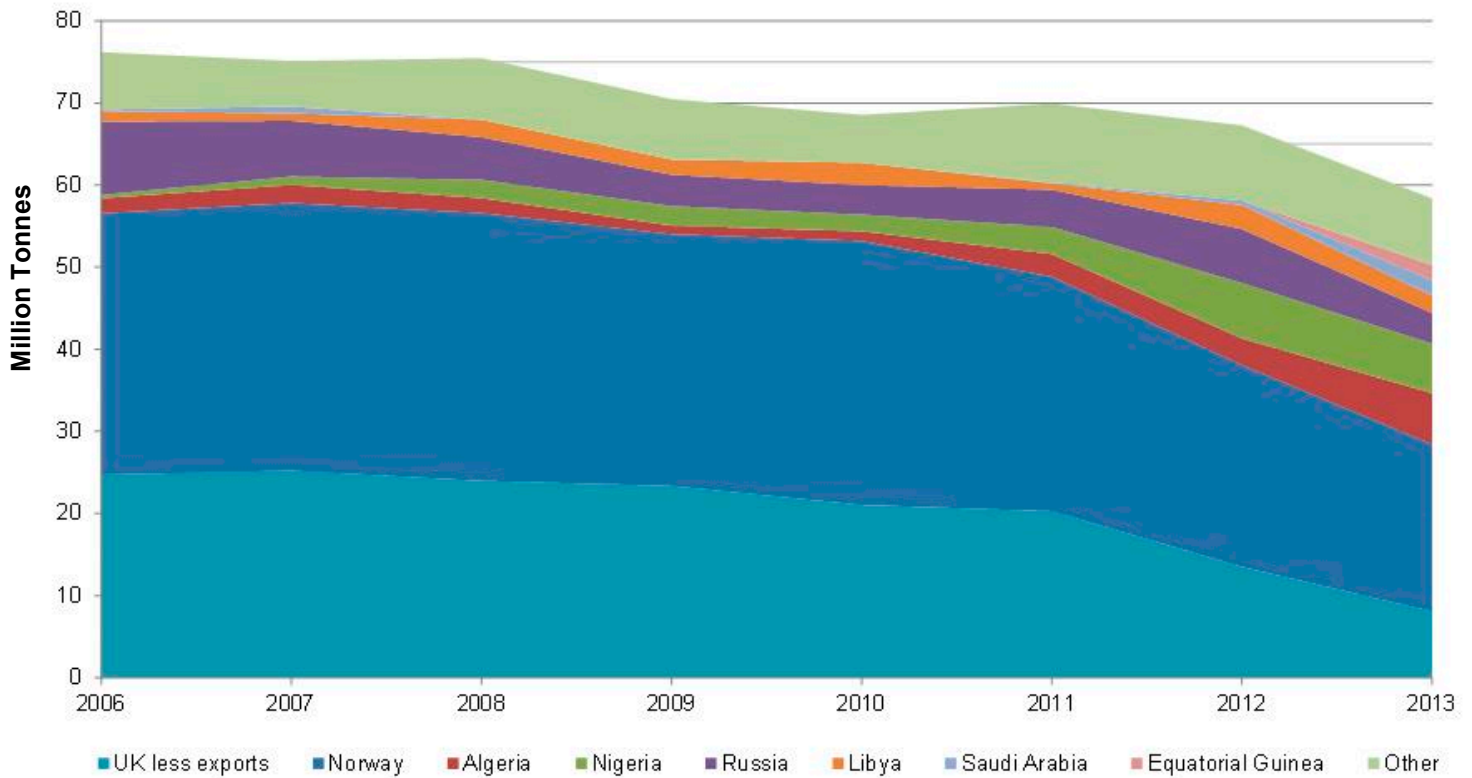


Chart B.13: