Department for
Business, Energy
& Industrial Strategy

UK National Risk Assessment on Security of Gas Supply 2022

Report completed for the Gas (Security of Supply) Regulation

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Contents

Executive Summary

This document forms the National Risk Assessment required by Gas (Security of Supply) Regulation EU 2017/1938 ('the Regulation'), incorporated into UK law by the Gas (Security of Supply and Networks Codes) (Amendment) (EU Exit) Regulations 2019.[1]

The Regulation is based on the principle that measures (even in situations of tight supply) should be market-based for as long as possible.

Introduction

The UK's gas infrastructure must be sufficient to:

- Meet 'peak' demand, including significant 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.
- Provide access to the most competitively priced gas supplies.

Diversity of gas supplies, sources, and routes to market are key features that support the UK's continued security of gas supply. 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 capacity. Risk analysis suggests that UK infrastructure could meet a peak day with demand 30% above the highest historical gas demand day. Currently only a portion of this import infrastructure is utilised, offering flexibility for future supplies.

Price signals have proven an effective means of delivering security of market supply. Shippers (gas traders) 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 System Operator of entering the market and buying or selling gas to balance the grid on a daily basis.

[1] S.I. 2019/531

Description of the UK Gas System

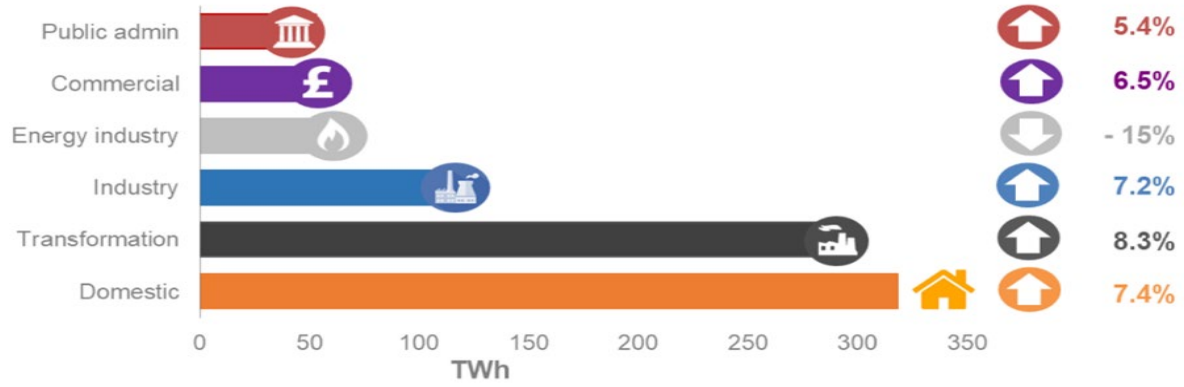
Gas Consumption

Natural gas provides the main energy source for heating homes and businesses in Great Britain (GB) and a significant proportion in Northern Ireland (NI). It is also a major primary energy source for industry and electricity generation, as well as being a feedstock for some industrial applications. In 2021, natural gas accounted for nearly 43% of all the UK's primary fuel consumption.[2]

In 2021, natural gas consumption increased by 5.9% on 2020 to 861 terawatt hours (TWh) (78 billion cubic metres (bcm)). This increase was largely attributable to the easing of restrictions in place to curb the spread of COVID-19, compounded by colder weather and weaker performance from renewable electricity generation (with gas filling a gap caused by less windy conditions). Despite the overall increase, demand remained slightly below pre-pandemic levels and varied by sector.[3]

In 2021, domestic sector consumption increased by 7.4% compared to 2020 at 318 TWh (29 bcm). Demand for natural gas from the industrial sector increased by 7.2% compared with 2020, reflecting substantially fewer restrictions on operations in 2021 compared with 2020. However, this trend was not uniform across industrial sectors with falls in consumption in the chemicals and the paper and printing sector, as a result of high wholesale gas prices.

Figure 1: Sectoral consumption of natural gas, 2020 to 2021



Source: Digest of United Kingdom Energy Statistics, BEIS

The peak winter day demand for 2021/22 was 370mcm on the 1st March, 45 mcm lower than 2020/21.[4]

[2] See table 1.1 in BEIS (2022) Digest of United Kingdom Energy Statistics (DUKES). Available at: https://www.gov.uk/government/statistics/energy-chapter-1-digest-of-united-kingdom-energy-statistics-dukes
[3] See Chapter 4: Natural Gas, in BEIS (2022) Digest of United Kingdom Energy Statistics (DUKES). Available at: https://www.gov.uk/government/statistics/digest-of-uk-energy-statistics-dukes-2022
[4] National Grid: Data Item Explorer. Available at: https://mip-prd-web.azurewebsites.net/DataItemExplorer/Index

Gas Supply

The UK has a diverse range of gas supply sources. These include indigenous gas production from the UK Continental Shelf, pipelines connecting the UK to the Norwegian Continental Shelf, two interconnectors to continental Europe, and Liquefied Natural Gas (LNG) landing at one of the UK's three LNG terminals (which provide the UK with one of the largest LNG import infrastructures in Europe). Table 1 shows the total volume of UK gas supply per sources and the percentage that those sources contribute to the overall supply mix.

