Risk assessment for the purpose of EU Regulation 994/2010 on security of gas supply

An addendum to the Statutory Security of Supply report 2011

November 2011

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Contents

1. Executive Summary

1.1. This addendum to the Statutory Security of Supply Report (SSSR) forms the risk assessment required by the EU Regulation on Gas Security of Supply (994/2010)[1] ('the Regulation'). The Risk Assessment builds on the information provided in that report to assess security of gas supply.

1.2. The UK Government is required under Article 9 of the Regulation to carry out an assessment of security of gas supply by 03 December 2011. The assessment is to be based on a number of common elements set out in the Regulation, including assessment of the N-1 and supply standards, a description of the market, stress tests, and interactions with other Member States. On the basis of the risk assessment, Member States will prepare Preventive Action Plans and Emergency Plans. Member States are required to update the risk assessment for the first time eighteen months after preparation of these Plans and thereafter every two years.

1.3. The analysis in this report suggests that, in the short to medium term, the UK gas supply infrastructure is resilient to all but the most unlikely combinations of severe infrastructure and supply shocks. There are, however, challenges in the medium to long term. Gas demand from the electricity generation sector is expected to increase as gas plant replace coal fired power plant, which will progressively close due to the requirements of the Large Combustion Plant and Industrial Emissions Directives. Gas fired generation will also be necessary to provide flexible back up for wind power. Along with this increase in gas demand for power generation, demand will become less flexible as the power sector will be less able to switch to coal fired generation at times of high gas demand.

1.4. DECC will use the outcome of the work carried out for this Risk Assessment to feed into the Preventive Action Plan and Emergency Plan. These plans will be adopted and made public by December 2012 in line with the requirements of the Regulation.

[1] 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.

2. Introduction

Security of Supply Overview

2.1. The UK’s gas supply infrastructure must, amongst other things, be sufficient to:

- meet ‘peak’ demand, which is a much more demanding requirement than meeting annual demand;
- allow for a sustained delivery of large volumes of gas, for example, due to the need to be prepared to meet demand over a particularly cold winter; and
- provide access to the most competitive gas supplies. Because price relativities will vary through time, this also implies some redundancy in gas supply infrastructure.

2.2. Security of supply in the UK is delivered through an effective gas market. Investment is driven by market reflective price signals providing commercial opportunities. The Government maintains arm’s length regulation through an independent regulator; in Great Britain (GB) that is the Gas and Electricity Markets Authority[2] and in Northern Ireland it is the Northern Ireland Authority for Utility Regulation.

2.3. The market has delivered a 500% increase in the UK’s gas import capacity during the last decade (150% of annual consumption) and a 30% increase in storage capacity, since around 2000. It responded well in the winters of 2009/2010 and 2010/11 to meet record demands and supply side pressures.

2.4. However, the UK Government is not complacent. Analysis commissioned by DECC from Pöyry Energy Consulting (see next section) has shown that, whilst the gas market is largely robust to a range of adverse events, the risk of shortfalls in supply cannot be ruled out, nor the risk that there may need to be significant rises in wholesale gas prices in order to balance the market. Further infrastructure, beyond that which exists or is under construction at present, will be needed in future in order to reduce supply or price risks to consumers.

2.5. Parliament has 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. Ofgem is conducting the Gas Security of Supply Significant Code Review (Gas SCR) to consider how current market arrangements could be improved to further enhance security of supply. This review is considering potential changes to the gas emergency arrangements as well as the rationale for further interventions including obligations on shippers, suppliers or the system operator.

2.6. Providing timely and accurate information on supply and demand, risks and drivers to the market is key to maintaining a well functioning market and hence security of supply. It is also important for Government, transmission system operators (TSOs) and Regulators. As noted in the section below, information is provided to the market through a combination of extensive daily /real time information, a number of regular reports and, where necessary, supplemented with one off assessments and reports.

[2] Ofgem, the Office of Gas and Electricity Markets, operates under the direction and governance of the Gas and Electricity Markets Authority (the Authority). For the purposes of this document the terms “Ofgem” and “the Authority” are used interchangeably.

Current Risk Assessment

Ongoing Risk Assessment

2.7. The UK already carries out a great deal of risk assessment on an ongoing basis. The System Operator in Great Britain, National Grid, is responsible for providing information to the market on gas supply, including real time information provided on their website, short term information on the supply situation for each coming winter, and longer term information to aid investment decisions in gas supply infrastructure.

2.8. Information is also consolidated annually in the Statutory Security of Supply Report, which is published by DECC and produced jointly with the economic regulator (Ofgem) with input from National Grid. That report provides analysis on security of supply risks and drivers, and scenarios to help inform the market.[3]

2.9. The relevant publications by National Grid as System Operator are:

- "The Winter Outlook Report"[4]: Published annually following stakeholder consultation. This provides information to market participants on the supply and demand situation for the coming winter;
- "Transporting Britain's Energy (TBE)"[5]: National Grid's annual consultation process on forecasting supply and demand which informs the Ten Year Statement and the Development of Energy Scenarios publications; and
- "Ten Year Statement"[6]: Published annually - a rolling ten-year forecast of gas transportation system usage and likely system developments that can be used by companies, which are contemplating connecting to the system or entering into transport arrangements, to identify and evaluate opportunities.

Supplementary Risk Assessment

2.10. From time to time, supplementary risk assessments are carried out to complement the work carried out by National Grid described above. This can involve looking in detail at specific issues, for example gas quality, or stress testing the system. Such work is often resource intensive, requiring specialised consultants, and it would be inefficient and impractical for it to be carried out routinely.

2.11. Examples of such work are:

- Occasional detailed consultancy reports – e.g. Pöyry reports[7]: These are three reports on aspects of security of gas supply including stress tests;
- The Gas Policy Statement[8]: A policy statement published in April 2010 outlining the then Government's strategy for ensuring secure UK gas supplies to 2020 and beyond;

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[3] The SSSR is the successor the Energy Markets Outlook, which itself succeeded the joint DTI/Ofgem JESS reports. Further information can be found at: http://www.decc.gov.uk/en/content/cms/meeting_energy/en_security/sec_supply_rep/sec_supply_rep.aspx

[4] http://www.nationalgrid.com/uk/Gas/TYS/outlook/

[5] http://www.nationalgrid.com/uk/Gas/OperationalInfo/TBE/

[6] http://www.nationalgrid.com/uk/Gas/TYS/

[7] http://www.decc.gov.uk/en/content/cms/meeting_energy/markets/gas_markets/gas_markets.aspx

- Project Discovery[9]: An Ofgem report that modelled several scenarios for the development of GB supply and demand and assessed the risks to security of supply under these scenarios. As part of Project Discovery, Ofgem also modelled stress tests, a serious interruption to gas supplies from either mainland Europe or other international markets;

- Reports on other aspects of gas security, e.g. the Gas Quality studies[10] that looked at the risk that future supplies may be out of GQ specifications and appliance safety implications from allowing a wider gas quality band; and

- Gas Security of Supply Significant Code Review: Ofgem published an initial consultation in January 2011 assessing whether reforms to the current arrangements are required to improve security of supply to avoid a gas deficit emergency . Ofgem will publish a draft policy decision on the Gas SCR shortly on its website.[11]

2.12. The UK Government also carries out much wider work relating to security of supply, for example in response to the oil spill in the Gulf of Mexico and earthquake and tsunami in Japan. In addition, the Government has published a suite of National Policy Statements for Energy[12] to aid planning applications for energy developments, and a White Paper on Electricity Market Reform,[13] setting out a package of measures including a capacity mechanism to ensure sufficient low carbon electricity generation comes forward in future. Gas fired generation plant, particularly if fitted with carbon capture and storage, is expected to play a significant role in the electricity generation mix for many years to come, and so these measures are particularly relevant when considering gas security of supply.

Consultation

2.13. The vast majority of the data used within this Risk Assessment has been consulted on through dialogue and an open consultation process.

2.14. National Grid conducts a formal ‘Transporting Britain’s Energy’ consultation process whereby it issues a number of targeted questionnaires to a wide range of industry stakeholders, including producers, importers, shippers, storage operators, terminal operators, transporters and consumers. These questionnaires are designed to gather data and enable the development of forecasts and scenarios for gas supply and demand. The culmination of the ‘Transporting Britain’s Energy’ consultation process is the holding of an annual Transporting Britain’s Energy seminar, which is generally attended by over 200 energy industry professionals. Provisional data and forecasts are released at the seminar. The finalised forecasts and scenarios are then included in the Ten Year Statement document. The data set used for this Risk Assessment has predominately been sourced from data published in July 2011, and will form the basis of the 2011 Ten Year Statement due for publication in December 2011.

2.15. National Grid also produce an annual Winter Outlook report, which has a shorter term horizon. The Winter Outlook report provides information to participants in the gas and electricity markets by publishing an outlook of supply and demand for the winter ahead.

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[8] http://www.decc.gov.uk/assets/decc/what%20we%20do/uk%20energy%20supply/energy%20markets/gas_markets/1_20100512151109_e_@@_gassecuritysupply.pdf
[9] http://www.ofgem.gov.uk/markets/whlmkts/discovery/Pages/ProjectDiscovery.aspx
[10] http://www.decc.gov.uk/en/content/cms/what_we_do/uk_supply/markets/gas_markets/quality/quality.aspx
[11] http://www.ofgem.gov.uk/Markets/WhlMkts/CompandEff/GasSCR/Pages/GasSCR.aspx
[12] http://www.decc.gov.uk/en/content/cms/meeting_energy/consents_planning/nps_en_infra/nps_en_infra.aspx
[13] http://www.decc.gov.uk/en/content/cms/legislation/white_papers/emr_wp_2011/emr_wp_2011.aspx

