Department for
Business, Energy
& Industrial Strategy

UK RISK ASSESSMENT ON SECURITY OF GAS SUPPLY

Report completed for EU Regulation 994/2010

September 2016

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1. Executive Summary

The UK has a very strong gas security of supply position brought about by extensive gas import capacity and storage infrastructure coupled with indigenous gas production. This is enhanced by a mature and liquid gas market that is expected to remain resilient to all but the most extreme combination of severe infrastructure failure or supply shocks. In addition to completing a National Risk Assessment, we have also considered a separate regional approach alongside the Government of Ireland, given that Ireland currently relies on Great Britain for more than 40% of its gas supply and Northern Ireland is 100% dependent.[1]

1.1 This document forms the Risk Assessment required by the EU Regulation on Gas Security of Supply (994/2010) ('the Regulation') and fulfils the requirement on the UK Government, under Article 9 of the regulation, to update the second Risk Assessment on Security of Gas Supply published in November 2014.[2]

1.2 The Regulation's overall aim is to enhance resilience to gas disruptions and exceptional climactic conditions. It sets supply and infrastructure standards to ensure that all necessary measures are being taken to ensure gas supply and infrastructure adequacy and promotes regional co-operation. All Member States have to conduct regular risk assessments and have in place preventive and emergency plans. The Regulation is based on the principle that measures (even in situations of tight supply), should be market based for as long as possible and stipulates that no Member State should take measures that impact negatively on another Member State's market.

1.3 The assessment of gas security is based on a number of common elements set out in the Regulation, including use of the N-1 calculation, which is the formula used to assess whether a Member State has sufficient capacity to meet its gas demand if it loses the use of its single largest piece of gas infrastructure for any reason, during a day of exceptionally high gas demand, occurring with a statistical probability of once in 20 years. In the UK this piece of infrastructure is the 100km Felindre pipeline

[1] The United Kingdom comprises Great Britain and Northern Ireland and, where appropriate, relevant information relating to Northern Ireland has also been included in this risk assessment.

[2] Regulation (EU) No 994/2010 of the European Parliament and of the Council of 20 October 2010 concerning measures to safeguard security of supply and repealing Council Directive 2004/67/EC.

connecting the two liquefied natural gas (LNG) terminals located at Milford Haven to the National Transmission System (NTS).

1.4 As required by the Regulation, the *Risk Assessment* also considers supply standards, a description of the market, stress tests, and interactions with other Member States. On the basis of the *Risk Assessment*, Member States prepare *Preventive Action Plans* and *Emergency Plans*. Updated plans will be published by December 2016.

1.5 The analysis in this report shows 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[3].

1.6 The Governments of the UK and Ireland have also undertaken a joint regional assessment of gas security, which is published separately. Where a Member State cannot meet the N-1 principle on its own, as is the case with Ireland, Article 6 of the Regulation allows the Competent Authorities to adopt a regional rather than national approach in meeting the requirements of the regulation.

1.7 The Republic of Ireland and Northern Ireland have an integrated gas system which, while independent from the GB system is significantly dependent on Great Britain for its gas supply. Northern Ireland is 100% dependent whilst Ireland is approximately 40% dependent. Prior to the Irish Corrib field coming on stream gas dependency was over 90%. Production from this field however, is expected to be short lived.

1.8 This document takes an initial view of risk from the point of view of the UK market alone. An over-arching Joint Regional Risk Assessment for the UK and Ireland has been submitted in parallel with this document and the corresponding National Risk Assessment submitted by Ireland. The document also sets out further work being done by the Government as we continue to monitor market functions and our Security of Supply position.

[3] The figures used to calculate the N-1figure in this document exclude exports to Ireland. Regional N-1 calculations that include Irish exports alongside UK demand are featured in the Regional Risk Assessment submitted to the EU Commission alongside this document. The UK N-1 calculation exceeds the target set by the regulations of more than 100% with a score of 127%.

2. Introduction

This Risk Assessment discharges the Government's duty, set down in EU regulation 994/2010, to assess the security of gas supply in a range of scenarios where supply is disrupted and demand is high. It complements other on-going work on security of gas supply.

Security of supply overview

2.1 The UK's gas supply infrastructure must be sufficient to:

- meet 'peak' demand, including sufficient capacity and deliverability to ensure the gas we have can be accessed with minimal delay;
- ensure the safe and efficient transportation of gas from domestic production, storage facilities, and import points to consumers across the country; and
- provide access to the most competitively priced gas supplies.

2.2 Diversity of gas suppliers, sources, and routes to market is a key feature of UK supply security. Due to the UK's interaction with the Continental European market, European-wide efforts to encourage supply diversity further improve our security. The principle of further supply diversity was, amongst other issues, reaffirmed at the meeting of G7 Energy Ministers 1-2 May 2016.

2.3 Security of supply in the UK is delivered through an effective gas market with investment in infrastructure driven by price signals. Through these price signals, the market has responded to declining domestic gas production with strong growth in gas import and storage capacities. We have import infrastructure with the capability to meet more than double our annual demand. Currently, around 30% of this infrastructure is utilised, offering much flexibility[4].

2.4 Market flexibility has been demonstrated in recent years with the market having proven its ability to meet sustained periods of late cold weather coupled with supply side pressures. Detailed case studies of extraordinary gas market conditions are outlined in section 4 of this document.

2.5 Price signals have proved to be an effective means of delivering security of supply. Shippers are obliged to balance what they put into and take out of the system. Shippers pay a penalty, called the 'cash-out price', for oversupply (being 'long') or undersupply (being 'short'). These charges are designed to recoup the costs to the

[4] Figures derived from BEIS' Digest of UK Energy Statistics (DUKES) 2016.

System Operator of entering the market and buying or selling gas to balance the grid on a daily basis.

2.6 However, the Government is not complacent. Whilst we believe the gas market is robust to a range of adverse events, we cannot rule out, either the risk of supply shortfalls in extreme circumstances, or the risk that there may need to be significant rises in wholesale gas prices to balance the market during times of system stress.

2.7 The Government considers that market incentives have a key role to play in ensuring, and enhancing security of supply. In the 2011 *Risk Assessment*, DECC(Now Department for Business, Energy and Industrial Strategy-BEIS) reported that it had given Ofgem a new power in the Energy Act 2011 to sharpen commercial incentives on gas market operators to ensure sufficient gas is available to reduce the likelihood, duration, and severity of a gas shortage. This led to the introduction of reform to cash-out arrangements and set out a process for the development of a Demand Side Response (DSR) mechanism. Further details on this may be found in paras. 3.8-3.11 and 3.31-3.33

Developments since the 2014 Risk Assessment

2.8 The UK reviews and manages its security in a number of ways including through the production of this document in line with the requirements of EU regulation 994/2010. However there is also on-going risk assessment and bespoke work, carried out by the Government, System Operator and Regulator. The following paragraph details documents relevant to gas security of supply which have been published since the 2014 *Risk Assessment*.

2.9 Assessments and reports

- Statutory Security of Supply Report 2014[5] and 2015[6]: an annual requirement of UK law which provides an assessment of the availability of secure, affordable electricity, gas and oil for meeting the needs of consumers.
- National Grid Winter Outlook[7]: provided annually with the security of supply outlook for the coming winter;
- National Grid Summer Outlook[8]: provided annually to gas market participants with the security of supply outlook for the coming summer;
- Gas 10 year statement [9]: an annual publication with a rolling ten-year forecast of gas supply and demand and the consequences for the operation of the National Transmission System;
- Future Energy Scenarios[10]: an annual view of credible energy scenarios from today out to 2050.

[5] https://www.gov.uk/government/publications/statutory-security-of-supply-report-2014
[6] https://www.gov.uk/government/publications/statutory-security-of-supply-report-2015
[7] http://www2.nationalgrid.com/UK/Industry-information/Future-of-Energy/FES/Winter-Outlook/
[8] http://www2.nationalgrid.com/UK/Industry-information/Future-of-Energy/FES/summer-outlook/
[9] http://www2.nationalgrid.com/UK/Industry-information/Future-of-Energy/Gas-Ten-Year-Statement/

- Northern Ireland transmission system operators also carry out an assessment of the transmission network through the *Northern Ireland Gas Capacity Statement*, the most recently published report looks at the period 2015/16-2024/25. This provides an assessment of the ability of the Northern Irish gas transmission network to deliver gas over a number of potential scenarios within the next ten years;[11]
- Northern Ireland's Premier Transmission Winter Outlook 2015/16, which assessed the supply and demand situation for that winter[12]. The Irish Authorities also conduct similar assessments and these are shared between both jurisdictions to support joint planning assumptions between Northern Ireland and Ireland.