Table 1: UK Gas Supply Portfolio: total volume (bcm) and percentage of supply mix.[5]

	2020		2021	
	bcm	**%**	**bcm**	**%**
UK Production	39	47%	33	39%
Total Pipeline Imports	25	31%	37	44%
Norway	24	29%	32	39%
Netherlands	1.0	1%	2.3	3%
Belgium	0.3	0.4%	1.8	2%
Total LNG Imports	18	22%	15	18%
Qatar [LNG]	8.9	11%	5.7	7%
US [LNG]	4.9	6%	3.9	5%
Russia [LNG]	2.3	3%	3.1	4%
Elsewhere [LNG]	2.2	1.16%	2.1	2.5%
Total Imports (Pipeline + LNG)	44	53%	51	61%
Total Supply	83	100%	84	100%

UK Continental Shelf (UKCS) Production

Table 1 above shows that indigenous production continues to be the largest single constituent of the UK gas supply mix. In 2021, UKCS production accounted for around 39% of total supply. This was a marked decrease from the previous year, though is primarily explicable by the effect COVID-19 had on upstream maintenance schedules. With COVID-19 affecting the ability of upstream assets to conduct maintenance in 2020, a heavy maintenance schedule was conducted in 2021. Several major terminals were shutdown, including the Forties Pipeline System (FPS) which serves a significant proportion of UK oil and gas production. This suppressed upstream activity over 2021 such that total UKCS production for the year, 33bcm

[5] Source Energy Trends 4.2. 4.4. For more information on the methodology by which these figures are derived, please see here: https://www.gov.uk/government/publications/natural-gas-statistics-data-sources-and-methodologies

(or 364TWh), is a record low. UKCS production in the first quarter of 2022 was 5% more than that for the equivalent period in 2021.[6]

Import Infrastructure

The UK benefits from access to a diverse range of import sources facilitated by robust infrastructure. Total import capacity is around 146bcm per year, split near-equally across three principal sources: LNG (48.1bcm), Norway (44.6bcm), and continental Europe (43.3bcm).

Table 2: Existing import infrastructure

Facilities	Operator/ Developer	Type	Location	Capacity (bcm/year)
Isle of Grain 1-3	National Grid	LNG	Kent	19.3
South Hook 1-2	Qatar Petroleum and ExxonMobil	LNG	Milford Haven	19.9
Dragon 1	Shell / Petronas	LNG	Milford Haven	8.9
Langeled	Gassco	Pipeline	Easington	24.9
Vesterled	Gassco	Pipeline	St Fergus	13.5
Tampen	Gassco	Pipeline	St Fergus	6.2
Interconnector	Interconnector Ltd	Pipeline	Bacton	26.9
BBL Pipeline	BBL Company	Pipeline	Bacton	16.4
			Total	146

Source: National Grid Gas Ten Year Statement 2021.

Norwegian Continental Shelf (NCS) Production

Norway has historically been a large import source to the UK with shared infrastructure in the North Sea allowing the UK to benefit from its geographical proximity to Norway's substantial gas reserves. Norway continues to be a reliable energy partner for the UK; Table 2 above shows that NCS supply is the largest constituent of UK imports and constituted 39% of the total supply mix in 2021.

[6] BEIS Energy Trends, June 2022, https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/1086781/Energy_Trends_June_2022.pdf

Interconnectors

The UK has four interconnector pipelines which can transport gas between neighbouring countries. Two of these have bi-directional flow capacity which facilitate both imports and exports:

- Interconnector Limited, between Belgium and the UK (INT).
- Bacton-Balgzand Line interconnector, between the Netherlands and the UK (BBL).