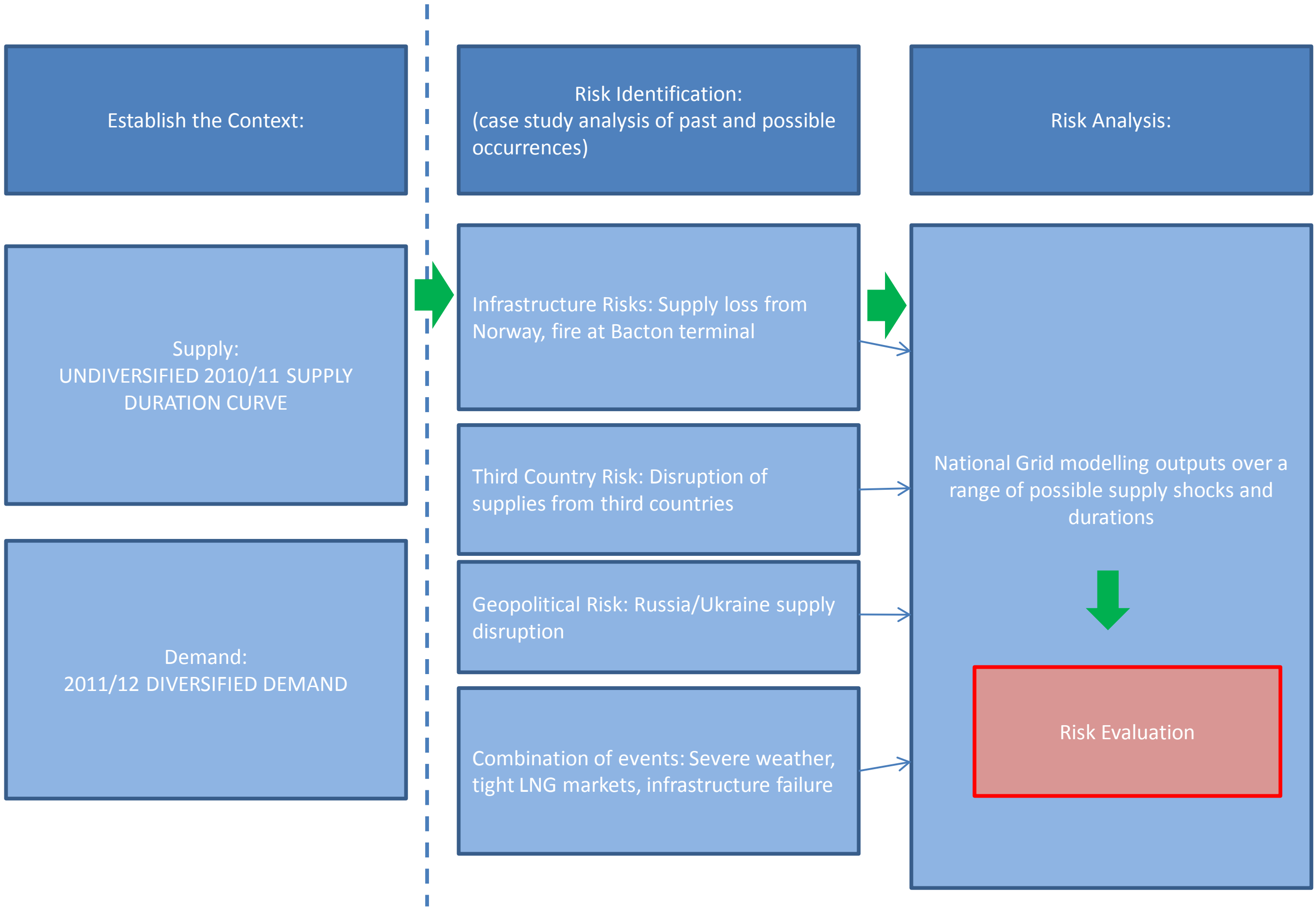
Information used within this Risk Assessment has also been sourced from the Winter Outlook report for 2011/12, published in October 2011; this report is also consulted on, through an open consultation process with stakeholders.

2.16. Ofgem has close relationships with industry. Project Discovery and the Gas Security of Supply Significant Code Review have been carried out in consultation with industry.

2.17. DECC works closely with Ofgem and National Grid, and is developing a Memorandum of Understanding to clarify roles and responsibilities with respect to the Regulation. As part of a review of the role of Ofgem, DECC is also developing a Strategy and Policy Statement for Ofgem, which reflects its energy security policy objectives.

3. Approach To Risk Assessment

3.1. The approach taken to risk assessment for the purpose of the Regulation, and therefore reflected in this report, is to complement the extensive work already carried out in the UK described in the previous section, with the aim, as far as possible, to ensure a thorough risk assessment completed with a proportionate level of effort. The process is illustrated in the diagram below, and discussed in detail in the sections that follow.



Establish the Context

3.2. The first stage of the risk assessment is to use the information collected through the processes mentioned in the previous section to set the scene in terms of gas supply and demand. In particular, the Statutory Security of Supply Report, to which this Risk Assessment is an addendum, summarises National Grid's latest figures for annual and peak supply and demand. The relevant charts are reproduced and summarised in Section 4. Readers wishing more detailed information on any of these charts should refer to the relevant section of the SSSR.

3.3. A number of demand and supply scenarios are presented. National Grid's 'Slow Progression' scenario is used for illustrative purposes to show annual and peak supply and demand. The charts also show the 'Gone Green' scenario, which has been developed as a plausible scenario to meet the 2020 EU environmental targets. More detail on these scenarios and others produced by National Grid can be found in the Development of Energy Scenarios Document.[14]

Risk Identification and Analysis

3.4. Once the context has been set, the next stage of the process is to identify the risks to security of supply. The Regulation specifies a number of scenarios that need to be analysed, including the "n-1" and supply standards, high gas demand and supply disruption and others such as geopolitical risks where relevant.

3.5. These are presented in this risk assessment as follows:

- A description of the n-1 calculation and the achievement of the supply standard;
- Analysis of the ability of the gas supply infrastructure to cope during an average and severe (1 in 50) winter with a supply shock equivalent to a failure of the largest piece of infrastructure (the Langeled Pipeline or IUK interconnector) over a day, week, month and the entire winter;
- A series of case studies describing real or possible supply shocks giving:
  - the background to the cause of the supply disruption;
  - the level and duration of supply loss experienced;
  - a description of how the market coped and whether any changes were made as a result of this event; and
  - a qualitative assessment of how likely such an event is to happen in future.

Evaluation

3.6. The planning assumptions underpinned by the risk assessment are reviewed annually as part of a National Grid led exercise which includes Northern Ireland. The outcomes of this Risk Assessment will be taken into account in the UK's Preventive Action Plan and Emergency Plan.

3.7. More widely, the UK Government uses risk assessments such as this in ongoing policy development on Energy Markets. For example, the Pöyry reports referred to above identified some low probability, but realistic, combinations of unusual demand, supply shocks and oil prices which could have a high impact on some GB consumers. In response to this, Parliament included a provision in the Energy Act 2011 for Ofgem to sharpen incentives on market players to ensure they have sufficient gas to meet demand including in a tight market.

[14] http://www.nationalgrid.com/uk/Gas/OperationalInfo/TBE/

4. Risk Assessment – Establish the Context

Long Term Trends

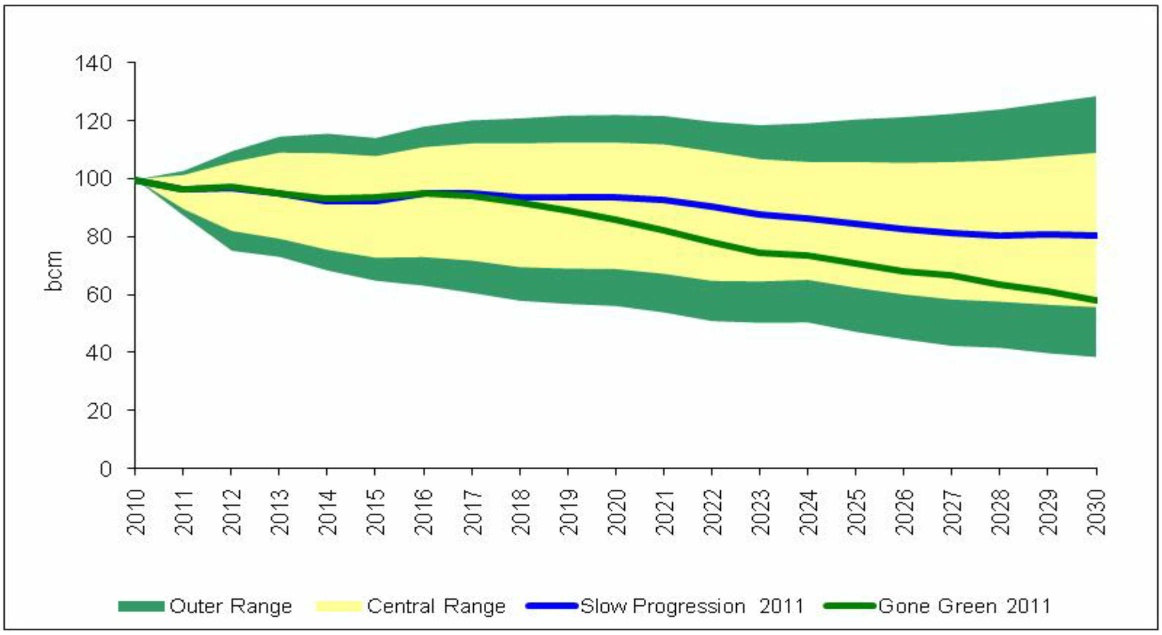
4.1. The charts that follow are intended to establish the context for the risk assessment. They are taken, in the main, from the SSSR, and the analysis from that report is summarised here. Readers wishing more detailed information on any of these charts should refer to the relevant section of the SSSR.

Demand

Annual Gas Demand

4.2. Chart 4.1 sets the scene for the risk assessment in terms of annual demand. It shows a number of gas demand scenarios produced by National Grid. Under the 'Slow Progression' scenario, gas demand trends downwards from around 100bcm (billion cubic meters) per year now to 80-90bcm per year in 2020. The Gone Green scenario shown on the chart has been developed as a plausible scenario to meet the 2020 EU environmental targets. The chart also shows a range of sensitivities. These are described in more detail in the SSSR.

Chart 4.1: UK Annual Gas Demand Range



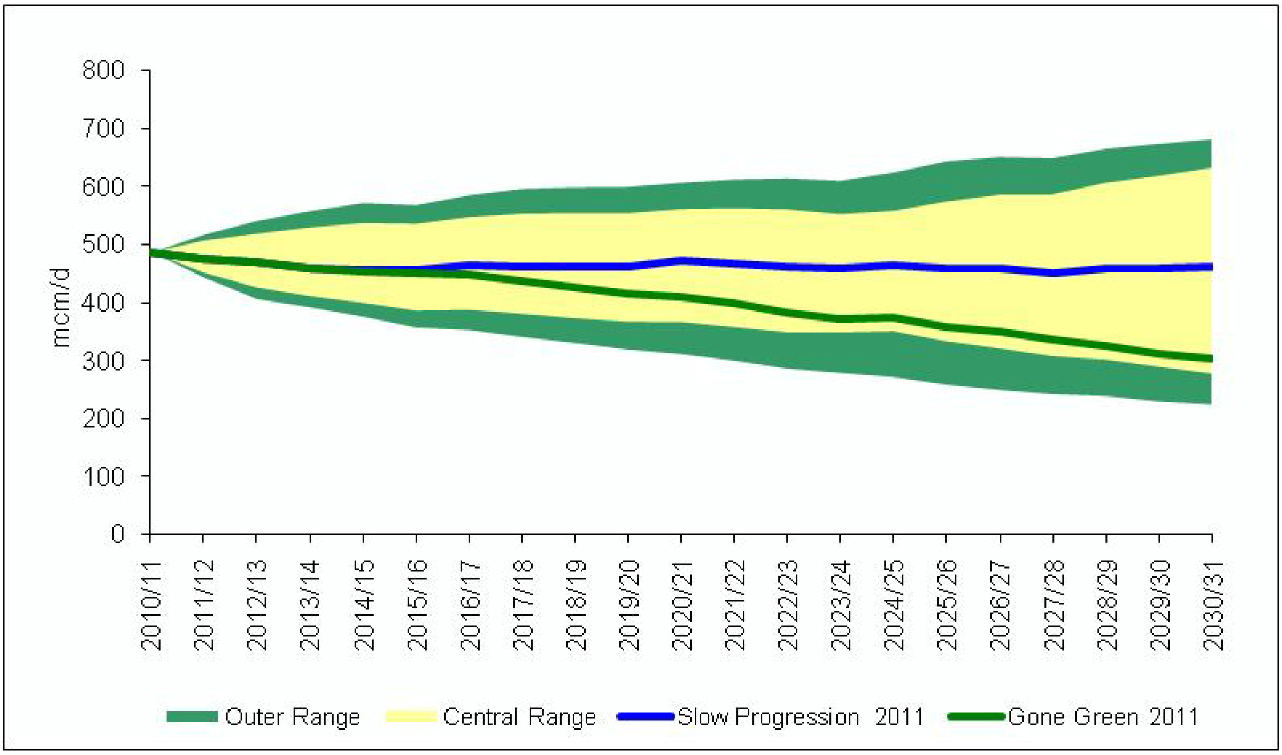
Source: National Grid

Peak Demand

4.3. The ability to meet peak demand on a particular day or over a more prolonged period (e.g. a severe winter) is particularly relevant in the context of security of supply, and a more challenging requirement to achieve than meeting annual gas demand. Gas market participants need to build some redundancy in their supply arrangements, above the minimum amount to meet peaks, to manage the risk that other capacity may not be available (for example, if undergoing maintenance).