2.10 Alongside general monitoring, the Government has taken some specific decisions on gas supply security. Details of these decisions and the analysis which underpinned them include:

2.11 Policy decision publications

- Redpoint Energy's The Impact of Gas Market Interventions on Energy Security in July 2013: commissioned by Government to review the costs and benefits of developing some of the gas market interventions identified in Ofgem's Gas Security of Supply Report;
- Pöyry's Gas Significant Code Review Cost Benefit Analysis for a Demand-Side Response Mechanism: a report published in January 2014, which was commissioned by Ofgem, and included analysis of potential interventions to enhance security of gas supply; and
- Ofgem's Gas Security of Supply Significant Code Review (Gas SCR): a process whereby the Regulator has considered changes to gas codes to reduce the likelihood, severity, and duration of a gas supply emergency. A final policy decision was announced in February 2014 and changes to cash-out arrangements came into effect on 1 October 2015.
- The Oil and Gas Authority (OGA) having been established as an executive agency of the Department of Energy and Climate Change (DECC) (Now the Department for Business Energy and Industrial Strategy, BEIS) on 1st April 2015, is on track to take on a new structure as a Government Company (on 1st October 2016), with new powers to enable maximising economic recovery of UK hydrocarbons (M.E.R) and is working towards issuing a number of strategy documents on decommissioning etc. The OGA's publication of the (M.E.R) UK Strategy came into force on 18th March 2016.

[10] http://fes.nationalgrid.com/fes-document/
[11] http://www.uregni.gov.uk/uploads/publications/2015-09-01_NI_Capacity_Statement_FINAL_v07.pdf
[12] http://www.premier-transmission.com/media/Winter%20outlook%202015-16.pdf

2.12 Overall, the above publications concluded consistently that the UK gas market is robust in all but the most extreme and unlikely combination of high demand and supply disruption and the flexibility of its varied supply sources means it is likely to remain resilient.

2.13 Government has also continued work on various strands of policy development which will have an impact on gas demand and supply and, therefore, gas security. This includes:

- the Electricity Market Reform (EMR) program, completed in the last parliament and set out in the Energy Act 2013, which contains measures to reform the GB electricity market including a Capacity Market to ensure sufficient capacity is available, including through reforms to demand-side response, and incentives for the deployment of low-carbon technologies.
- the current regulatory regime which requires new gas plants be constructed as "carbon capture ready" to enable them to be fitted with Carbon Capture and Storage (CCS) as necessary, as planning controls already ensure that new electricity generation facilities that emit greenhouse gases are prepared for CCS. Currently most new thermal plants larger than 300 MWe must be constructed 'carbon capture ready', which means they must demonstrate that it would be technically and economically feasible to retrofit CCS. Any new coal plants must be constructed with CCS fitted to at least 300 MW of their proposed generating capacity.
- initiatives to incentivise the uptake of energy efficiency measures by domestic and small business consumers such as the Energy Company Obligation and its successor, Supplier Obligation, under which £640m will be spent annually until 2022 on domestic energy efficiency measures.
- the continuation of the Renewable Heat Incentive, which supports the deployment of low-carbon heat generation technologies
- continued work on the Smart Meter program, which requires GB suppliers to install gas and electricity smart meters for all non-daily metered customers between 2015 and 2020.
- the Shale Gas Team (formerly The Office for Unconventional Gas and Oil (OUGO)), within BEIS, which was launched in March 2013 works closely with regulators and industry to encourage the development of the UK's shale industry whilst ensuring that robust regulations are in place to safeguard public safety and protect the environment.
- implementing the recommendations of the UKCS Maximising Recovery Review: Final Report (the Wood Review), through setting out a strategy to maximise economic recovery of petroleum from the UKCS, establishing the Oil and Gas Authority and passing the Energy Act 2016 to give it additional powers.

Consultation

2.14 This Risk Assessment was subject to an informal consultation period in early 2016 with the Regulator and System Operator. In addition, we discussed and shared this document in draft with the Regulator and Department of Communications, Climate Action and Environment (Ireland), the relevant governmental and regulatory agencies in Northern Ireland, and the Government of the Netherlands.

3. Gas Market Context

Current UK indigenous gas production and existing import infrastructure is more than sufficient to meet demand in all but the most extreme and unlikely combination of infrastructure failures and is likely to remain so in the near future. Looking further ahead, there are a wide range of possible supply patterns but the gas market provides sufficient gas from Europe and beyond to address the shortfall between the forecasts of the UK's indigenous supply and demand. [13]

3.1 The UK consistently has one of the largest and most liquid gas markets in Europe. In 2014, UK consumption was the second largest in Europe, just behind Germany[14]. High levels of liquidity at the UK's hub, the National Balancing Point (NBP), are evidenced by the level of trades there: alongside the Dutch the UK dominates gas trade in Europe, with both countries covering 88% of hub-traded volumes.[15]

3.2 Figure 3.1 below shows the sources of UK gas demand broken into major components in 2014 and 2015.

Figure 3.1 – Gas demand in the UK 2014 and 2015

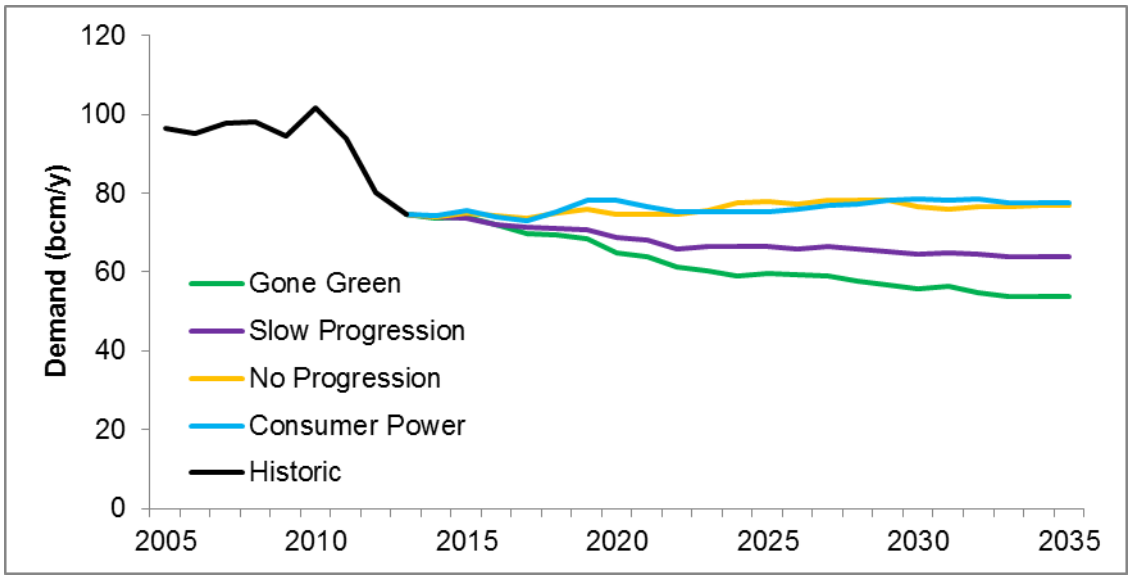
Source	2014 (bcm)	2015 (bcm)
Electricity generation	19.8	19.3
Domestic	25.3	26.6
Industry	8.5	8.6
Other	17.0	17.7
Total demand	**70.6**	**72.2**

Source: Digest of United Kingdom Energy Statistics 2016

[13] https://www.gov.uk/government/publications/statutory-security-of-supply-report-2015
[14] Eurostat, *Energy statistics – supply, transformation, consumption – gas – annual data*.
[15] *European Commission, Quarterly Report on European Gas Markets, Volume 8, issue 4.*

3.3 Figure 3.2 shows the future gas demand scenarios produced by National Grid out to 2035.[16] Both Gone Green and Slow Progression see demand fall from today's level due to increasing renewables in the power sector and the electrification of heating demand. Consumer Power and No Progression see demands remain relatively stable as gas retains a greater role in the power sector and economic growth and increases in energy efficiency largely offset each other.

Figure 3.2 – Historic and projected annual UK gas demand



Source: National Grid

3.4 Figure 3.3 below shows the highest daily demand recorded in the UK in 2013/14 and 2014/15. This is greatly influenced by annual weather conditions.

Figure 3.3 – Highest Recorded Daily Gas Demand in the UK 2013-2015

	2013/14 (mcm)	2014/15 (mcm)
Peak Winter Day Demand	327	366

Source: Statutory Security of Supply Report 2014 & 2015[17][18]

[16] National Grid, Future Energy Scenarios (2015). National Grid's Future Energy Scenarios document outlines a range of credible pathways for the future of energy out to 2050. The scenarios outline the possible sources of and demands for, gas and electricity in the future and the implications of this for the energy industry. Four scenarios are sighted:

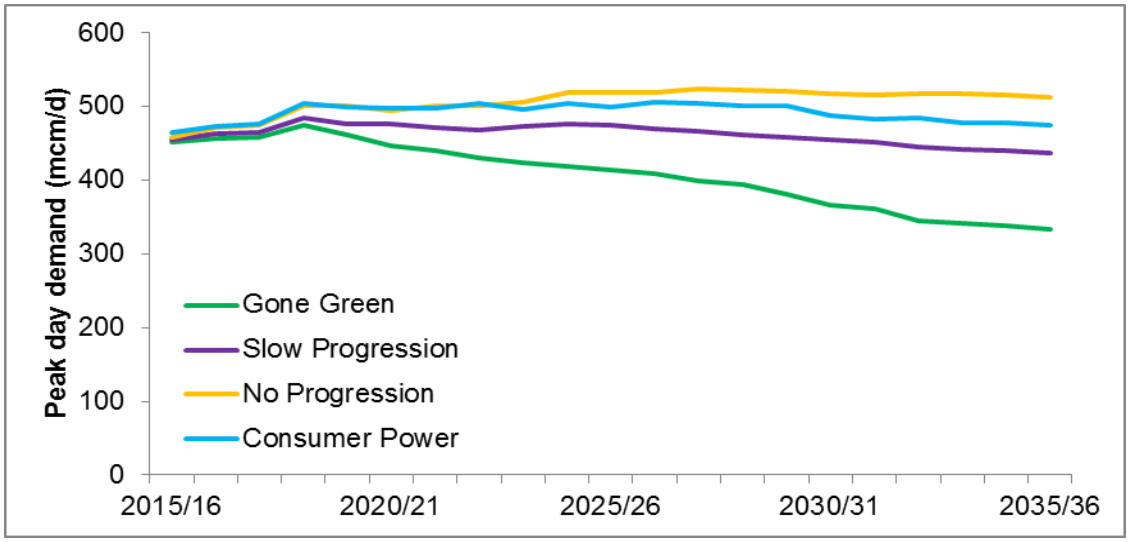
- Consumer Power - A wealthy, market –driven world.
- Gone Green - A wealthy world where environmental sustainability is top priority.
- No Progression - A world focussed on low cost solutions.
- Slow Progression – A world focussed on long term industrial strategy.