Supply of diesel in the UK

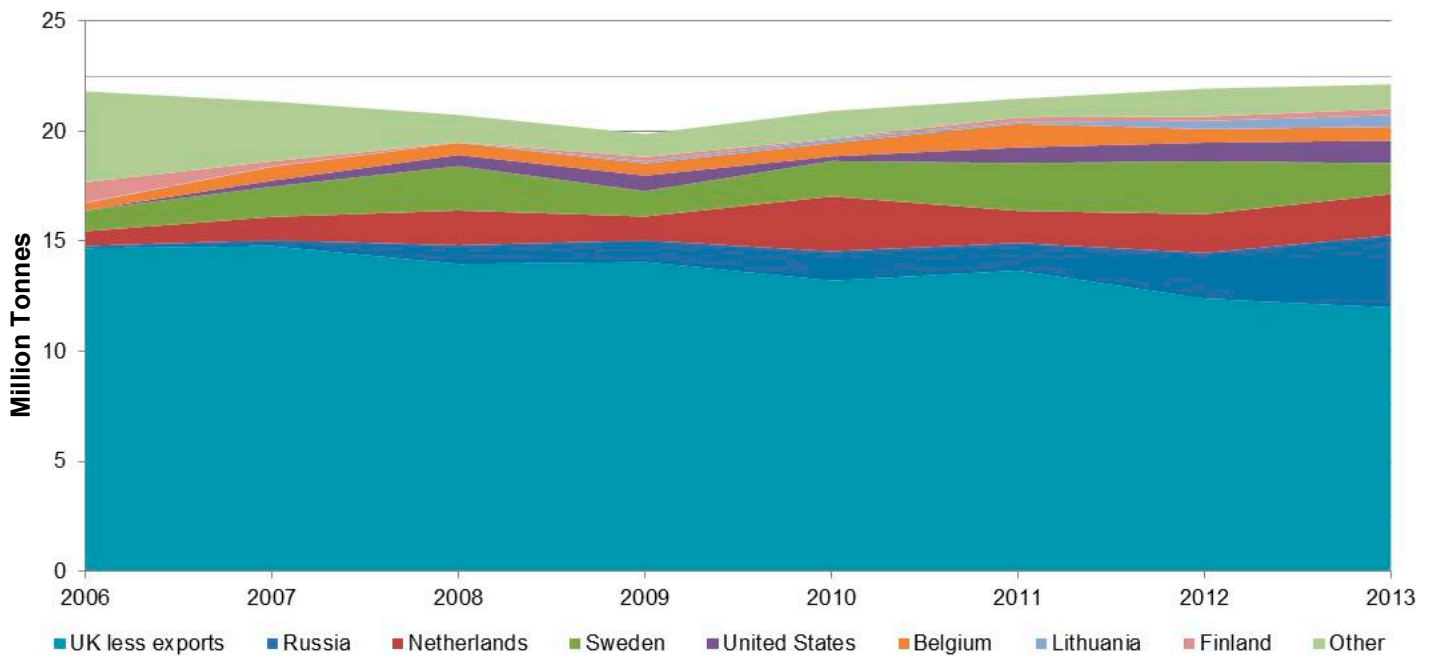