4.4. Chart 4.2 shows a range of potential peak demands using the same sensitivity analysis as for annual demand. The 'Slow Progression' scenario predicts peak demand to decrease slightly from the current levels (around 500 million cubic meters (mcm)/day) to around 462mcm/day in 2020.

Chart 4.2: Peak Demand Sensitivity Analysis



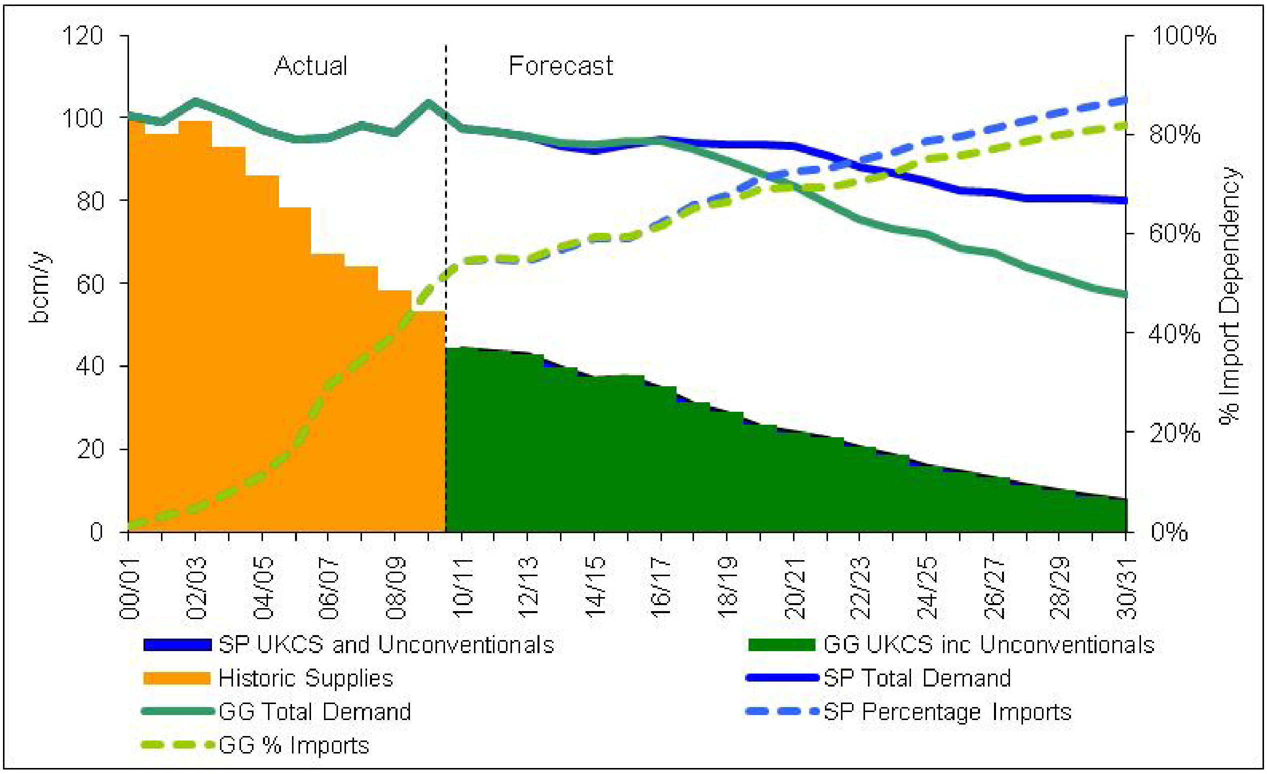
Source: National Grid

Supply

Production

4.5. Chart 4.3 shows National Grid's projections for future UK Continental Shelf (UKCS) production. Under the 'Slow Progression' scenario (labelled as SP on the chart, whereas GG is the Gone Green scenario), production from the UKCS peaked in 2000 and is projected to decline from its current 44bcm per year to 26bcm per year in 2020.

Chart 4.3: Production Projections



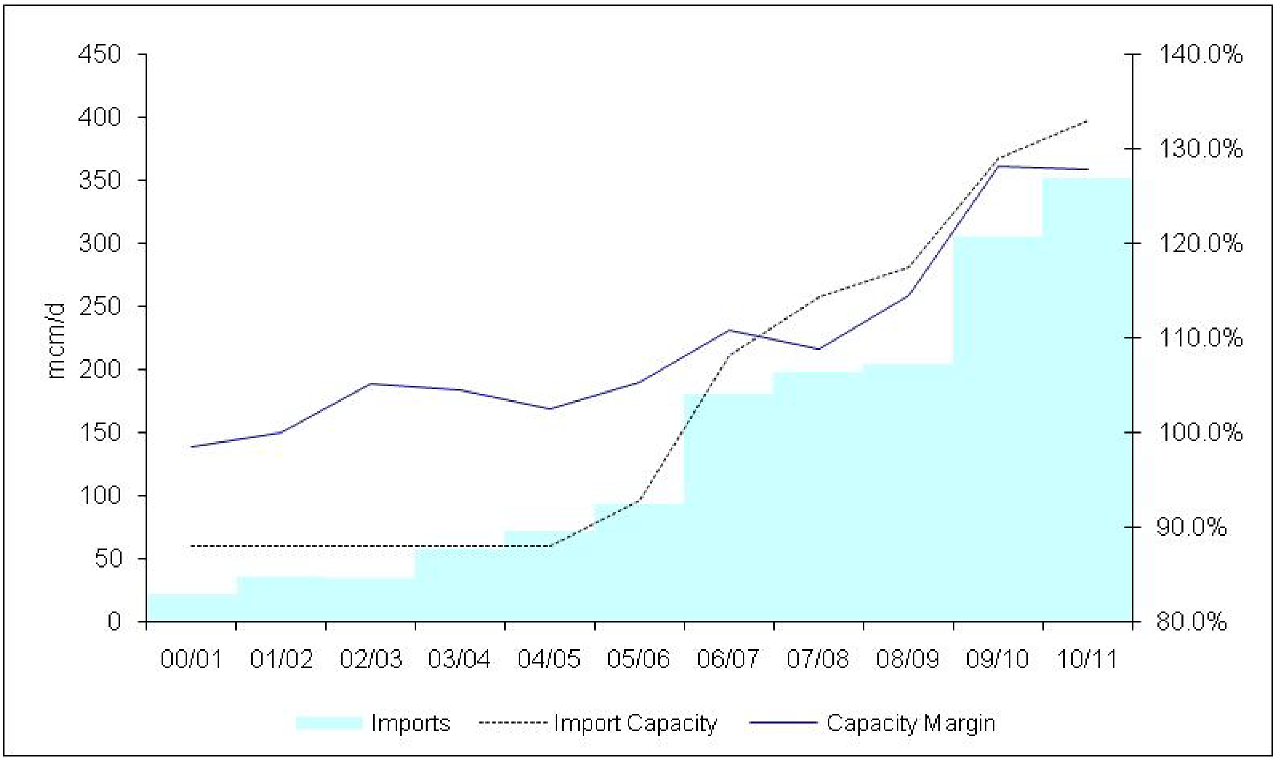
Source: National Grid

Imports

Production and Import Flexibility

4.6. Chart 4.4 shows that, despite significant decreases in indigenous production, import capacity has increased to such an extent that capacity margins[15] have seen a net increase over the last decade.

Chart 4.4: Production and Import Flexibility



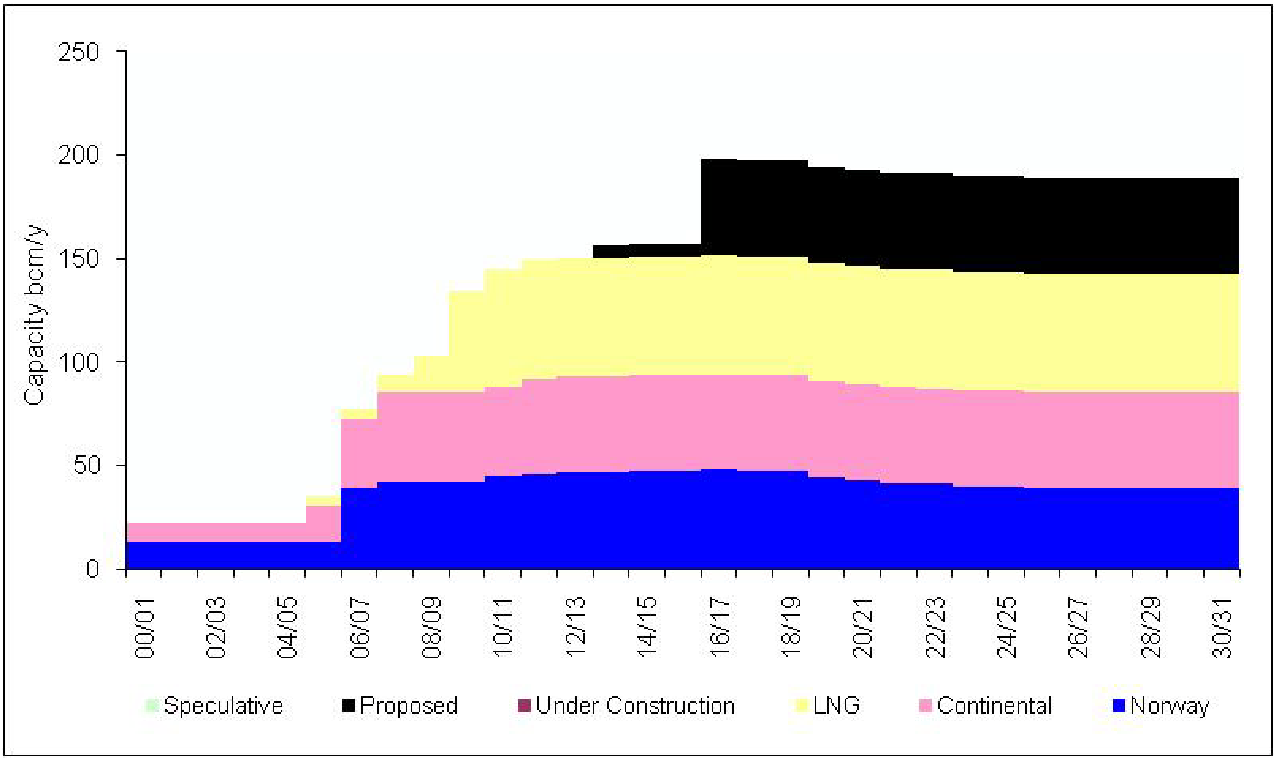
Source: National Grid

[15] The capacity margin on this chart includes all supply, including UKCS, storage and imports measured against a typical peak demand of 500 mcm/d.