[17] https://www.gov.uk/government/publications/statutory-security-of-supply-report-2014
[18] https://www.gov.uk/government/publications/statutory-security-of-supply-report-2015

3.5 The ability to meet high levels of demand on a particular day, or a more prolonged period such as a severe winter, is particularly relevant in the context of security of supply. Gas market participants build redundancy into their supply arrangements, above the minimum amount to meet these levels, to manage the risk that other capacity may not be available.

3.6 Peak diversified day gas demand is projected in Figure 3.4 for all scenarios, with 2015/16 peak diversified demand estimated at around 465mcm/d. The trends are broadly similar to the annual demand. Gone Green sees declines in peak demand, with the impact of the electrification of heating demand leading to peak demands of 330mcm/d by 2035 in the Gone Green scenario. No Progression has the highest peak by 2035, rising to over 510 mcm/d, this is due to strong demand for gas in the power sector as well as domestic heating.

Figure 3.4 – Projected peak diversified demand to 2035



Source: National Grid

3.7 The price of gas reduced throughout winter 2015/16 and gas became the more favourable fuel for electricity generation. There is however, uncertainty as to the future of gas demand for generation. The Government's aim to end coal-fired power generation by 2025 and the increasing use of intermittent generation technologies such as solar and wind may increase demand for gas as a back-up fuel. Gas demand could be mitigated by shippers and the electricity System Operator making use of the range of balancing tools available.

Demand Side Response (DSR)

3.8 DSR is a mechanism used in times of market tightness to balance supply and demand by voluntary shedding of demand. The power generation sector provides an opportunity for switching demand away from gas to coal or oil generation, reducing

overall gas demand. However, in recent years, coal and oil generation capacity has progressively closed through the Large Combustion Plant Directive (LCPD) and the Industrial Emissions Directive (IED), limiting the potential use of fuel switching to manage demand.

3.9 Price signals in the UK gas market allow larger non-domestic consumers to respond by either changing their demand profile or reducing demand altogether. Larger industrial consumers may also have the ability to switch to alternative fuels during times of high gas prices. A conservative estimate by Ofgem was that around 1.2% (0.4mcm/d) of industrial and commercial daily metered gas volumes are currently on interruptible contracts[19].

3.10 The conclusions of Ofgem's Gas SCR[20] placed an obligation on National Grid to develop a centralised demand side response mechanism to encourage greater demand-side participation from industrial and commercial users. National Grid's proposed DSR methodology has been approved by Ofgem and will be in place for winter 2016/17. This new DSR mechanism will allow end gas users to signal their willingness to make additional DSR energy quantities available following a Gas Deficit Warning. It is expected that, in some cases, this may provide sufficient additional system balancing volumes to avoid the system entering later stages of an emergency. Modelling undertaken as part of the Gas SCR estimated that the volume of industrial and commercial DSR could increase from a negligible level currently to up to 26mcm/d[21].

3.11 Currently, non-daily metered consumers (domestic consumers and small businesses) are not so exposed to fluctuations in wholesale prices and therefore have no short-term signal to reduce gas demand. Following the roll-out of smart meters across the UK, to be completed by 2020, it is expected that the provision of 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 1bcm in 2020, remaining roughly constant out to 2030[22].

Supply

3.12 The UK has a wide range of gas supplies and sources. This includes significant levels of domestic gas production, access via pipelines to Norwegian gas production, interconnection with the Continent through the IUK and BBL pipelines and some of the largest and most modern LNG infrastructure in Europe. In response to decreasing

[19] Ofgem, Gas Significant Code Review Impact Assessment for Final Policy Decision, p.16.
[20] https://www.ofgem.gov.uk/publications-and-updates/gas-security-supply-significant-code-review-conclusions
[21] Ofgem, Gas Significant Code Review Impact Assessment for Final Policy Decision, p.16.
[22] DECC, Impact Assessment: Smart meter roll-out for the domestic and small and medium non-domestic sectors (GB). (IA No: DECC0009).

indigenous supply, import infrastructure has increased with capacity to meet 227% of annual demand in 2015[23]. Figure 3.5 outlines sources of UK gas in 2013 to 2015.

Figure 3.5 – Annual sources of UK gas 2013 – 2015

Source	2013(bcm)	2014(bcm)	2015(bcm)
Total pipelines:	**38.4**	**31.0**0.4	**30.7**
Belgium	3.2	6.4	0.2
Netherlands	7.4	24.3	3.3
Norway	27.8		27.2
Total LNG:	**9.3**	**11.3**	**13.9**
Algeria	0.4	0.5	0.5
Egypt	0.07	-	-
Nigeria	-	0.05	0.04
Norway	0.1	-	0.05
Qatar	8.7	10.3	12.8
Trinidad & Tobago	0.1	0.4	0.5
USA	-	-	-
Yemen	-	-	-
Total imports	**47.8**	**42.3**	**44.5**
UK production	**38.7**	**40.0**	**41.9**
Total exports	9.1	10.6	14.4
Total supply	77.4	70.5	72.3

Source: Digest of United Kingdom Energy Statistics 2016

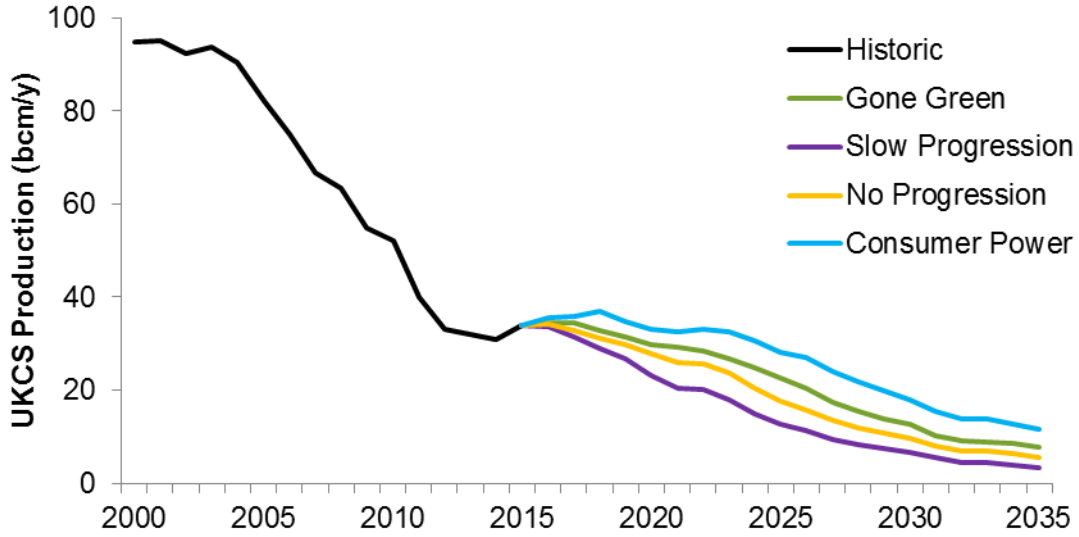
[23] Internal BEIS calculations based on figures from Digest of United Kingdom Energy Statistics 2016.

UK Continental Shelf (UKCS) Production

3.13 Domestic North Sea production is still the UK's single largest source of gas. Indigenous production was sufficient to meet nearly 60% of the UK's demand in 2015.[24] North Sea production however, is set to decline significantly out to 2035 and beyond whilst import dependency will rise even if there are decreases in demand.

3.14 Figure 3.6 shows National Grid's projections for future UK Continental Shelf (UKCS) production under Consumer Power, Gone Green, Slow Progression and No Progression scenarios. Following many years of decline, production in 2013 and 2014 was slightly higher, a trend which continues for a few years in the two more affluent scenarios, Consumer Power and Gone Green, before it declines again. In Slow Progression and No Progression, supplies do not rise above the 2015 level and decline from 2017 onwards. Differences between the four scenarios are inevitably quite small in the first few years as our projections are based on fields that are already in, or close to, production. In later years the UKCS sees greater expansion in Consumer Power and Gone Green. The growing economy and a high level of technical innovation support development of fields that are too difficult or too expensive for the poorer economic conditions of Slow Progression and No Progression.