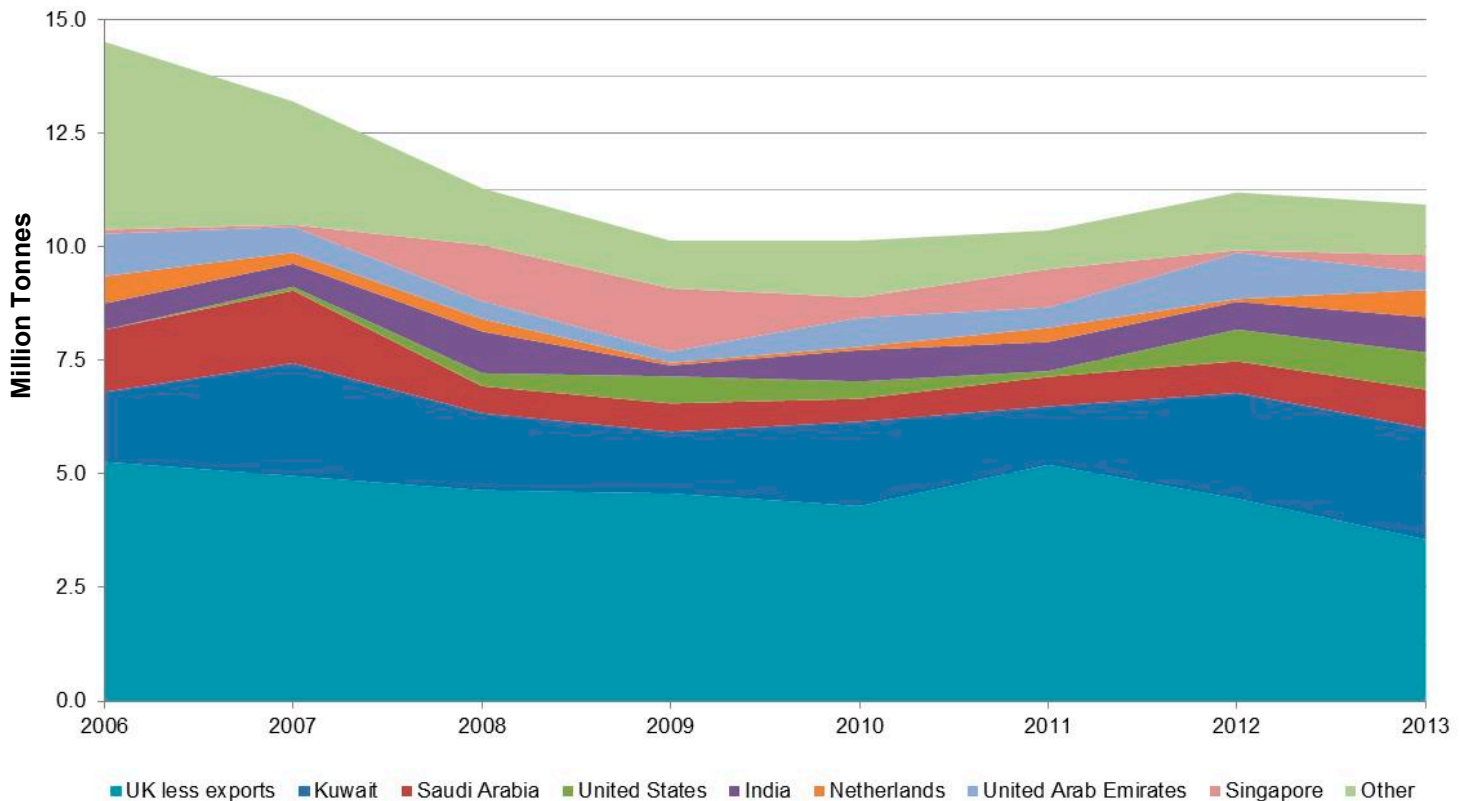