The other two interconnectors remain uni-directional, facilitating exports. They are:

- The Moffat interconnectors (IC1/IC2) between Scotland and Ireland.
    - The Scotland-NI Pipeline (SNIP) branches off from these and flows gas to Northern Ireland.
    - Ireland continues to be heavily reliant on the GB market for its gas. Indigenous production from the Corrib gas field is expected to decline steadily in the future and currently there is no potential for sustained gas flows from Ireland to the GB market.
- The South-North Pipeline (SNP), which flows gas from Ireland and Northern Ireland, but is not in use at present. SNP gas flows across the interconnector have been for specific operational and maintenance purposes by the Transmission System Operator, GNI UK. Gas can currently only flow from Ireland to Northern Ireland via the SNP. Reverse flow would provide another supply route into Ireland, but this would be the same gas that had already come through IC1 and IC2, which flow directly to Ireland from GB (as these interconnectors also spur off to supply 100% of Northern Ireland's gas). There is currently therefore no demand for gas to flow through SNP from Northern Ireland to Ireland.

Liquefied Natural Gas (LNG)

The UK has one of the largest LNG import infrastructures in Europe which provides access to the growing volume of global liquefaction and export capacity. This import infrastructure includes three LNG terminals, providing an aggregate import capacity of around 48.1bcm (see Table 2 above). While total LNG imports fell year-on-year from 2020 to 2021 (Table 1), imports in the first quarter of 2022 were up by almost 50% versus the same period in 2021.[7] This contributed to the GB system oversupply which allowed for large volumes of exports to the EU via the BBL and INT interconnectors over this period and into summer. These exports have contributed to security of supply in the EU, particularly after Russia's invasion of Ukraine and the subsequent reduction in Russian supply to Europe.

[7] BEIS Energy Trends June 2022
https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/1086781/Energy_Trends_June_2022.pdf

Gas Storage

Gas storage is an important flexibility provider in GB, offering flexibility to the gas market when other sources (UKCS, NCS, Interconnectors, LNG) are more expensive or not available. It responds to price volatility allowing shippers to utilise market opportunities throughout the year, and support security of supply.

Currently, the GB storage landscape is made up of seven sites all of which are commercially driven i.e., gas is injected when prices are lower (summer) and withdrawn when prices are higher (winter). Storage acts as a source of system flexibility when responding to short-run changes in supply and demand. GB storage has a capacity of c.1.5billion cubic meters. This has a maximum deliverability of 117mcm/day (i.e., the volume per unit of time that can be injected into the transmission network), 36% of average January daily demand. See table below for more information.

Table 3: List of current GB gas storage sites[8]

Facility & owner	Estimated working volume (mcm)	Approx. withdrawal rate (mcm/d)	Approx. max. injection rate (mcm/d)	Full to empty rate (days)	Opened
Stublach (Storengy)	400	30	30	13	2014
Hornsea (SSE Hornsea Limited)	300	12	3	21	1979
Humbly Grove (Humbly Grove Energy)	243	7	8	34	2005
Holford (Uniper UK Ltd)	237	22	26	19	2011
Aldborough (SSE Hornsea Limited/Equinor)	221	31	29	7	2009
Hatfield Moor (Scottish Power)	70	2	2	60	2000
Hill Top Farm (EDF Energy)	59	13	13	5	2011

There are different operating models for gas storage in the UK. Some operators sell their capacity to shippers in pre-agreed contracts whilst others operate the site themselves – selling their gas when there is market demand. They are all considered medium-range storage which