Figure 3.6 – Historic and projected UKCS production



Source: National Grid Future Energy Scenarios 2015

3.15 The Wood Review of February 2014 considered ways to maximise North Sea Production. As its recommendations are implemented we expect to see greater volumes of production from the UKCS. These are expected over the next 20 years to be in the region of 3-4 billion boe.

[24] Digest of United Kingdom Energy Statistics 2016, Chapter 4, Natural Gas, pp 97.

Unconventional Gas Production

3.16 National Grid also forecast a likely increase in on-shore gas production coming from possible new developments in biogas and shale gas. As a proportion of UK demand, the contribution of onshore gas sources in the Gone Green scenario increases from near zero today to c.1% in 2020 and c.8% in 2035. For the Slow Progression scenario, this increases from near zero today to c.1% in 2020 and c.3% in 2035. For both the Gone Green and Slow Progression scenario, the onshore gas contribution consists entirely of biogas supplies. In the National Grid's Consumer Power scenario, with moderate economic growth, a focus on indigenous security of supply, high innovation and more relaxed renewables ambitions, the contribution of onshore gas sources increases from near zero today to c.2% in 2020 and c.46% in 2035, with the large majority consisting of shale gas supplies. Under these projections for Consumer Power, shale gas production would reach 32bcm/year in 2035, which would require the development of 100 sites each with 10 vertical and 40 lateral wells. There is, however, significant uncertainty as to the timescales and the volumes that may be generated from any on-shore production.[25]

3.17 BEIS is responsible for encouraging and overseeing the development of shale gas resources in the UK, including ensuring we make the best use of our available natural resources. The Government has undertaken a range of measures to progress shale development and ensure its safety, including:

- ensuring a robust regulatory regime is in place from all the key regulators (Environment Agency, Health and Safety Executive and Oil and Gas Authority).
- the Infrastructure Act 2015, which enables operators to drill horizontally without gaining permission from all the landowners on the surface. It also introduces a range of safeguards on fracking, including setting out protected areas where it cannot take place.
- a joint Ministerial statement with Department for Communities and Local Government(DCLG) on the planning regime for shale; a strong statement of need case and expectation that councils will make decisions within 16 weeks.
- HM Treasury (HMT) is currently consulting on a Shale Wealth Fund to benefit communities near shale sites.
- industry has announced a community benefits package of £100k per site during the exploration phase, and at least 1% of revenues during production.

[25] National Grid Future Energy Scenarios 2015 (http://fes.nationalgrid.com/fes-document/)

Import Infrastructure

3.18 Currently, the UK has an import deliverability of ~54 bcm/y from Norway, ~46 bcm/y from capacity connected to the Continent, and ~53 bcm/y from LNG import terminals.[26] Figure 3.7 below, shows the range of facilities that currently make up the UK's import infrastructure.

Figure 3.7 – Existing GB import infrastructure (May 2015 figures)

Project	Operator/ Developer	Type	Between/Location	Maximum flow rate (Million m^3/day)
IUK	Interconnector (UK) Ltd	Pipeline	Zeebrugge (Belgium) and Bacton	74[27]
BBL Pipeline	BBL Company	Pipeline	Balgzand (Netherlands) and Bacton	53
Isle of Grain	National Grid	LNG	Kent	56
Teesside GasPort	Excelerate Energy	LNG	Teesside	11
South Hook	Qatar Petroleum & Exxon Mobil	LNG	Milford Haven	58
Dragon	BG Group & Petronas	LNG	Milford Haven	21
Langeled	Gassco	Pipeline	Nyhamna (Norway) and Easington	72
Vesterled	Gassco	Pipeline	Heimdal Riser Platform (Norway) to St Fergus	39
Tampen	Gassco	Pipeline	Links Statfjord to FLAGS(from Norway)(terminating at St Fergus)	27

[26] https://www.gov.uk/government/publications/statutory-security-of-supply-report-2015.
[27] Maximum flow rate(export) on IUK - 55mcm/d, DUKES 2016.

Gjøa	Gassco	Pipeline	Links Gjøa/Vega to FLAGS(from Norway) and St Fergus (terminating at St Fergus)	17
			Total	**428**

Source: Digest of United Kingdom Energy Statistics 2016

Norwegian Continental Shelf Production

3.19 Norway is a crucial gas supplier to the UK, supplying around (37.8%) of total gas demand in 2015 as our biggest single source of imported natural gas (61.1% of imports in 2015). Norwegian gas is supplied to the UK via the Langeled pipeline to Easington; Vesterled pipeline to St Fergus and the FLAGS pipeline system which includes Tampen + Gjøa to St Fergus). Norwegian infrastructure flows at near full capacity in the winter.

3.20 Total Norwegian gas exports for 2015 were 114 bcm. Of this, 108 bcm came via pipeline to Europe, with 28 bcm to the UK. In recent data published by the Norwegian Ministry of Petroleum & Energy (MPE), around one third of Norway's estimated gas resources have been produced so far and production is expected to remain stable for the next 20 years. Forecasts by MPE suggest another third of resources could be produced during this period with a further third beyond 2035.[28]Longer term projections are based on resources yet to be found, but which Norway expects to be significant e.g. in the Barents Sea.

Interconnectors

3.21 The UK currently has four interconnectors with other Member States:

- Interconnector UK (IUK), which flows gas in both directions between Bacton and Zeebrugge in Belgium;
- The BBL pipeline, which flows gas in one direction from Balgzand in the Netherlands to Bacton;
- The Moffat interconnectors (IC1 and IC2), which to flow gas in one direction from Moffat in Scotland to Ireland; and
- The South North Pipeline (SNP) which can flow gas, in one direction, from Gormanston in Ireland to Northern Ireland if required. Primarily these flows have been for operational purposes/maintenance by the Transmission System Operator (TSO). Northern Ireland currently receives all of its gas via the Scotland to Northern Ireland Pipeline (SNIP).

[28] Norwegian Ministry of Petroleum & Energy: http://www.norskpetroleum.no/en/production-and-exports/exports-of-oil-and-gas/

3.22 During winter 2015/16, gas interconnectors with Belgium and the Netherlands helped to meet the UK's gas demand, supplying 6% of the UK's gas supply over the winter period[29]. They have the capacity to deliver much more and are increasingly taking a role in flexing supply by responding to price signals.

3.23 One of the UK's interconnectors, IUK, has bi-directional flow enabled. The remaining three were exempted from the mandatory bi-directional flow requirement. These exemptions were renewed on September 30th 2016. Sections 5.14 – 5.19 of this document consider the current situation with regards to bi-directional flow and sets out the assessment and decision to allow continued exemption.

Liquefied Natural Gas (LNG)

3.24 The UK is connected to global gas markets through four LNG import terminals. The UK currently has the infrastructure capacity to import around 53 bcm/y of LNG through: Milford Haven (South Hook (21bcm/y) & Dragon (8bcm/y)), Teesside Gasport (4bcm/y) and Isle of Grain (20bcm/y)[30]. This means that the UK has the second largest LNG infrastructure in Europe, behind Spain,[31] receiving around a quarter of EU LNG imports.

3.25 These terminals connect the UK to any LNG producing country, although historically the majority of UK LNG has come from Qatar (around 28.9% of total UK gas imports in 2015), the world's largest LNG producer.

3.26 Imports of LNG to the UK have increased over the last few years as global supplies have increased and demand growth slowed. Supply is expected to continue to grow in the coming years as new export projects come on line, notably from the US and Australia.

Gas Storage

3.27 The UK has traditionally had very good gas supplies. Until recently the North Sea has provided a steady and reliable source of gas to the UK. As the proportion of gas from the UKCS has declined, the market has provided strong, diverse import infrastructure. This has meant that storage has generally played the role of smoothing out price volatility (particularly inter-seasonally). As the fundamentals of the gas market changes, particularly with the expansion of LNG, the role of storage within the GB market will need to be examined further.

3.28 In July 2013, the UK Government announced that it would not intervene to incentivise further gas storage, based on a cost-benefit analysis study by independent consultants.[32] The analysis highlighted that the costs of intervening largely outweigh the possible costs of low storage levels in the event of a gas deficit. The report also

[29] National Grid, *Winter Review 2016*
[30] *Digest of United Kingdom Energy Statistics 2016.*
[31] International Energy Agency, *Natural Gas Information 2016*.
[32] Redpoint Energy, *The Impact of Gas Market Interventions on Energy Security.*

highlighted the risk of unintended consequences of intervention, principally dis-incentivising construction of certain types of gas storage.

Proposed New UK import Infrastructure

3.29 Figure 3.9 outlines the list of proposed import infrastructure projects of which Government is currently aware. It should be noted that there is no guarantee that proposed projects will go on to be operational.

Figure 3.9 – Proposed UK import infrastructure

Project	Operator /Developer	Type	Location	Start up	Capacity (bcm/y)	Status
Isle of Grain 4	National Grid	LNG	Kent	-	-	Open Season
Dragon Extension	BG Group & Petronas	LNG	Wales	-	Unknown	On hold
Norsea LNG	ConocoPhillips	LNG	Teesside	-	Unknown	Planning granted, no FID. Currently on hold.
Port Meridian	Port Meridian Energy	LNG	Wales	2016+	5	Open Season
Amlwch	Halite Energy	LNG	Wales	-	~30	Approved Onshore
				Total	**~35**	

Market Actors

3.30 The main participants in the GB energy market can be broken down as follows:

- The **Department for Business, Energy and Industrial Strategy (BEIS)**: the 'Competent Authority' as defined in the Regulation. BEIS leads energy and climate change policy for the GB market, including international engagement with key energy suppliers.
- The **Department for the Economy (DfE):** the relevant government department in the devolved administration of Northern Ireland.
- The **Utility Regulator Northern Ireland (UREGNI):** the independent utility regulator in the devolved administration of Northern Ireland.