Chart B.14: Supply of jet fuel in the UK



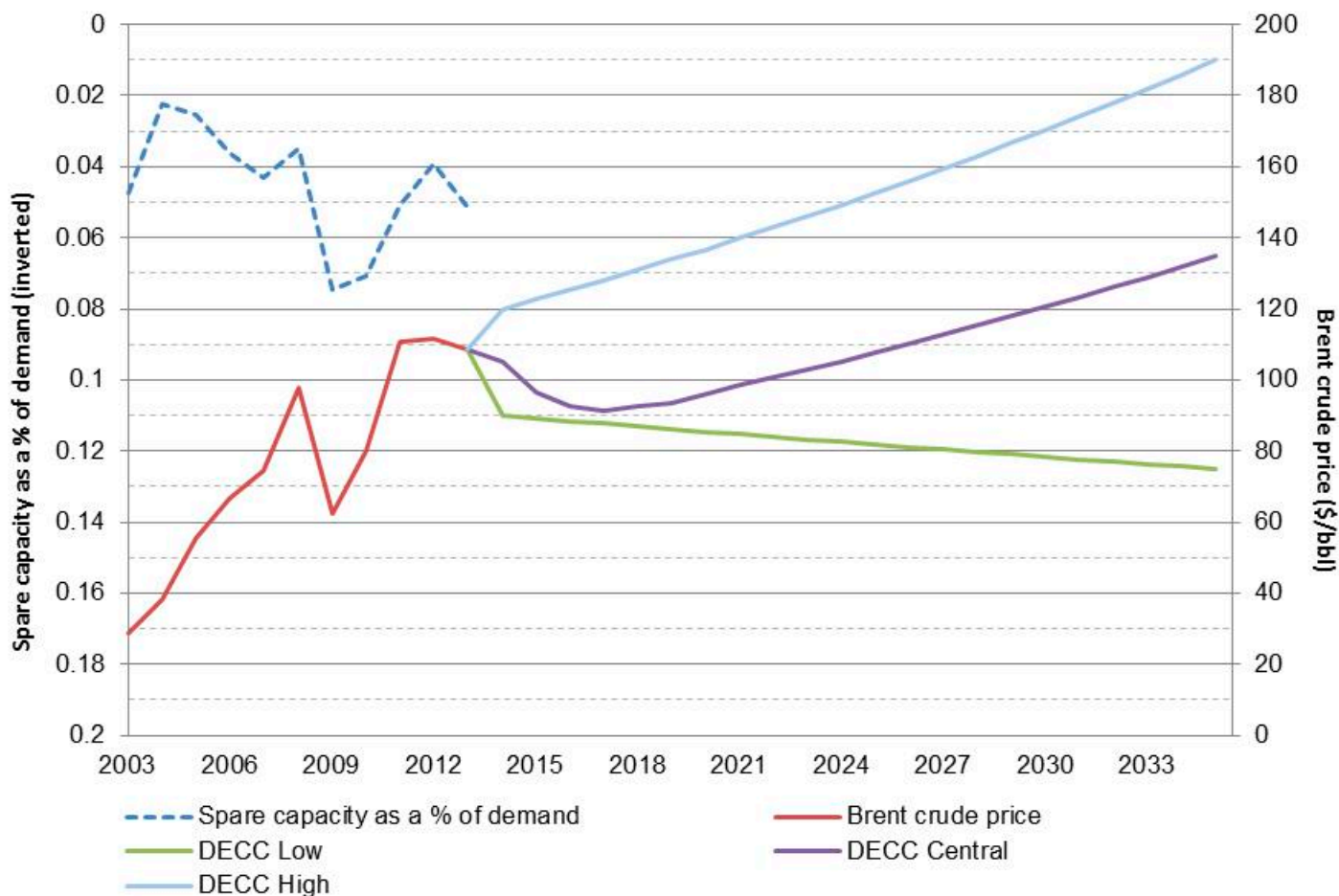
Source for above three charts: DUKES 2014

Indicator XIV: Oil Reliability - Spare capacity as a percentage of global demand, Brent oil price and DECC fossil fuel price projections, \$ per barrel (2013 prices)

- B.34 Spare capacity refers to the availability of additional supply of oil that is not currently being produced but that can be available to meet demand particularly in the event of a shock to global supply.
- B.35 Spare capacity is often referred to as OPEC spare capacity partly because as a cartel OPEC members can agree on specific production levels to ‘balance markets’ whilst non-OPEC countries are assumed to be producing at maximum levels.
- B.36 It therefore serves as an indicator of the world oil markets ability to respond to potential crises that inhibit global oil supplies, in what is deemed a ‘call on OPEC.’
- B.37 Oil prices are governed by supply and demand fundamentals. Any shocks to supply are expected to pose upward pressures on price. Spare capacity acts as a mechanism to curb price volatility by attempting to cover any losses to supply.
- B.38 Conversely, DECC expects in a well-functioning market for periods of high prices to stimulate investment and supply growth. Its effects on spare capacity however are ambiguous given the multiple variables that feed into its calculation.
- B.35 The chart below shows spare capacity as a percentage of demand. This is plotted alongside DECC’s fossil fuel price projections published earlier this month.¹¹¹