Import capacity

4.7. Chart 4.5 shows National Grid's views on how gas import infrastructure will evolve and suggests a possible increase in import capacity to around 193bcm per year in 2020, although the extent to which the proposed projects will come to fruition is uncertain.

Chart 4.5: Possible evolution of UK gas import capacity (bcm/y, Imports at 100%)



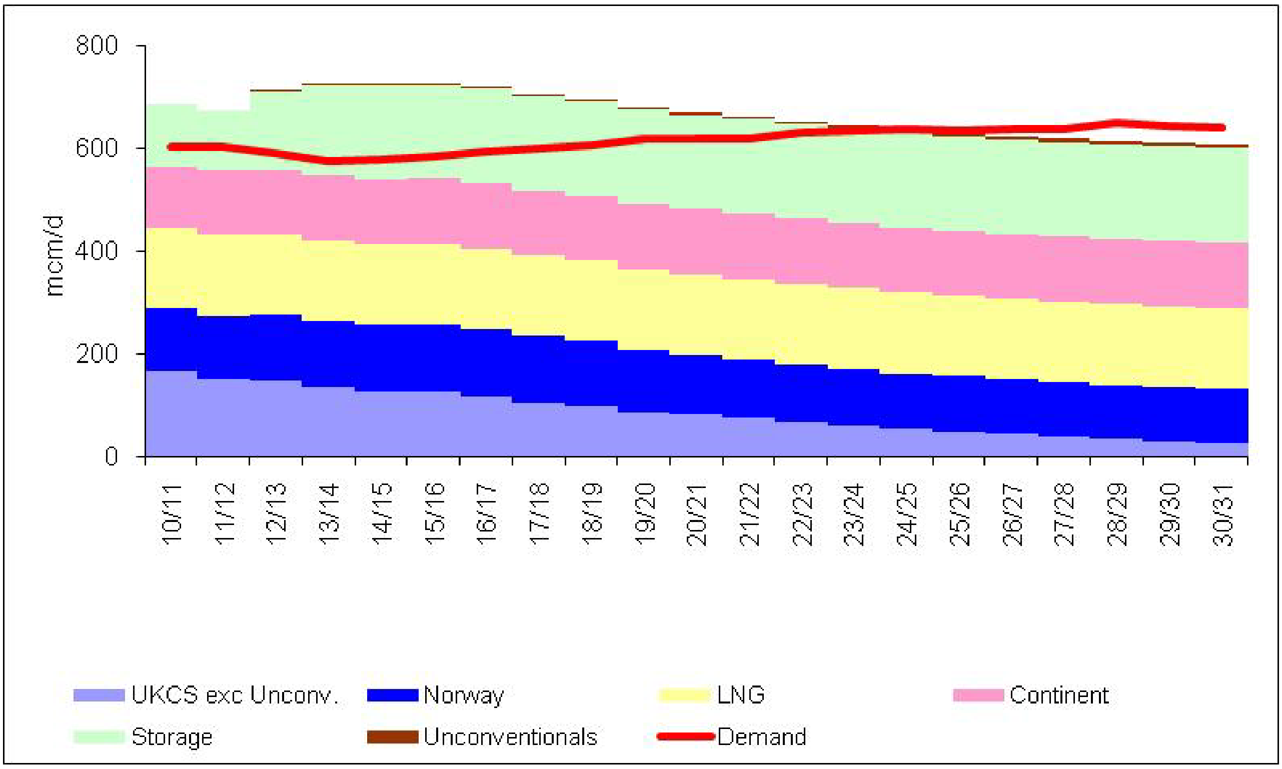
Source: National Grid

Peak daily winter gas undiversified demand and supply capacity

4.8. Chart 4.6 shows National Grid projections for peak supply availability under the “Slow Progression” scenario. The supply capacity has been ‘de-rated’ to reflect typical winter operational characteristics of import infrastructure. The chart excludes all ‘proposals’ for further import capacity.

4.9. It should be noted that the derating factors can reflect factors unrelated to the infrastructure itself – for example, the availability of gas in Europe for export through the IUK or the availability of LNG into import terminals. In this case therefore, if estimated derated capacity falls short of peak demand it does not necessarily indicate that more import (or storage) capacity is needed. Capacity utilisation could be higher or lower than indicated or rise or fall over time. All other things being equal, we would expect GB wholesale prices to signal the demand for gas and that more gas would be available when GB wholesale prices increase (e.g. at times of peak demand).

Chart 4.6: Peak daily winter gas demand (undiversified) and supply capacity



Source: National Grid

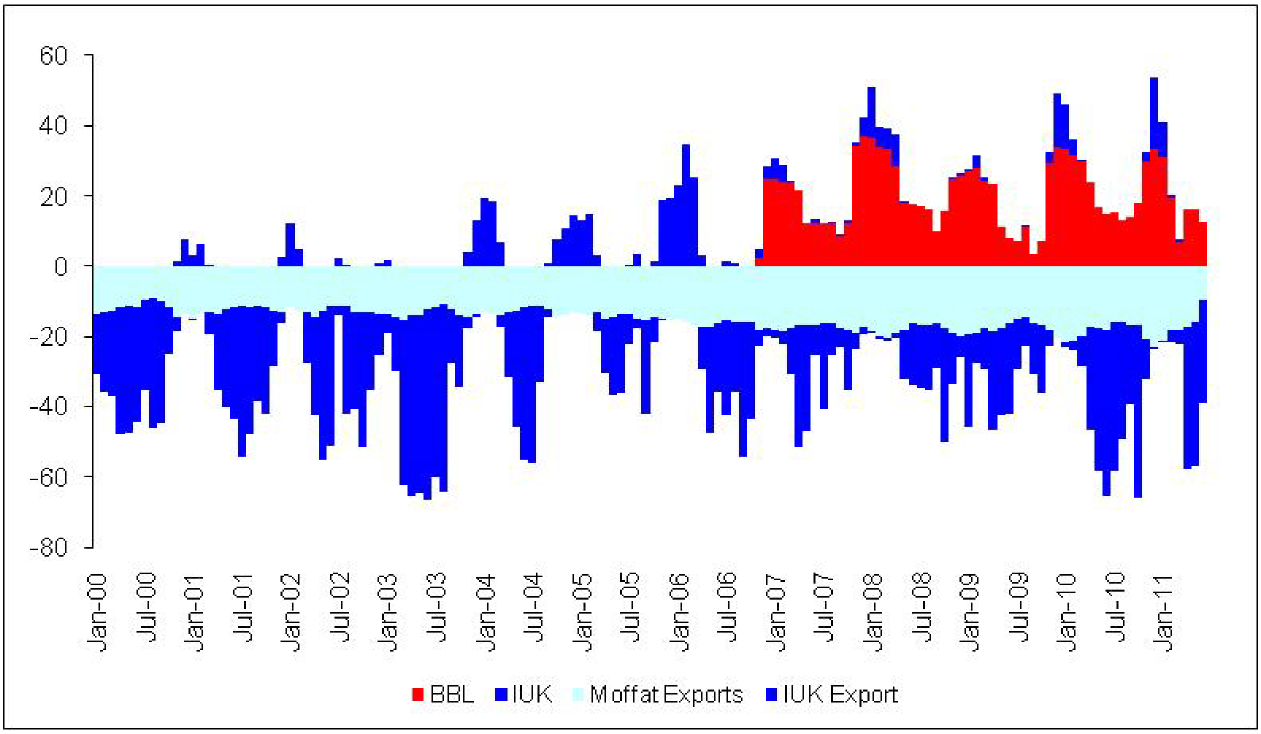
Interconnection

4.10. The UK currently has three interconnectors with other Member States:

- Interconnector UK (IUK), operated by Interconnector (UK) Limited, which flows gas in both directions between Bacton and Zeebrugge in Belgium;
- the BBL pipeline, operated by BBL company, which currently flows gas from Balgzand in the Netherlands to Bacton; and
- the Moffat interconnectors, operated by Gaslink, which are currently configured to flow gas from Moffat in Scotland to Ireland.

4.11. Chart 4.7 shows interconnector flows in both directions since 2000.

Chart 4.7: Physical flows in both directions



Source: National Grid

Reverse Flow

4.12. As required by the Regulation, market assessments are currently ongoing to determine whether reverse flow should be enabled on the BBL pipeline and the Moffat interconnectors.

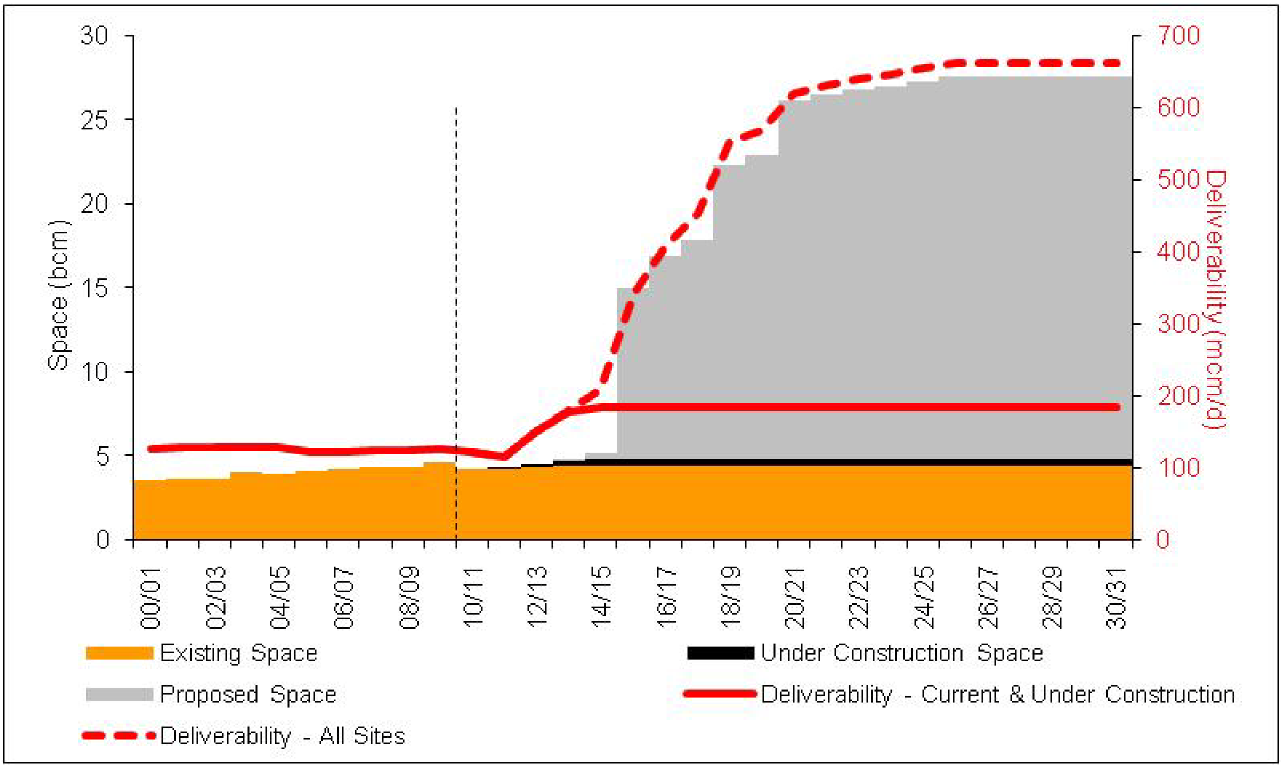
4.13. The result of the market assessments is expected in late 2011. If the results show that market demand is sufficient to justify enabling physical reverse flow then we would expect the TSO to make a proposal to enable physical reverse flow. If the results are not sufficient to justify enabling physical reverse flow then the security of supply benefits from physical reverse flow will be assessed. TSOs will be submitting a proposal to enable physical reverse flow, or a request for an exemption from this requirement, by 3 March 2012.