- The **Office of Gas and Electricity Markets (Ofgem):** the independent 'Regulator' responsible for protecting the interests of present and future energy consumers, including security of supply, supervising market function, and competition.
- **National Grid**: the 'System Operator', that owns and operates the National Transmission System with the right to buy, sell, and store gas to keep the system in balance. National Grid also owns and operates four of the eight local distribution networks and one of the three LNG import terminals. National Grid is the natural gas undertaking required to meet supply under the conditions outlined in Article 8 of the Regulation.
- **Gas shippers**: licensed shippers buy gas from producers and importers, arrange for its transportation through the National Transmission System, and sell gas to suppliers. There are currently over 200 licensed gas shippers.
- **Distribution network operators**: gas which leaves the National Transmission System is distributed to end customers through eight regional, regulated monopolies owned and managed by four separate companies.
- **Suppliers**: There is an increasing number of licensed suppliers who buy gas from shippers and compete to supply both domestic and business consumers. Over 90% of the domestic market is dominated by the six larger suppliers,[33] although the number and market share of small suppliers is on the increase.[34] In the larger daily metered and non-daily metered market, the position of the six larger suppliers is less dominant.

[33] Centrica, EDF, Scottish Power, SSE, E.ON, npower.
[34] Ofgem, *State of the Market Assessment*, pp.7-9.

Figure 3.10 – UK NTS

Figure 3.11 – Gas distribution

Ofgem's Gas Significant Code Review (SCR)

3.31 Ofgem began a gas security of supply Significant Code Review (SCR) in 2011 in response to concerns with gas emergency arrangements. The Gas SCR process included extensive stakeholder engagement on how current market arrangements could be improved to further enhance security of supply. The conclusions of the Gas SCR introduced reform to cash-out arrangements and set out a process for the development of a Demand Side Response (DSR) mechanism.

3.32 Previously, cash-out prices were frozen during a Gas Deficit Emergency (GDE), a period where there is a risk of insufficient gas supply to maintain safe operating pressures in the gas network. Frozen cash-out prices meant the incentive to bring gas to the GB market could be weakened at precisely the time when it should be sharpest. The conclusions of the Gas SCR included unfreezing cash out prices so that they can reflect market conditions during an emergency, with no cap on prices. These changes to cash-out arrangements came into effect on 1 October 2015.

3.33 The Gas SCR also included proposals for a demand-side response mechanism to encourage greater demand-side participation from industrial and commercial users, to be administered by the System Operator, to help avoid an emergency. These are set out in section 3, Demand Side Response.

Conclusion

3.34 The UK has more than adequate indigenous production with a broad and diverse import infrastructure that can deliver more than adequate supplies of gas to meet demand. The UK is predicted to have changing supply and demand profiles the exact balance of which will be dictated by global market conditions and the extent to which the UK decarbonises its economy. However, between now and the next Risk Assessment in 2018, we do not expect significant changes to demand, supply and existing import infrastructure and can conclude that our security of supply position will remain strong.

4. Risk Assessment – risk identification and analysis

Risk analysis suggests that UK infrastructure can meet protected gas demand across a range of scenarios, up to and including a combination of exceptional demand caused by severe weather with the failure of a large proportion of import infrastructure.

4.1 This section identifies and assesses risks relevant to the gas supply infrastructure, as required by the Regulation. The impact of a supply shock equivalent to the loss of the largest single piece of gas supply infrastructure (the 100km Felindre pipeline connecting the two liquefied natural gas (LNG)) terminals located at Milford Haven to the National Transmission System (NTS) is analysed over the course of a day, week, month and entire winter, for severe demand conditions.

4.2 The Regulation requires us to test UK resilience to disruption using the 'single largest gas infrastructure'. This connects the two LNG facilities at Milford Haven, South Hook and Dragon, to the National Transmission System, and is therefore theoretically responsible for conveying up to 28.8bcm/year of gas.

4.3 Note that this is a more stringent test of UK infrastructure than the Regulation requires, which is 1-in-20 demand conditions; 1-in-50 conditions have been used in order to maintain consistency with National Grid's Safety Monitor calculations. These calculations ascertain the level of gas that is required to remain in storage to enable safe operation of the network.

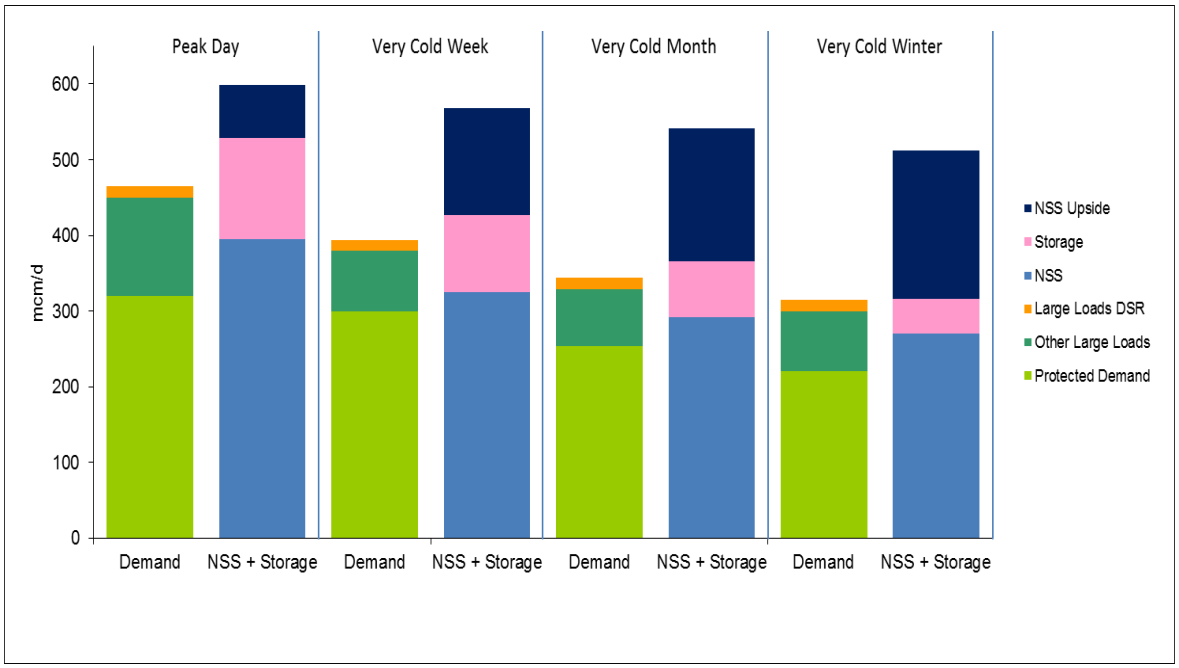
Demand modelling – severe conditions with no supply disruption

4.4 Figure 4.1 shows a similar analysis for severe 1-in-50 demand conditions with no supply disruption:

- Peak Day,[35]
- Very Cold Week
- Very Cold Month
- Very Cold Winter

[35] Peak day conditions are based on 1-in-20 demand conditions. A peak day does not always occur in a severe year. The coldest day in the last 80 years, 13 January 1987, was in a 1-in-3 winter.

Figure 4.1 - Demand analysis under severe winter conditions with no supply disruption



Source: National Grid

4.5 The chart shows the level of demand and supply for each period. The demand (light green, dark green, and orange) is broken down into three components:

- 'Protected demand': all customers protected by National Grid's Safety Monitor;[36]
- 'Other large loads': Large loads that are not expected to respond to a short-term increase in gas price;
- 'Large loads DSR': Large loads that are expected to respond to a short-term increase in the gas price and therefore provide a demand side response.

4.6 The DSR is assessed at 15 mcm/d based on previous levels. A more detailed assessment on the potential of DSR can be found in sections 3.8 – 3.11.

4.7 The supply (blue, pink and dark blue) is also broken into three components:

[36] 'Protected demand' includes all loads up to 5860MWh non-daily metered (including residential and small business consumers), non-daily metered demand in Ireland, and priority load. Priority load is split into three categories: Category A includes any customer where disruption could lead to loss of life (e.g. hospitals, care homes); Category B includes those that would have been in Category A except that they have signed interruptible contracts (because they have access to alternative generation) and can continue to use gas during the time it takes for them to switch to the alternative; and Category C, customers where interruption would lead to damage in excess of £50 million. This covers non-daily metered demand in both Eire and Northern Ireland.

- NSS (non-storage supply): supply from UK production, Norwegian imports, European imports and imports of LNG. This represents the expected level for the given conditions.
- Storage: gas from the UK storage facilities. This is the maximum available for the period modelled, this level declines for the longer durations.