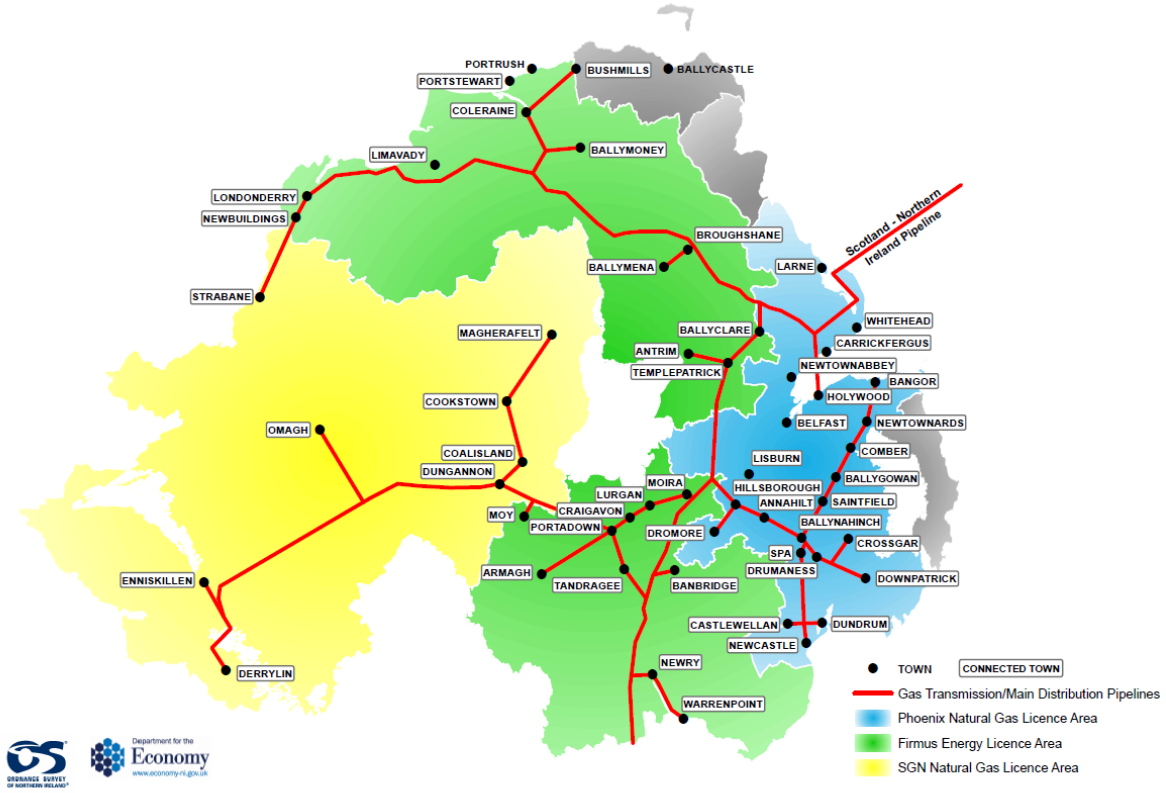
[8] https://www.ofgem.gov.uk/publications/gb-gas-storage-facilities-2022

means they can cycle gas regularly – however some sites can empty and refill within days, others within months (this is dependent on pressure and age of the facilities). Six out of seven are exempt from third party access, the seventh is currently undergoing the exemption process with Ofgem.

Figure 2: Offshore oil and gas infrastructure and onshore major gas pipelines[9]

[9] BEIS Natural Gas Statistics: Data Sources and Methodologies, February 2022, https://www.gov.uk/government/publications/natural-gas-statistics-data-sources-and-methodologies

Figure 3: The Northern Ireland Gas System[10]



[10] Department for the Economy, Northern Ireland

Infrastructure Standard

The UK N-1 calculation shows that the UK passes the requirements of the Regulation with a result of 110%.

N-1 Assumptions and Calculations

The N-1 calculation tests that the National Transmission System (NTS) has been designed to meet the 1-in-20 peak day demand even with the failure of the single biggest piece of infrastructure.

The N-1 calculation has been updated by National Grid Gas for their 2022/2023 Gas Winter Outlook Report.[11] For the coming winter, the supply margin at peak 1-in-20 demand under N-1 conditions has increased from a 104mcm/day surplus last winter to a 122mcm/day surplus.

The assessment is based on testing the impact of a failure of the 100km Felindre pipeline connecting the South Hook and Dragon LNG terminals at Milford Haven to the NTS. The failure of this pipeline represents the failure of the UK's single largest gas infrastructure, and it would lead to the loss of an estimated 72 mcm/d of capacity.

The N-1 formula is as follows:

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

Where:

- EPm – technical capacity of entry points, other than production
- Pm – maximal technical production capacity
- Sm – maximal technical storage deliverability
- LNGm – maximal technical capacity of LNG facilities
- Im – technical capacity of the single largest gas infrastructure
- Dmax – total daily gas demand
- Deff – demand-side measures

[11] https://www.nationalgrid.com/gas-transmission/insight-and-innovation/winter--outlook

2022	Capacity (mcm/d)	Notes
Main infrastructure (Im)	72	Felindre pipeline to reflect the combined capacity of both Milford Haven LNG terminals
Max pipeline imports (EPm)	230	Include entry points other than production with: continental Europe (89mcm/d) Norway (141 mcm/d)
Max domestic production (Pm)	117	Total indigenous production from the UK sectors of both the North Sea and Irish Sea along with gas produced onshore
Max storage (Sm)	117	The maximum daily technical capacity of GB storage
LNG (LNGm)	141	Includes South Hook, Dragon and Isle of Grain
Max demand (Dmax)	483	Diversified 1-in-20 peak day demand. It includes exports to the island of Ireland.

At peak: N-1 = (230 + 117 + 117 + 141 – 72) / 483 = 110%

If the 1-in-20 peak demand value considered UK-only demand, without factoring in any exports, then the value of the Dmax parameter would be 453 mcm/d. This would lead to an N-1 score of 118%.