Gas storage capacity

4.14. Chart 4.8. shows that National Grid expect gas storage infrastructure to increase modestly by 2020. However deliverability is expected to increase considerably, to around 184 MCM per day, due to the completion of new storage facilities.

4.15. In addition, there are a considerable number of gas storage projects at various stages of the planning process – as many as 18bcm in 2020. However, given that there are significant uncertainties surrounding some of these projects, they are not included in the figures for this risk assessment until they reach a positive final investment decision and commence construction.

Chart 4.8: Gas storage capacity projections



Source: National Grid

Other Issues

Information on contracting arrangements

4.16. Natural gas undertakings are required by the Regulation to inform DECC, as the Competent Authority for the purpose of the Regulation, of details of long term contracts they hold with suppliers from outside the EU. Ofgem and DECC issued information requests to natural gas undertakings in August 2011, and DECC will notify this information in aggregate to the Commission, as required by the Regulation.

4.17. Prior to this, DECC had reporting obligations to provide information on long term contracts under Directive 2004/67/EC, which has now been repealed by the Regulation. These obligations were discharged through a contract with Wood Mackenzie, which collected information on DECC's behalf about contracts with a duration of over 10 years with third country suppliers.

4.18. The most recent data are shown in the table below and come from Wood Mackenzie's European Gas and Power Service. This aggregates estimates of quantity of imports under long term contracts based on publicly available data and Wood Mackenzie's own estimates, and assumes that some major contracts will be extended beyond their current expiry, given the importance of these supply sources.

Bcm	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Algeria	3.08	3.08	3.08	3.08	3.08	3.08	3.08	3.08	3.08	3.08
Egypt	1.38	1.38	0.95	0.76	0.93	2.03	0.00	0.00	0.00	0.00
Equatorial Guinea	1.68	1.68	1.68	1.68	1.68	1.68	1.68	1.68	1.68	1.68
Norway	9.33	8.68	8.68	8.68	6.47	1.93	1.79	1.43	1.43	1.29
Norway Assumed Extension	0.00	0.00	0.00	0.00	1.50	5.11	5.11	5.11	5.11	5.11
Peru	1.27	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Qatar	14.69	16.34	16.34	15.44	14.97	14.97	14.97	14.97	14.97	14.97
Total Contracted ACQ	**31.4**	**31.2**	**30.7**	**29.6**	**28.6**	**28.8**	**26.6**	**26.3**	**26.3**	**26.1**
Total Contracted Take or Pay	**16.9**	**16.0**	**16.0**	**15.5**	**14.7**	**13.8**	**13.7**	**13.4**	**13.4**	**13.2**
Bcm	**2021**	**2022**	**2023**	**2024**	**2025**	**2026**	**2027**	**2028**	**2029**	**2030**
Algeria	3.08	3.08	3.08	3.08	3.08	0.00	0.00	0.00	0.00	0.00
Egypt	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Equatorial Guinea	1.68	1.68	1.68	0.95	0.00	0.00	0.00	0.00	0.00	0.00
Norway	0.93	0.76	0.33	0.33	0.33	0.33	0.00	0.00	0.00	0.00
Norway Assumed Extension	5.11	5.11	5.11	5.11	3.61	0.00	0.00	0.00	0.00	0.00
Peru	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Qatar	14.97	14.97	14.97	14.97	14.97	14.97	14.97	14.97	14.97	14.97
Total Contracted ACQ	**25.8**	**25.6**	**25.2**	**24.4**	**22.0**	**15.3**	**15.0**	**15.0**	**15.0**	**15.0**
Total Contracted Take or Pay	**12.9**	**12.8**	**12.4**	**12.4**	**11.0**	**7.8**	**7.5**	**7.5**	**7.5**	**7.5**

Source: Wood Mackenzie

Gas quality issues

4.19. Natural gas is not a homogenous commodity – it is a cocktail, predominantly methane, but with a variety of other components. Some of these are combustible, others non-combustible. The nature of the cocktail – the "quality" of the gas – determines the combustion characteristics of the gas. One dimension of particular significance is the calorific content of the gas, measured by the "Wobbe Index" or "WI".

4.20. The specification of gas conveyed into National Grid's National Transportation System is regulated, for safety reasons, by the Health and Safety Executive (HSE), under the Gas Safety (Management) Regulations 1996 (GS(M)R).

4.21. Much internationally traded gas (e.g. in the continental EU and LNG) has a Wobbe Index above the range permitted by the GS(M)R. From 2002-2007, DECC's predecessor departments (DTI and then BERR) reviewed the case for modifying the characteristics (including the WI range) permitted under the GS(M)R, in order to minimise the requirement to process gas as we become increasingly dependent on imports. A published Impact Assessment (with Cost-Benefit Analysis) in 2007 pointed unambiguously to the "no change" option.[16] On this basis, the then Government confirmed that it would not propose (to the HSE) any change to our regulated specification to take effect before 2020, and on current evidence after 2020 either.

4.22. This has enabled commercial investment to install gas processing plant (to "ballast" high WI imported gas with inert nitrogen) at our major new gas import terminals – Isle of Grain, Teesside GasPort, South Hook, Dragon, Easington.

4.23. However, there remains a risk that the difference in gas quality standards between the UK and the European mainland could prevent the IUK interconnector from importing gas at times in the future. Should this situation arise, the short fall (up to 40mcm/day in National Grid's planning scenarios) would need to be made up from other supply sources such as LNG, Norway, UKCS and storage. Consequently, the severity of the risk would depend on the circumstances in which it occurred – i.e. could be critical at times of high peak demand and failure of other supply routes.

4.24. The GB market framework clearly allocates this risk to shippers, via the daily balancing requirement. Therefore, to the extent that shippers judge supplies through the IUK Interconnector to be at risk they may rely upon a number of supply and demand side measures (indigenous production, withdrawals from storage, imports via other routes, demand-side response) in order to ensure their portfolios are balanced.

4.25. Meanwhile, in January 2007, the EU Commission gave a mandate to the standardisation body CEN to draw up European wide standard(s) for gas quality that are the "the broadest possible within reasonable costs". This work is currently on-going.

4.26. Several options can be conceived of to address the risk. Facilities could be constructed at Bacton, Zeebrugge or upstream of Zeebrugge. The UK Government understands that Fluxys, the Belgian gas network operator, is planning to install ballasting facilities at a disused Peak Shaving plant in the Zeebrugge area. This facility would allow optimal operation of the Belgian entry/exit system, not being constrained by the existing difference in H-gas quality as it is now, but still guaranteeing the same contractual firmness and

[16] http://www.decc.gov.uk/en/content/cms/meeting_energy/markets/gas_markets/quality/quality.aspx

reassurance to the market players to ship "UK on-spec" gas to the UK. Such a facility, once constructed, could ballast gas destined to be transported from the Continent to GB via the IUK pipeline (but this functionality will pretty much depend on the level of commitment received from interested parties). Further details about the facility's capacity, and planned commissioning date, should become clear in the near future.

Role of gas fired electricity generation in the energy mix

4.27. Detail on the role of gas in the electricity mix is set out in DUKES,[17] which shows that gas fired generation accounted for some 47% of net electricity supplied in 2010.

4.28. Three factors are likely to lead to increased reliance on gas for electricity generation in the future:

- Electricity demand is expected to increase considerably as we move to a low carbon economy with electrification of heat and transport. Under some scenarios, electricity demand is expected to double by 2050.[18]
- The Large Combustion Plant Directive,[19] and subsequently the Industrial Emissions Directive,[20] will lead to closures of coal fired power stations from 2016. This generation capacity is expected to be replaced by some gas fired generation along with renewable generation and other low carbon technologies; and
- Increasing use of renewable generation technologies, in particular wind power, will lead to an increased requirement for flexible generation in future to compensate for the intermittent nature of wind. Currently, it is expected that gas fired generation will have a key role in balancing the electricity system at times of high demand and low wind.

4.29. Currently, there is considerable scope for the power generation sector to switch from gas to coal at times of high gas demand or supply shortages. This flexibility provides a valuable tool for balancing the gas market and thereby underpinning gas security of supply.

4.30. The combination of an overall increase in gas fired generation and a reduction in coal fired generation may lead to an overall reduction in demand side flexibility for gas. The extent to which this will be a problem will depend to a large extent on the future generation mix, which is a matter for the market to decide.

Short-Term Context

Demand

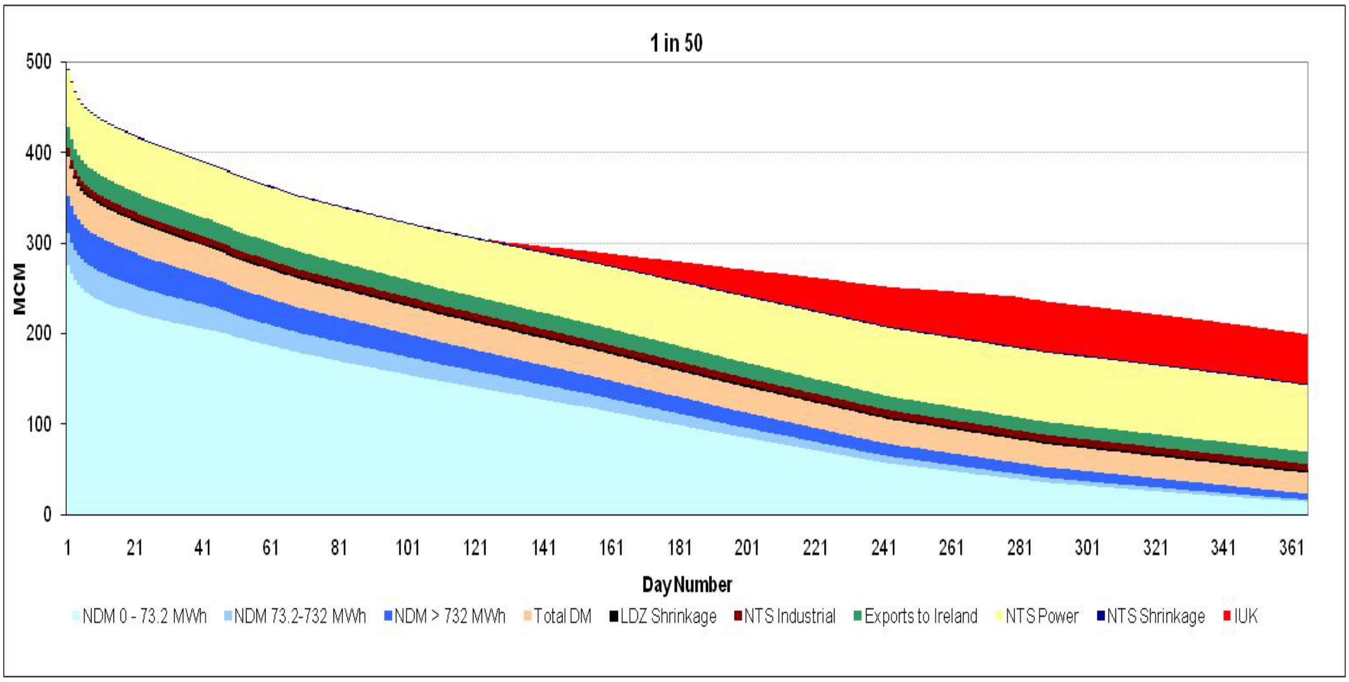
4.31. The load duration curve shown in Chart 4.9 displays observed demand levels from different sectors and customer groups ordered from highest to lowest demand days over the course of a year. Chart 4.9 is a forecast, which shows the national diversified demand position, based on 1 in 50 severe conditions. In the below scenario, it would be expected

[17] http://www.decc.gov.uk/assets/decc/11/stats/publications/dukes/2307-dukes-2011-chapter-5-electricity.pdf
[18] http://www.decc.gov.uk/en/content/cms/tackling/2050/2050.aspx
[19] Directive 2001/80/EC of the European Parliament and of the Council of 23 October 2001 on the limitation of emissions of certain pollutants into the air from large combustion plants.
[20] Directive 2010/75/EU of the European Parliament and of the Council of 24 November 2010 on industrial emissions (integrated pollution prevention and control) (Recast)

that there would be a market led demand side response which would lower the overall demand burden, particularly at the extremities commensurate with very cold weather.