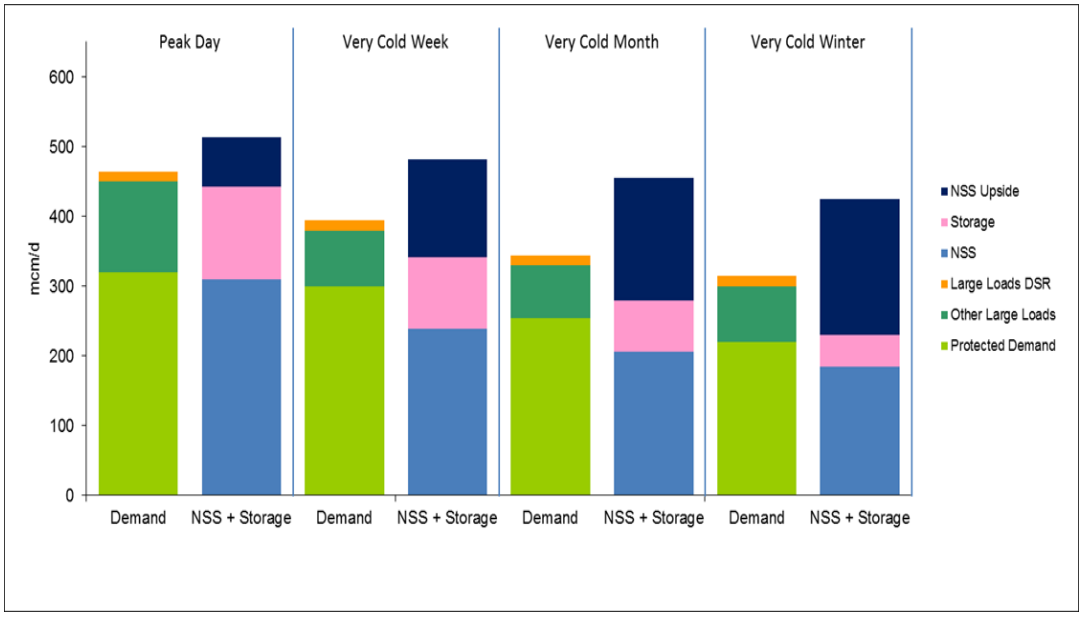
NSS Upside: The maximum available from NSS. This is primarily the additional imports which could be available if the pipelines and LNG terminals deliver at their maximum level

4.8 For all durations the modelled supply and storage is sufficient to meet demand without the need to utilise DSR or NSS upside.

Demand modelling – severe conditions with supply disruption

4.9 Figure 4.2 shows analysis for severe demand conditions, as outlined in paragraph 4.4, with an 86mcm/d supply disruption equivalent to the loss of the Milford Haven-Felindre pipeline. Again, the 1-in-50 demand conditions are more severe than those required by the regulation.

Figure 4.2 – demand analysis under severe winter conditions with supply disruption



Source: National Grid

4.10 For all durations the modelled supply and storage is sufficient to meet the protected demand. However, some DSR or NSS upside would be required to meet the total demand.

Case studies – gas market disruption

Case Study 1 – Infrastructure failure

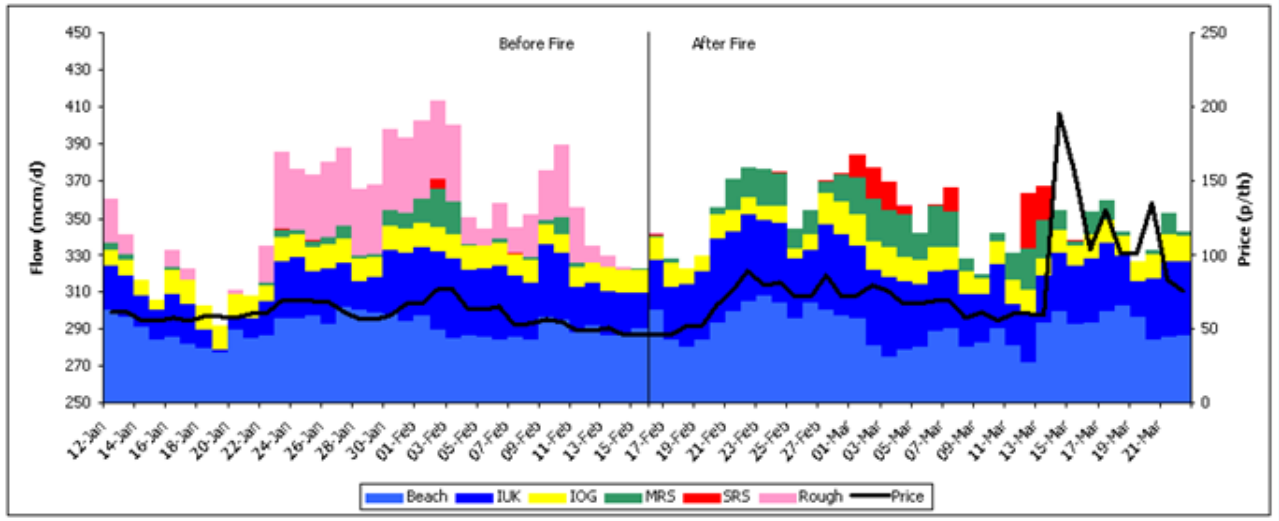
Fire at the Rough Storage Facility

4.11 In February 2006, a failure of a cooler unit on the Rough storage platform caused an explosion and fire resulting in the closure of the facility between February and June. The Rough facility, off the east coast of England, is by far the UK's largest gas storage facility accounting for almost 70% (3.3bcm) of total available storage capacity today. At the time of the fire in 2006 this percentage was even higher.

4.12 Considering the significance of this particular facility, the length of time for which it was inactive, and the time of year at which it occurred, this incident represents one of the most notable unplanned supply disruptions in recent years.

Market Response

4.13 The diagram below contrasts the 35 day period before and after the fire. The pink areas on the left show the significance of Rough as a major supply source during January of that year. The area on the right shows the sharp increase in supplies from medium- and short-range storage facilities. The initial steady price rise following the fire and then the sharp price increase (around the 13 March) that coincided with National Grid issuing an alert are notable.



Source: National Grid

4.14 The table below shows how the loss of Rough represented a 21mcm/d shortfall over a 35 day period and details how that shortfall was met through a combination of other storage and increased imports through the IUK interconnector.

	Beach	IUK	Isle of Grain	Rough	Med range storage	Short range storage	Total supply	Price (p/therm)
12 Jan-15 Feb	291	26	12	21	3	0	353	60
16 Feb-22 Mar	291	34	12	0	11	3	352	81
Difference	0	9	0	21	8	3	-1	21

Source: National Grid

Implications and risk of future re-occurrence

4.15 This case study demonstrates the flexibility of supply options open to the UK and how the integrated European market can act to bolster supply at alternative entry points when a major source suffers a disruption.

4.16 A report by Pöyry for Ofgem examined a more extreme scenario which included the loss of the Rough facility and all Norwegian supplies delivered to GB through Langeled and Belgium through Zeepipe.[37] This outage was modelled to last for a 60 day period beginning on 1 January during a 1-in-50 winter in 2016, 2020, and 2030.

4.17 The report modelled against National Grid's Gone Green scenario and a high demand scenario and found that GB infrastructure met demand in the Gone Green scenario, with some unserved energy under a high-demand scenario in 2020 and 2030.

4.18 The report estimated the probability of loss of both Rough and Norway at 1%.

4.19 In the years since this failure, GB's gas import infrastructure has grown substantially with additional LNG terminals and import pipelines. This has further increased GB's security of supply when faced with such a disruption.

[37] Pöyry, *Gas SCR – Cost-benefit Analysis for a Demand-side Response Mechanism*.

Case Study 2 – Very cold weather with infrastructure failure

22 March 2013 – IUK disruption

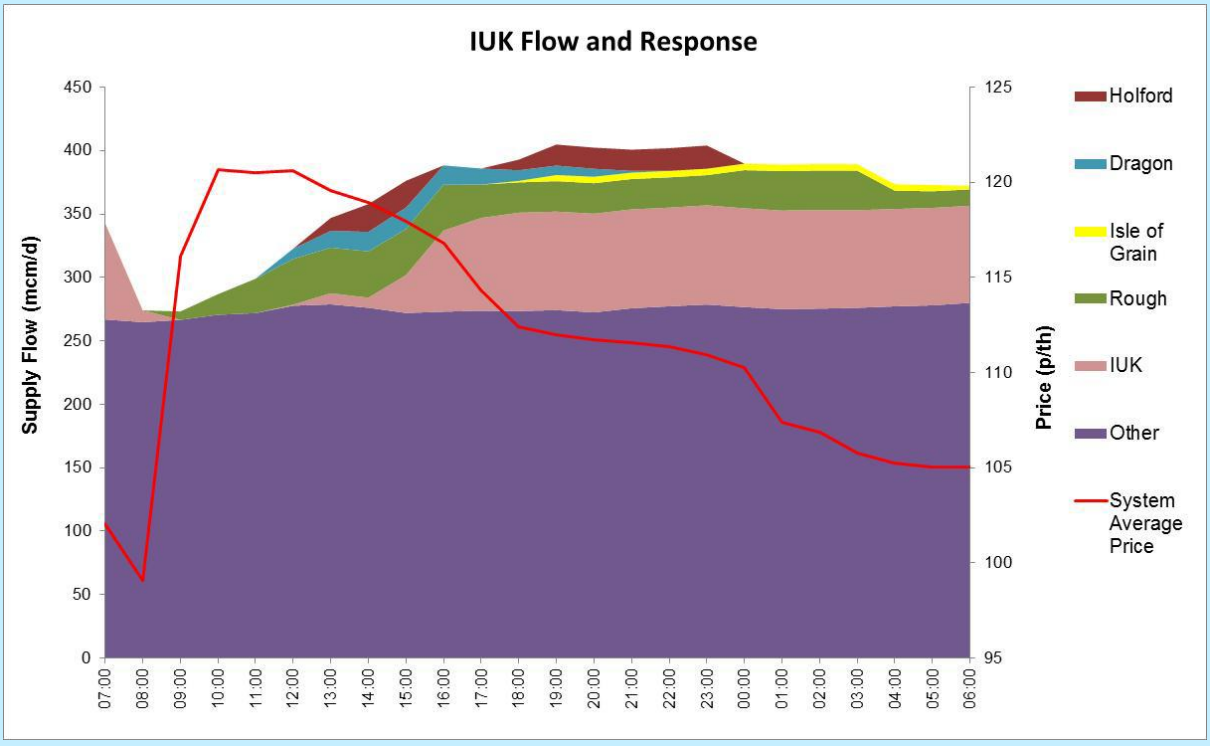
4.20 March 2013 was the coldest March in the UK since 1962 with a mean temperature of just 2.2°C across the month and, as it was towards the end of winter, storage levels were low.