¹¹¹ Available from: www.gov.uk/government/uploads/system/uploads/attachment_data/file/360598/DECC_2014_fossil_fuel_price_projections.pdf

Chart B.15: Spare capacity as a percentage of global demand



Source: IEA, Bloomberg, DECC Fossil Fuel Price Projections

Indicator XV: Oil Demand Side Response

- B.39 UK oil consumption, as in other countries, is relatively insensitive to price changes. The UK has limited tools over demand reduction for oil, other than promotion of alternative fuel technologies and the destruction of consumer demand.
- B.40 In 2010, the Office for Budget Responsibility (OBR) found that the HMRC fuel duty forecasting model suggests a short-run demand elasticity of -0.14 with respect to pump prices and a longer-term demand elasticity of -0.22 i.e. a 1% rise in the pump price reduces demand by just over 0.2%. It is possible that over several years, there could be a larger effect from permanently higher oil prices given that this would incentivise drivers to choose and car producers to supply, more fuel-efficient cars

Glossary

AGR	Advanced Gas-cooled Reactor (a type of nuclear reactor)
Associated Gas Field	A well or field which contains both “wet” and “dry” hydrocarbons, as in both gas and oil
BBL	Balgzand-Bacton Line, a gas pipeline from the Netherlands to the UK
bcm	Billion Cubic Metres
CCGT	Combined Cycle Gas Turbine (a type of electricity generation)
CCGT-CHP	Combined Cycle Gas Turbine with Combined Heat and Power (as above but with waste heat from the generation process put to other uses, often district heating systems)
CfD	Contracts for Difference: mechanism to provide long term price support to low carbon plant
CM	Capacity Market: mechanism to provide payments to reliable sources of electricity generation capacity to ensure they are available when needed
DECC	Department of Energy and Climate Change
DNO	Distribution Network Owner, a company which owns the distribution infrastructure
Dry Gas Field	A well or field which contains only gas, as opposed to gas and oil
DSR	Demand Side response
DUKES	Digest of UK Energy Statistics, published by DECC
EBSCR	Electricity Balancing Significant Code Review
EU	European Union
EU ETS	EU Emissions Trading Scheme (sometimes system)
FES	National Grid’s Future Energy Scenarios publication, released annually by NG
GB	Great Britain
GDE	Gas Deficit Emergency
GG	“Gone Green”, the name of one of the NG FES scenarios
GWh	Giga Watt Hours, a unit of both electricity and gas
IED	Industrial Emissions Directive (2010/75/EU), an EU directive which replaces the LCPD and places more stringent limits on emissions from combustion plant

Interconnector	A bi-direction pipeline (in the case of gas) or power line (in the case of electricity) where the flow of the product can be switched from import to export and vice versa. The switching does not necessarily have to be “real” but can instead be “virtual”
IUK	Interconnector UK, a gas interconnection between Bacton in the UK and Zeebrugge in Belgium
LCPD	Large Combustion Plant Directive (2001/80/EC), an EU directive which imposes limits on the emissions of combustion plant over 50 MW in size
LNG	Liquefied Natural Gas
LOLE	Loss of load expectation
mcm	Million Cubic Metres
MTOE	Million Tonnes of Oil Equivalent
MW	Mega Watt
NG	National Grid
NGET	National Grid Electricity Transmission plc.
NGG	National Grid Gas
NTS	National Transmission System
Ofgem	Office of Gas and Electricity Markets
ONR	Office of Nuclear Regulation
PWR	Pressurised Water Reactor – a type of Nuclear Reactor
RIIO	“Revenue = Incentives + Innovation + Outputs”
SAP	System Average Price
SCR	Significant Code Review
SP	Slow Progression
STOR	Short Term Operating Reserve
tcm	Trillion Cubic Metres
TO	Transmission Owner, a company which owns the transmission infrastructure
TSO	Transmission System Operator (in GB the major TSO for both electricity and gas is NG)
TWh	Terra Watt Hours

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