4.32. This demand side response would be expected to occur, because a proportion of industrial and generation load is price sensitive, and therefore responds to higher wholesale gas prices which could be traded at the National Balancing Point (NBP). It would also be expected that higher gas prices would result in non-gas fired electricity generators displacing some Combined Cycle Gas Turbine (CCGT) power stations in the generation mix. Such volumes of market responsive demand side reduction are determined by the relative volume of available power station generation margin and its fuel type mix i.e. coal, gas oil etc. Based on the position to date, such typical measures could provide a daily overall demand reduction of up to 40mcmd for a peak demand day in the 1 in 50 winter scenario. However if gas is the marginal source for power generation due to relatively high costs compared to alternative fuels (particularly coal) the level of relief could be considerably reduced.

Chart 4.9: Load Duration Curve[21] – 1 in 50 winter



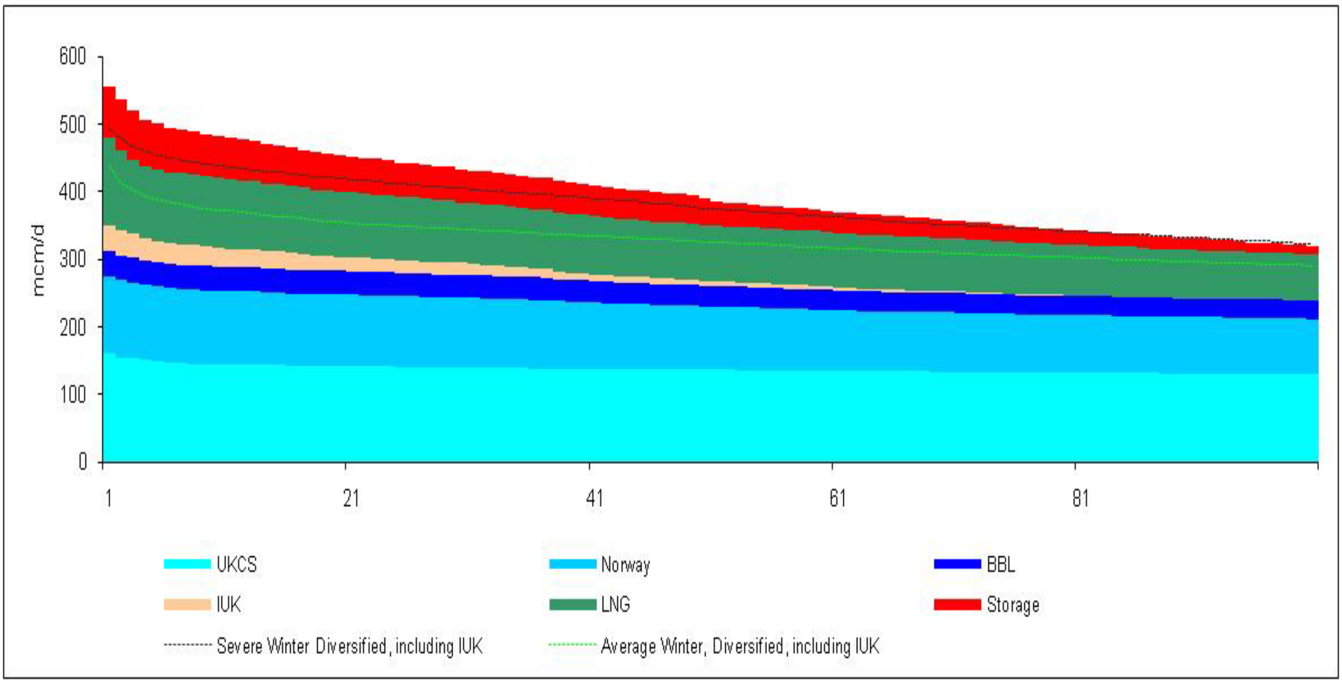
Source: National Grid

[21] The 1 in 50 severe load duration curve is that curve which, in a long series of years, with connected load held at the levels appropriate to the year in question, would be such that the volume of demand above any given demand threshold (represented by the area under the curve and above the threshold) would be exceeded in one out of fifty years.

Supply

4.33. Chart 4.10 shows cumulative supply deliverability over 100 days. This is actual supply data from winter 2010/11 but ordered in terms of the highest day of supply for each supply component to reflect the supply characteristics and responsiveness to demands. Storage supplies drop off quite rapidly as short and medium range sites become depleted. Other supply sources remain relatively constant (such as supplies across the BBL import pipeline). Others show some degree of responsiveness to demand; LNG is a good example of this. UKCS and Norwegian supplies also show some responsiveness.

Chart 4.10: Supply Duration Curve with 2011/12 ‘Gone Green’ Diversified Demand



Source: National Grid

4.34. Medium-range storage (typically in salt caverns) is capable of being refilled relatively quickly, as is long-range storage. Price signals in the gas market provide commercial incentives and replenish storage facilities in the course of the winter. ‘Cycling’ of this kind adds to supply resilience and means that our ‘virtual storage capacity’ exceeds our physical storage capacity.

5. Risk Assessment – Risk Identification and Analysis

5.1. This section identifies and assesses risks relevant to the gas supply infrastructure, as required by the Regulation. First, the impact of a supply shock equivalent to the loss of the largest single piece of gas supply infrastructure (either the Langeled pipeline or IUK interconnector) is analysed: over the course of a day, week, month and entire winter and under both average and severe demand conditions. This analysis has been prepared by National Grid for their 2011 Winter Outlook report, and constitutes National Grid's current view of gas supply and demand for winter 2011/2012. If gas demand is significantly higher than the current assumptions, the risks to security of supply become more significant.

5.2. This is followed by a series of five detailed illustrative case studies to give an idea of events that have in the past caused supply shocks or realistic events that could cause such shocks. For each example, the case study details the impact (or potential impact) of the shock, the disruption these caused (or could potentially cause), an indication of how the market coped (or could cope) with this disruption and a quantitative assessment of the likelihood of such a risk recurring.[22]

5.3. Finally, this section presents analysis on the achievement of the N-1 and supply standards, as required by the Regulation.

Supply Shocks

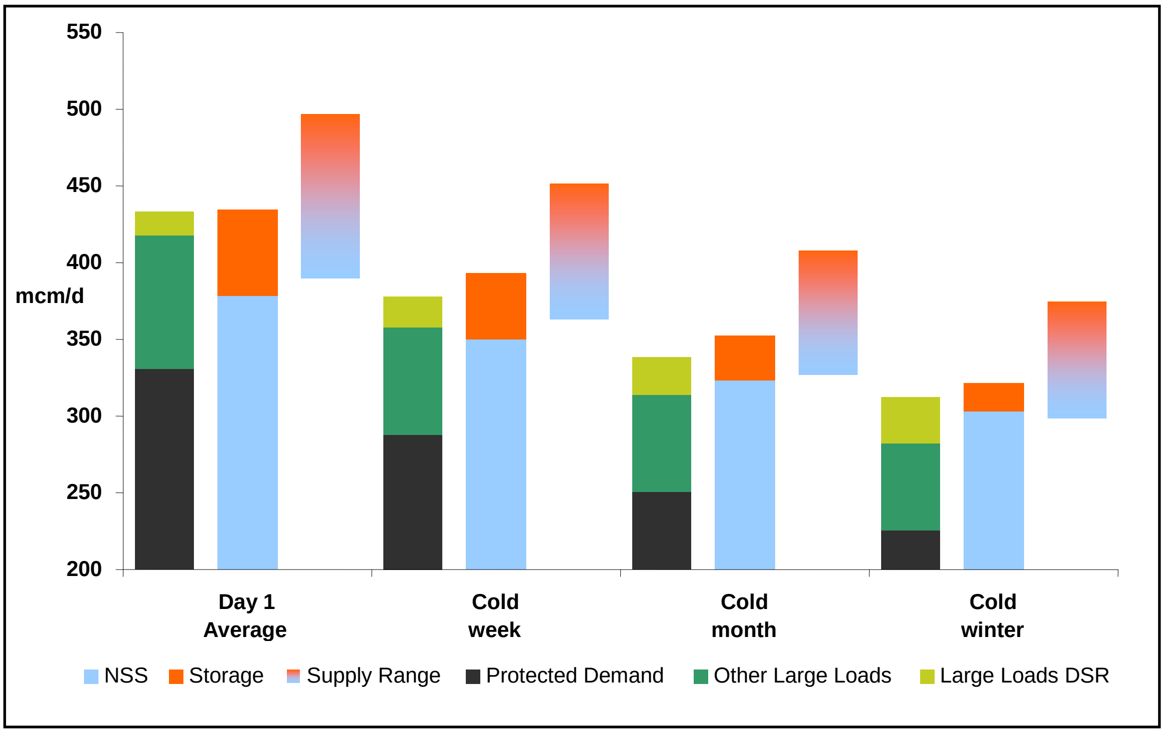
Cold Spell Analysis

5.4. Chart 5.1 shows a cold spell analysis for average demand conditions for 4 durations:

- The coldest day typically -2°C
- The coldest week of the winter at about 1°C
- The coldest month at about 3°C
- The coldest 3 months of the winter at about 5° C

[22] Ofgem intends to publish the draft policy decision on the Gas Security of Supply Significant Code Review in shortly. As part of the draft policy decision, a draft impact assessment will be published which includes an assessment of gas supply security and the costs and benefits of reform options.

Chart 5.1: Cold spell analysis for average winter conditions



Source: National Grid

5.5. The chart shows 3 bars for each level of demand. The first bar shows demand as 3 components:

- Protected demand [23];
- Large loads that are not expected to respond to a short term increase in gas price. These are defined in the chart as ‘other large loads’;
- Large loads that are expected to respond to a short term increase in the gas price and therefore provide a demand side response (DSR). These are defined in the chart as ‘large loads DSR’ .