4.21 Gas prices in GB had not been particularly high over most of the winter and GB had not attracted many LNG cargoes. As the winter extended into March, the IUK interconnector from Belgium played an important part in the supply mix, flowing at record import supply levels and accounting for just over 20% of total supplies at the peak of the coldest period.

4.22 On the 22 March IUK experienced an unplanned shut down due to a steam release from a heater pump, which triggered an automatic cessation of flows from Belgium.

Market Response

4.23 The 'within-day' wholesale price increased in response to the market sourcing alternative gas supplies to make up the shortfall and briefly reached a maximum of 150p/therm, before falling back as new replacement supplies came from storage at Rough and Holford and an increase in LNG flows from the Isle of Grain and Milford Haven. The chart below shows the prevailing supply portfolio against the within day System Average Price (SAP), illustrating how new supplies responded following the IUK loss.



Source: National Grid

4.24 IUK resolved the problem by noon the same day, steadily returning flows to previous importation levels by mid-afternoon. By the end of the gas day, National Grid needed to sell gas back to the market to balance an oversupplied system, a combination of the return of IUK and the continued supply from some of the storage sites.

Implications and risk of future reoccurrence

4.25 This event is a good demonstration of how normal market operations ensure a secure UK gas supply even in the most unusual conditions and allowing for a major supply shock.

4.26 Again, the Pöyry report mentioned above modelled the loss of all Continental interconnection through an infrastructure failure at Bacton.[38] Using the same parameters, demand was met under the Gone Green scenario across all the modelled years. The Stressed scenario saw some unserved demand in 2020 and 2030 but not 2016.

4.27 The report estimated the loss of Bacton at a probability of 2%.

[38] Ibid.

Case Study 3 – Geopolitical events

2009 Russia/Ukraine supply disruption

4.28 The Ukraine crisis of 2014 again highlighted the country's role as a major supply route for EU bound Russian gas.

4.29 Whilst Russian gas supplies to the EU via Ukraine were not entirely significantly affected during the winters of either 2014 or 2015, a few Member States did experience some significant disruption; for example Slovakia experienced cuts of up to 50% from Russia (although it was able to replace this with other gas). It therefore remains prudent to consider the UK's resilience to a disruption in supplies, given that in January 2009, a gas dispute between Russia and Ukraine saw all gas supplies to Ukraine, including transit gas for the EU, cut off for two weeks. This equated to 30% of EU gas imports at the time.

Market response

4.30 The greatest impact was in Central and Eastern Europe, where a number of countries were completely dependent on Russian gas routed via Ukraine, and had very limited or no alternative pipeline routes to access other gas supplies. By comparison the dispute impacted little on UK gas wholesale prices and supply continued to meet demand with strong imports from Norway and the Netherlands.

4.31 The main impacts in the UK were increased exports through the Interconnector (in response to higher prices in continental Europe) and some additional drawdown of UK storage.

Implications and risk of reoccurrence

4.32 Since 2009, various arrangements have been implemented to enhance gas supply resilience and to reduce/mitigate the impact of a recurrence of significant supply disruptions in the future. The European Commission committed in February 2015 to build a 'resilient Energy Union' with energy security at its core. Based on results of EU wide 'stress tests' conducted by Member States in the wake of Russian actions in Ukraine and the incursion into Crimea, the Commission has published proposals for a revision of the security of gas supply regulation. The proposals aim to build on measures taken since 2009 to enhance resilience and place increased emphasis on regional co-ordination. Negotiations on the proposals are on-going.

4.33 In the event that the 2009 supply cut-off had been further prolonged, or repeated in 2014-15, we might have expected an increase in UK prices, reduced price differential with continental Europe, and, in turn, reduced exports, together with increased imports from the global gas market

5. N-1 Calculation and Bi-Directional flow

The UK N-1 calculation shows that the UK passes the requirements of the Regulation with a result of 127%. Our projections over four different demand and supply scenarios suggest that we will continue to pass the test out to 2030. On the basis of this favourable outlook, BEIS, as Competent Authority, has concluded that bi-directional flow is not required for security of supply reasons.

N-1 assumptions and calculation

5.1 In accordance with the Regulation, BEIS, as the Competent Authority for the Regulation, asked National Grid Gas, as System Operator, to calculate the N-1 figure as at January 2016.

5.2 For the first year (2015/16) the 2015/16 Winter Outlook has been used for the basis of the calculation as this contains our latest intelligence for demand, storage and domestic production.

5.3 From 2016/17 onwards the figures are based on the Future Energy Scenarios 2015; this formed the basis for the UK submission for the European Gas Ten Year Network Development Plan (TYNDP) 2017. Further detail on the location of this capacity is further detailed in the *Gas Ten Year Statement 2015*.

5.4 The level of gas supply capacity is determined by an assessment of UK indigenous supply along with all existing import and storage projects as well as those where a final investment decision has been taken.

5.5 The assessment is based on a failure affecting the single 100km pipeline connecting Milford Haven to Felindre, which would lead to a loss of supplies from South Hook and Dragon LNG terminals, which could be up to 86 mcm/d. However, there are a number of scenarios where a series of infrastructure failures within the NTS could lead to a loss of supply greater than that assessed for the N-1 calculation.

5.6 We have outlined the figures using both the Gone Green and Slow Progression scenarios.

5.7 The N-1 formula, as described in Annex I of the Regulation, is as follows:

$$N-1\,[\%] = \frac{EP_m + P_m + S_m + LNG_m - I_m}{D_{max}} \times 100, \quad N-1 \geq 100\%$$

5.8 Winter 2015/15 Winter Outlook:

	Capacity (mcm/d)	Notes
Main Infrastructure (I_m)	86	Felindre Pipeline to reflect the combined capacity of both Milford Haven LNG terminals
Max imports (EP_m)	253	Excludes LNG imports (includes IUK (74), BBL (48), Langeled (70), Vesterled (36), FLAGS - Tampen & Gjoa (25)
Max indig. production (P_m)	112	Total indegenous production from the UK sectors of both the North Sea and Irish Sea along with gas produced onshore
Max storage (S_m)	146	The technical capacity of UK storage
LNG (LNG_m)	145	Includes South Hook (59), Dragon (27) and Grain (59)
Max demand (D_{max})	449	Diversified 1-in-20[39] demand. Includes gas flows to Northern Ireland but excludes Ireland

5.9 At peak: N-1 (Winter Outlook 15/16) = (253 + 112 + 146 + 145 - 86) / 449 = **127%**

5.10 For 2016/17 this is the position for all four scenarios:

	2016/17			
mcm/d	**Gone Green**	**Slow Progression**	**No Progression**	**Consumer Power**
Main Infrastructure (I_m)	86	86	86	86
Max imports (EP_m)	253	253	253	253
Max indig. production (P_m)	114	104	109	119
Max storage (S_m)	156	156	156	156
LNG (LNG_m)	145	145	145	145
Max demand (D_{max})	414	425	432	430
N-1 %	**140%**	**135%**	**133%**	**136%**

[39] The demand used in the N-1 calculation is Dmax as defined in Annex 1 of the regulations - "The total daily gas demand (in mcm/d) of the calculated area during a day of exceptionally high gas demand occurring with a statistical probability of once in 20 years."- This is the diversified demand and makes the report consistent with both the regulations and National Grid's Winter Outlook.

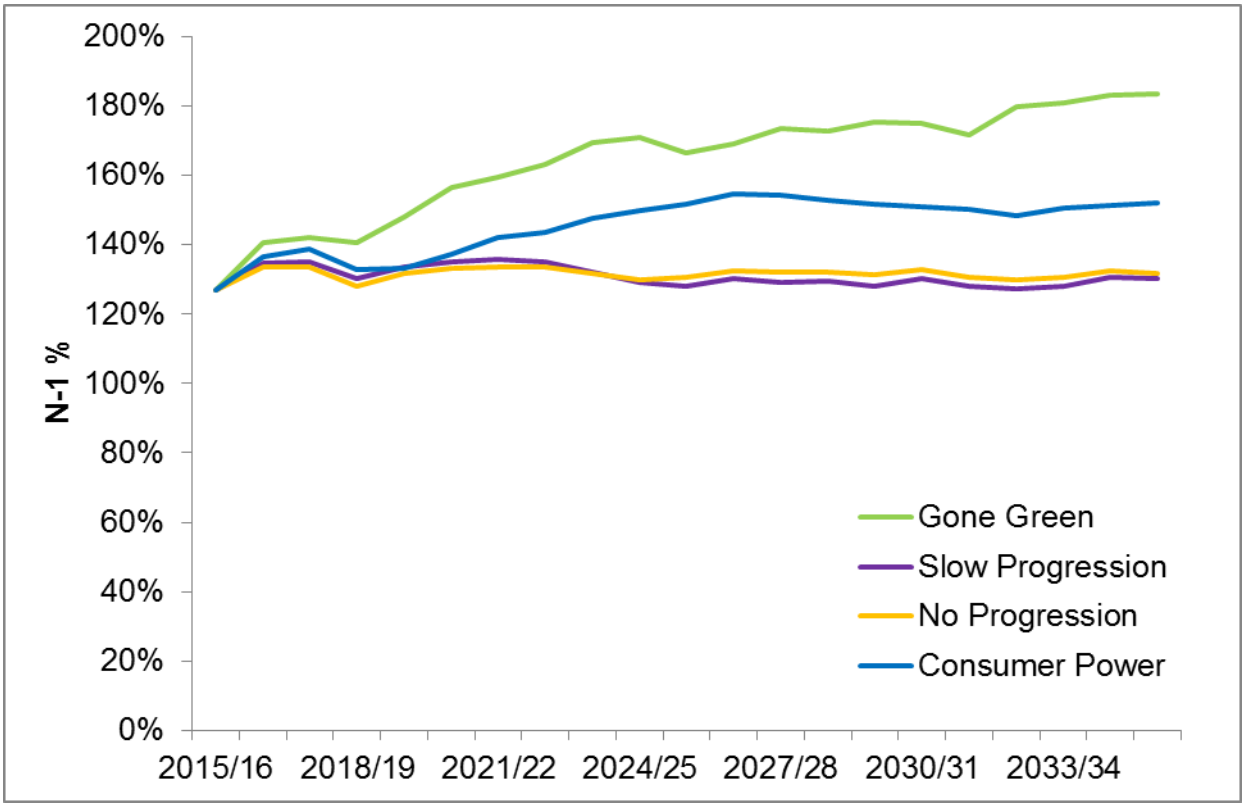
Projected N-1 calculations until 2035

5.12 Along with the calculations for 2013/14, National Grid also provided a projected annual N-1 calculation until 2035, as shown in Figure 5.1.

5.13 Under both Slow Progression and No Progression, the N-1 projections stay at today's levels throughout the period as declining domestic production is balanced by falling demand and increased storage.

5.14 The Gone Green and Consumer Power scenarios see the N-1 margin grow from today's levels. The reasons for this differ between the two scenarios. For Gone Green the primary factor is declining demands, driven by an increased share of renewables and the electrification of heating. For Consumer Power the primary factor is increased domestic production, as this scenario sees significant development of shale gas reserves.

Figure 5.1 – Projected N-1 calculations by year to 2035



Bi-directional flow (reverse flow requirements)

5.15 As per Section 3.23, three of the four interconnectors between the UK and other Member States do not have bi-directional flow capability: IC1/IC2 flowing from the Scotland to Ireland; the BBL interconnector flowing from the Netherlands to the UK, and the South North Pipeline flowing gas from Ireland to Northern Ireland. The IUK interconnector between Belgium and the UK has bi-directional flow capability.

5.16 BEIS has laid out a process through non-legislative guidance and informal consultation for reviewing the status of bi-directional flow exemptions. BEIS has continued to take account of market developments and notes the following:

- The Netherlands is a net gas producer and has little to no market demand to import gas from the UK in the short term. Like the UKCS, Netherlands gas production is declining but net gas export is expected beyond the term of this Risk Assessment.
- A cap has been placed on the level of production from the Groningen field in the Netherlands due to seismic activity. The reduction in Groningen field gas has been met by increased gas imports into the Netherlands from existing pipelines. There continues to be significant available export capacity on IUK to the continent.
- Ireland will continue to be significantly reliant on the GB market for its gas and, therefore, any gas deficit within GB would similarly affect Ireland. In relation to the Shannon LNG facility mentioned in the 2014 Risk Assessment, the timeline for the delivery of the plans for its development are not yet clear; the ultimate deliverability of the facility was projected to be approximately 28 mcm/d. The Corrib gas field which has recently started production (2015) is expected to produce at a rate of approximately 9 mcm/d but is expected to decline rapidly. It is therefore not a long term source of supply at significant volume. Therefore no potential for sustained gas flows from Ireland to the GB market.
- Gas can flow from Ireland to Northern Ireland via the South- North Pipeline. Reverse flow from North-to-South would provide another supply route into the Republic of Ireland, but this would be the same gas that had already come through the sub-sea interconnectors, IC1 and IC2, that flow directly to Ireland from GB (as these interconnectors also spur off to supply 100% of Northern Irish gas). There is currently therefore no demand for gas to flow via SNP from Northern Ireland to Ireland.
- Sufficiently robust market testing information on SNP was not provided by the Transmission System Operator (TSO) when the initial application for bi-directional flow was made.

5.17 With this in mind, there is no additional security of supply benefit for reverse flow on any of the already exempted pipelines. We have also reassessed the original market assessments provided for the initial exemption and have concluded that there have been no material changes to the market that would alter ultimate conclusions over the next exemption period. It is highly unlikely that there will be market demand for gas

from the UK for use in the Netherlands (via BBL), from Ireland for use in the UK (via IC1/IC2) or from the UK (Northern Ireland) for use in Ireland (via SNP), over the course of this Risk Assessment (i.e. before September 2018).

5.18 Without any significant security of supply benefit the UK Government's view is that it would be disproportionate to expect TSOs to commence investment in facilitating bi-directional flow if there is no market demand for physical reverse flow and the potential to provide a consistent supply of gas from prospective developments (to make reverse flow viable) is unlikely.

5.19 We have decided to grant exemptions on the UK side of operations for a further two years to BBL and IC1/IC2 which do not have bi-directional flow capability. An interim exemption for 1 year has been issued to SNP as sufficiently robust market testing information was not provided by the TSO on initial application for exemption. The 1 year period will allow time for the TSO to make an application for a further exemption supported by sufficient evidence or to start work to enable bi-directional flow.

5.20 If market demand does develop between now and the next Risk Assessment, a TSO may at any time respond to that demand by enabling bi-directional flow over their infrastructure. Furthermore, the terms of the exemptions issued allow the UK Government to revoke them if there is disagreement with their issuance at EU level or a clear security of supply need for bi-directional flow develops during the issuance period. We will review the case for further biennial exemptions during the drafting of the next Risk Assessment.

6. Further security of supply work and conclusions

The UK gas market is resilient to all but the most unlikely combination of high demand and supply disruption. Our analysis suggests that protected demand is met in all circumstances. Nevertheless, we will continue to monitor risks to our gas security of supply and will continue to work to strengthen our position.

6.1 Security of gas supply in the UK is provided through access to a diverse range of supply sources, facilitated by effective gas market arrangements with shippers sharply commercially incentivised to supply their customers. Low demand coupled with a high N-1 score and robust demand side response mechanisms further enhances the UK's security of supply position. The UK carries out significant ongoing risk assessment, and National Grid has regular consultative processes to collect data on supply and demand in order to inform the market.

6.2 The analysis presented in this Risk Assessment demonstrates that UK gas supply infrastructure is resilient to all but the most unlikely combinations of supply shocks. The supply ranges are sufficient to maintain supplies to protected consumers. In some extreme scenarios the market would need to respond to ensure all demand can be met, either by increasing available supplies or reducing demand. This highlights the need for continued efforts to further establish robust and dependable demand-side response as well as to ensure sufficient flexible sources of supply are available as indigenous supplies decline.

6.3 Despite the favourable picture of gas security of supply presented in this report, the Government is not complacent. Since the last Risk Assessment, we have continued to develop work on security of supply. To ensure that we can set the right strategic direction on security, we must ensure we have the right evidence base. We have therefore introduced a process of regular, systematic assessments to examine the risks to the system over the longer term and the level of security we can expect it to deliver. We are currently undertaking the first fundamental assessment and expect to run these at approximately 5 yearly intervals. We will draw on this to undertake annual reviews in line with our Statutory Security of Supply Report commitments.

6.4 Ofgem will continue to implement its findings from the Significant Code Review, with key focus on implementing and assessing Cash-out reform and a new Demand Side Response mechanism. National Grid's proposed DSR methodology has also been approved by Ofgem and will be in place for winter 2016/17 whilst changes to cash-out arrangements came into effect on 1 October.

6.5 Government will also continue with existing work:

- to maximise domestic gas production, by conventional means through the Wood Review and unconventional methods through an appropriate regulatory framework focussing on safety and the environment;
- through continued cultivation of international relationships with major gas producers to encourage continued supply diversity and reliability.

6.6 The UK will use the analysis presented in this Risk Assessment to inform the development of the Preventive Action Plan and Emergency Plan required by the Regulation by December 2016.

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