5.6. The DSR is shown as a range from 15 - 30 mcm/d. Approximately 5 - 25 mcm/d of this response is assumed from gas fired power stations, arising through increasing prices during a period of either high demand, a supply shortage or a combination of both. For weekdays at high gas demand, the DSR could be as low as 0 – 10 mcm/d.

5.7. The low assessment for DSR from power generation arises as coal fired power stations rather than gas is assumed for base load power generation. Other generating assumptions also limit the response, namely low wind (8%), relatively low nuclear availability (83%) and some electricity interconnector exports.

[23] For the purpose of this risk assessment, ‘protected customers’ relates to all customers protected by National Grid’s safety monitor, which includes all non-daily metered demand (including household customers), customers where disconnecting gas supplies would be life threatening (e.g. hospitals and care homes), a limited number of larger commercial customers and gas flows to NI and exports to Republic of Ireland. This definition, therefore, is wider than that used in the Regulation.

5.8. For each additional GW of non-gas generating plant available, the DSR increases by about 4.5 mcm/d. Though not shown, an additional DSR of typically 10 mcm/d may be possible for a limited time through use of distillate.

5.9. The second bar represents supply shown as non-storage supply (NSS) and storage The third bar shows the range of supply for NSS and from an assessment of storage use. The wide range of the NSS and storage highlights the significant amount of supply flexibility that is available within the UK. Flexible supplies include storage, LNG imports, IUK and to a lesser extent Norway and BBL.

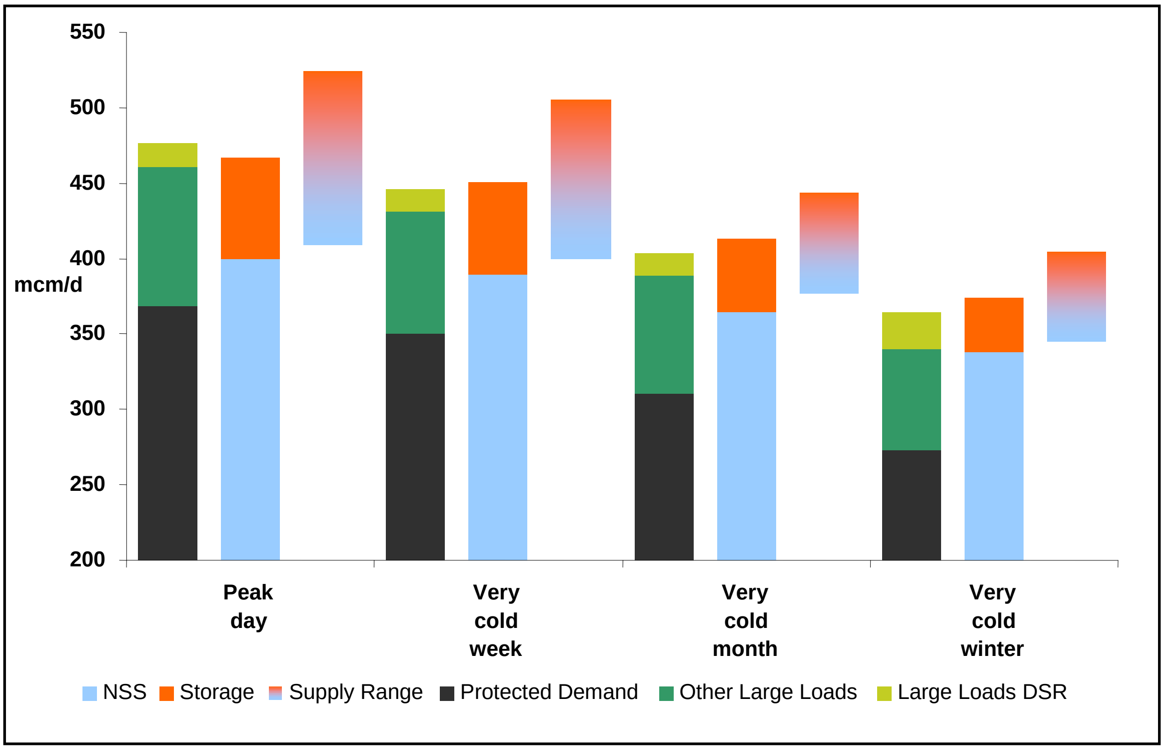
5.10. The analysis shows that, for average conditions, all demand is met by central case supplies for all demand conditions evaluated. Protected demand is readily met by NSS for all demand conditions.

5.11. Chart 5.2 shows a similar cold spell analysis for severe (1 in 50) demand conditions:

- The peak day[24] (1 in 20), typically -5°C
- The coldest week of the winter at about -3°C
- The coldest month at about -1°C
- The coldest 3 months of the winter at about 1.5°C

[24] 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, January 13th 1987, was in a 1 in 3 cold winter.

Chart 5.2 - Cold spell analysis for severe conditions



Source: National Grid

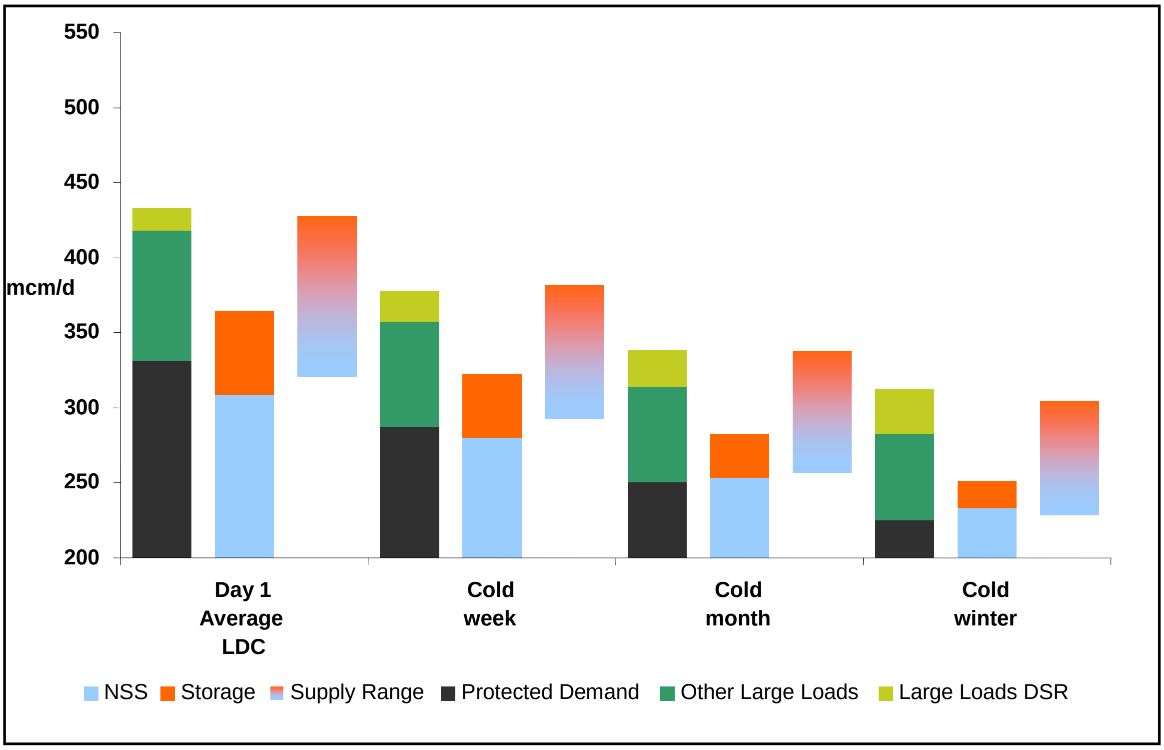
5.12. Apart from a 10 mcm/d requirement for either additional NSS or storage or an equivalent demand side response for a peak day, all demand could be met by the central case supply assumptions for all demand conditions evaluated. The wide range of the NSS and storage at peak and the potential for a demand side response indicates that a requirement for 10 mcm/d should in principle, be achievable.

5.13. Protected demand is readily met by NSS for all demand conditions.

Supply Loss Analysis

5.14. Chart 5.3 shows the cold spell analysis for average demand conditions and a 70 mcm/d supply loss, shown as a reduction in NSS. The 70 mcm/d supply loss applies to the day, week, month and winter (3 month) periods, i.e. from a single day supply loss to a winter-long loss. A 70 mcm/d supply loss would be broadly consistent with the loss of the current largest source of imports, namely the Langeled pipeline or close to capacity of IUK.

Chart 5.3 - Cold spell analysis for average conditions and 70 mcm/d supply loss



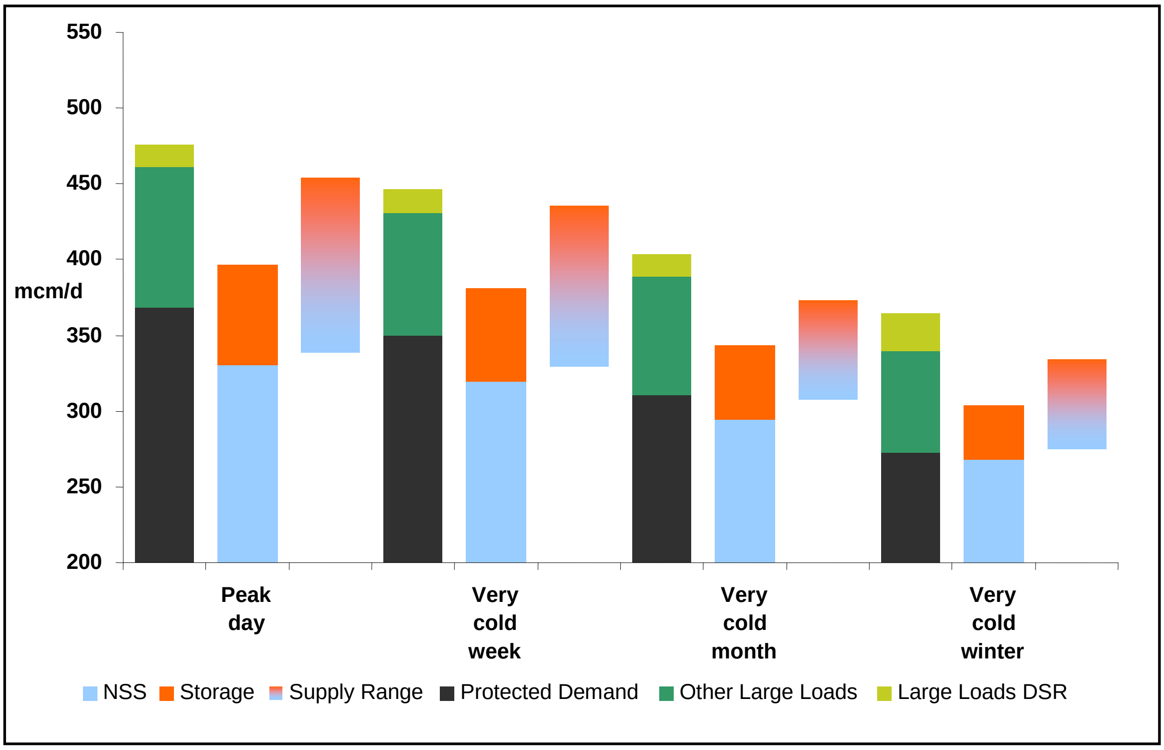
Source: National Grid

5.15. Predictably, the resulting analysis shows a requirement for an increase in NSS and storage and potentially a demand side response.

5.16. Protected demand is met by central case NSS and storage for all demand conditions.

5.17. Chart 5.4 shows the cold spell analysis for severe demand conditions and a 70 mcm/d supply loss.

Chart 5.4 - Cold spell analysis for severe conditions and 70 mcm/d supply loss



Source: National Grid

5.18. As expected, the resulting analysis shows a requirement for an increase in NSS and storage and potentially a demand side response. Even with these responses, further supplies or more demand response may be needed. Protected demand is met by central case NSS and storage for all demand conditions.

Case Studies

5.19. The case studies below detail various supply shocks that have happened or are plausible. In each case, the cause of the supply shock is outlined, together with an indication of the impact of the shock and a description of how the market coped.

Case study 1 - Very high demand + supply disruption: January 2010 supply loss from Norway

Background

1.1. During the cold snap in early January 2010, demand remained consistently above 400 mcm for twelve successive days (From 3-14 January). This is well above the 330-350 mcm associated with a typical winter's day. Demand for gas also surpassed the previous record for gas demand, peaking at 465 mcm on 8 January 2010.

1.2. The high levels of gas demand coincided with temporary disruptions to gas supplies from Norway. The outages occurred at a number of Norwegian processing plants and gas fields over the period from 2 to 9 January 2010.[25] These outages reduced gas flows through the Langeled pipeline. From 2 to15 January, volumes averaged slightly over 50 mcm, compared to an average of just over 70 mcm during the week preceding the difficulties.

Operational response

1.3. These combined supply and demand-side factors caused National Grid to issue four within-day Gas Balancing Alerts (GBAs) between 4 and 11 January. GBAs are a way of indicating to the market that additional supplies and/or demand-side response are required, in order to avoid a shortfall.

Market Response

1.4. Wholesale gas prices rose around the time of the GBAs. Within-day prices increased from around 35p/therm on 31 December 2009 to around 61p/therm following the first of the GBAs, and briefly peaked within day at around £1/therm following the third GBA on Saturday 9 January. This provided the incentive for additional supplies to come forward (from LNG terminals, IUK pipeline and storage) and for gas demand to fall (through coal being favoured over gas in the power generation sector). Industrial consumers with shorter term contracts reacted more than those with longer contracts. This indicated that the market perceived the tightness to be short lived. After the last of the GBAs was lifted, prices quickly returned to their pre GBA levels.

[25] On the weekend of 2-3 January 2010 the Kollsnes processing plant and Troll Platform A suffered outages. These outages were resolved by 3 January, but it took the sites several days to ramp up, and thus flows from Norway to the UK continued to be affected in the week commencing 4 January. Outages subsequently occurred again at Troll Platform A on 7 January, and at the Ormen Lange field and the Kårstø processing plant the following weekend.

Case study 1 - Very high demand + supply disruption: January 2010 supply loss from Norway

Implications and risk of future reoccurrence

1.5. The market responded well to unprecedented levels of demand and the coincidence of supply side failures. The use of GBAs proved successful in prompting the necessary corrective action by the market.

1.6. It is likely that similar events may happen in the future.

Case Study 2 - Failure of import terminal: Fire at Bacton terminal, 2008

Background

2.1. A fire at a water-treatment facility at a Shell-operated Bacton import sub-terminal instantaneously removed 30mcm/day of supply between 28 February and 3 March, 2008. It took place at a time of average winter demand.

Operational response

2.2. None taken – see market response.

Market response

2.3. Spot prices immediately increased by around 25%. This had a knock on effect on the forward curve, with March forward prices trading 11% higher the next morning. However, it should be noted that at the same time as the Bacton incident day on day increases in the oil markets occurred, so the rise in gas price may not have been fully linked to Bacton.

2.4. In response, withdrawals from storage increased, making up for the supply shortfall.

Implications and risk of future reoccurrence

2.5. Shell UK, the terminal operator, were prosecuted by Environment Agency and the Health and Safety Executive. They were fined £1m plus £240,000 after admitting seven safety and pollution offences.

2.6. There are strong commercial pressures on companies to take necessary steps to avoid the incidence of such events. The high-profile nature of the incident, combined with the legal proceedings and significant fine, add further pressure on operators. However, it is not possible to rule out similar events in the future.

2.7. Such events underline the value of diversity of supply sources and routes.

Case Study 3 - Geopolitical Events: 2009 Russia/Ukraine supply disruption

Background

3.1. In January 2009, in a gas dispute between Russia and Ukraine, all gas supplies to Ukraine, including transit gas for delivery to the EU, were cut off for two weeks. This equated to 30% of EU gas imports at the time.

Operational response

3.2. None taken – see market response.

Market response

3.3. 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. The main impacts in GB 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 future reoccurrence

3.4. Following the dispute various actions have taken place at an EU level and in Member States to enhance resilience and to reduce / mitigate against the impact of a recurrence of such a supply disruption in the future. Measures and obligations in the EU Security of Gas Supply Regulation (which *inter alia* require preventive and emergency plans and detail supply and infrastructure standards) will lead to greater EU cross-border pipeline interconnection and reverse flow capabilities, and possibly also lead to investment in additional storage capacity.

3.5. In the event that the 2009 supply cut off had been further prolonged, we would 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.

Case Study 4 - Disruption of supplies from third countries

4.1. The UK has on many occasions experienced supply disruptions from 3rd countries: for example in 2010 and 2011 from Norway as described in case study 1. There have also been temporary disruptions at Isle of Grain LNG import terminal. On their own such disruptions do not cause significant supply shocks - the diversity and spare capacity of other supply routes to the UK enables other supply sources to make up the shortfall.

4.2. However, they are likely to increase prices – to a degree broadly related to the extent and magnitude of the outage. Such price increases would be expected to attract additional gas supplies to the UK (assuming they are available), withdrawals from

Case Study 4 - Disruption of supplies from third countries

storage, and demand-side response. Therefore, we do not consider a third country supply disruption, in an otherwise benign situation, to be a catastrophic risk.

Case Study 5 - Combination of events: Severe weather, tight LNG markets, infrastructure failure

5.1. DECC carries out periodic assessments of possible risks, to test the robustness of the gas market under different scenarios. Conclusions from the most recent 'stress tests' analysis are summarised below.[26]

5.2. This looked at a number of extreme and highly unlikely combinations of events, at 5-year intervals:

Case 1 – loss of GB's largest gas storage facility for a whole year including a severe winter;

Case 2 – loss of GB's largest terminal for a whole year including a severe winter;

Case 3 – loss of GB's largest source of imports for a whole year including a severe winter; and

Case 4 – combined shock for a whole year (for example, loss of the Bacton terminal and loss of Russian gas through Ukraine), including a severe winter.

5.3. Although these scenarios are extreme, and highly unlikely to arise, the analysis suggested that the gas market is currently robust to them. None of these scenarios would result in shortages of gas that would necessitate involuntary interruptions to industrial consumers.

[26] A full write up can be found in the independent report from Poyry: GB Gas Security of Supply, 2010.

Other Risks

Failure of transmission infrastructure

5.20. In accordance with the Regulation, DECC (as the Competent Authority for the Regulation) has asked National Grid Gas (in its capacity of transporter of Natural Gas) to calculate the N-1 standard. In determining the inputs to the N-1 calculation, the relevant largest credible supply loss is the one that affects only a single system entry capacity infrastructure point or sub-terminal. Bacton IUK comprises the largest capacity at 74mcmd today, and therefore is the volume loss applied in the calculation. There are, however, a number of potential scenarios where a catastrophic failure of infrastructure within the national transmission system (NTS) could lead to a loss of supply greater than that assessed for the N-1 calculation. In general this would require a simultaneous failure to affect multiple plant items (e.g. the total loss of compression capability at key nodes). These scenarios have not been considered for the N-1 calculation.

5.21. Moving forward, a failure affecting the single 100km pipeline connecting Milford Haven to Felindre would lead to a loss of supplies from both Milford LNG terminals. This is not currently the case, but post October 2012 such a loss would equate to ~86mcm/d and National Grid would anticipate using this higher figure in future N-1 calculations. Notwithstanding this and assuming that other supply / demand figures remain broadly stable, National Grid do not currently anticipate that this will lead to the UK failing the N-1 test in the short to medium term.

N-1

5.22. N-1 calculation based on the formula of:

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

N-1 Calculation for Great Britain & Northern Ireland 2011/12 (all data from National Grid's 2011 planning basis, flows in mcm/d)

	Capacity (mcm/d)	Notes and Assumptions
Main Infrastructure (I_m)	**74**	74 for IUK (Langeled 70). From 2012/13 this is expected to increase to 86 to reflect the combined capacity of both Milford Haven LNG terminals)
Max imports (EP_m)	**252**	Excludes LNG imports (includes IUK 74, BBL 54, Langeled 70, Vesterled 36, Tampen & Gjoa ~19
Max indig. production (P_m)	**149**	
Max storage (S_m)	**114**	Includes a contribution from Holford
LNG (LNG_m)	**157**	Excludes Teesside GasPort but includes South

		Hook II and Grain III (South Hook 59 , Dragon 27, Grain 59)
Max demand (D_{max})	**532**	2011 forecast for peak 1 in 20 demand for 2011/12. Includes gas flows to Northern Ireland but excludes 29 to Republic of Ireland. This number represents **undiversified 1 in 20 firm** demand, our design basis for provision of network capacity. All NTS interruptible demand is assumed to be off due to demand side response. From 2012/13 there will be no interruptible demand.

For loss of IUK:

At Peak: N-1 = (252 + 149 + 114 + 157 - 74) / 532 = **113%**

Supply standard

5.23. The cold spell analysis in section 5 demonstrates that the UK comfortably achieves the supply standard requirements to ensure gas supply to protected customers in the circumstances set out in Article 8 of the Regulation.

5.24. In practice, the UK achieves the requirements of the supply standard through sharp commercial incentives on shippers/suppliers to provide sufficient gas to meet the needs of all their firm customers[27] on any gas day and under any weather conditions or other circumstances.[28] These incentives are being sharpened further through the Ofgem Gas Security of Supply Significant Code Review.

5.25. DECC are, however, considering whether the UK needs to take any further action in order to formalise the terms of the Supply Standard within the UK arrangements.

[27] It should be noted that shippers can have interruptible contracts to help facilitate an overall balance.
[28] The ability of shippers to meet demand under all circumstances, in response to the incentives, is of course subject to the shippers continuing to access the necessary credit and remain in business. There could come a point at which a shipper would become insolvent.

6. Conclusions

6.1. Security of gas supply in the UK is provided through effective gas market arrangements with sharp commercial incentives on shippers to supply their customers. The UK already carries out significant risk assessment, and National Grid have ongoing, consultative, processes to collect data on supply and demand and inform the market.

6.2. The analysis presented in this risk assessment demonstrates that the UK gas supply infrastructure is resilient to all but the most unlikely combinations of supply shocks. Supplies to protected consumers (including households) are maintained in all scenarios. However, the UK Government is not complacent. Previous risk assessments have shown that there are some plausible, if unlikely, scenarios that could lead to supply difficulties. Further, mid to longer term challenges for gas supply exist in particular as gas demand for electricity generation increases and becomes less flexible.

6.3. In response to these challenges, Parliament included measures in the Energy Act 2011 to enable Ofgem to implement in a more timely way a sharpening of the commercial incentives on gas shippers to ensure that they have sufficient gas available to meet demand, if Ofgem's Significant Code Review should demonstrate the need for such action.

6.4. 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.

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