Moreover, in order to provide a conservative estimate of the N-1 value no demand-side measures (Deff) have been include in the calculation.

Identification of Risks

The UK has highly resilient gas networks with a diverse gas supply and is able to react swiftly to any disruption. The Department for Business, Energy & Industrial Strategy, alongside the Department for the Economy (the relevant government department in the devolved administration of Northern Ireland), works with the System Operators and Regulators to continually assess risks to supply and have in place bespoke resilience plans to respond to a wide range of risks.

This section identifies the key risk factors which have been considered as applicable to the UK and could have a negative impact on the security of gas supply.

Political

Russia's aggressive action in Ukraine has impacted gas markets across the world. There are no gas pipelines directly linking the UK with Russia and imports from Russia made up less than 4% of total UK gas supply in 2021. On 6th April 2022, the Government announced its intention to ban imports of Russian LNG. The objectives of this measure are to deprive Russia of a key export market for these goods and reduce revenue generation and build on the voluntary phase-out of Russian LNG imports already made by UK industry (which has not imported any shipments of Russian LNG since March 2022). Legislation to implement this ban will be brought forward in due course.

While the UK has received very little gas from Russia, the integrated nature of the European gas market, and the fact that gas is an internationally traded commodity, means that factors that influence European or international prices are likely to be reflected in UK prices. Greater reliance on Russian supplies in continental European nations may result, in at least the short term, in some of those markets continuing to trade at a premium to GB's National Balancing Point (NBP) while they seek alternatives to Russian supply, curbing the commercial incentive to import gas from Europe to the UK. Further disruption to supplies on the Continent may motivate a continuation of minimal imports through the interconnectors as seen for large period of winter 21/22. Adjustments in wholesale contract prices may facilitate imports from Europe under normal market conditions.

Technological

Although significant levels of resilience are built into the UK's infrastructure, there can be instances of gas infrastructure suffering technical failure, such as equipment malfunction. These malfunctions could impact the availability or transportation of gas, which could lead to localised disruption to customer gas supplies. The likelihood of technical failures are, however, greatly reduced through regular inspections and compulsory maintenance carried out by the gas industry and appropriately monitored via the relevant Regulator. It is also the responsibility

of the gas sector to ensure robust plans are in place in order to respond to a wide range of risks.

Other examples of risk include malicious attacks, which could disrupt gas supply through physical or cyber means. A ransomware attack and supply chain vulnerability exploitation are examples of cyber threats to the gas sector. However, the Network and Information System Regulation (NIS) place requirements on operators, including gas transmission and distribution, to take appropriate and proportionate technical and organisational measures to manage risks to network and information systems. They are also required to take measures to prevent and minimise the impact of incidents and report such incidents to regulators. Physical and personnel security mitigations are in place at critical gas infrastructure to protect against physical threats such as terrorism.

Market and Financial

The UK gas system is supported by market flexibility and dynamic price signalling. Market flexibility ensures that continued balancing of supply and demand is facilitated by market responses causing adjustments in wholesale gas prices.

As we are integrated with continental European markets due to our interconnected gas systems (via the BBL and INT pipelines described above), factors that influence European prices are also likely to be reflected in UK prices. For this reason, prices on the UK's gas trading hub, the NBP, have historically risen alongside the continental European trading hubs with which the UK is directly connected: the Dutch Title Transfer Facility (TTF), and the Belgian Zeebrugge markets.

UK security of gas supply does not, in and of itself, depend on broad alignment between European and UK trading hub prices. The UK has received gas via the interconnectors from European suppliers when continental European gas demand has been met during the winter months (and prices in the directly interconnected European hub market(s) have subsequently been lower than the NBP). Moreover, if import bottlenecks exist in Europe and more LNG cannot arrive to continental Europe, the UK, possessing one of the largest LNG import infrastructures in Europe, remains a viable alternative market for LNG supply even in instances of the NBP price falling below the TTF/Zeebrugge price.

European price premiums above East Asia are expected to result in similarly strong price premiums between the NBP and East Asia during the winter period 22/23. Risks pertain to UK wholesale trading prices falling significantly below East Asian trading prices, however, which may incentivise LNG to flow to East Asian markets. UKCS production of natural gas has broadly been in decline since 2000, with some exceptions such as upon the commencement of new fields was seen in 2015-16. Operators and their trade associations have declared approximately £20bn of possible capital expenditure between 2022-26. However, the sector has raised concerns around the Energy Profits Levy, which they feel may disincentivise

ongoing investment in the UKCS.[12] Nonetheless, mergers and acquisitions across the UKCS have been prevalent, with various acquirers entering the sector since 2020.[13] The North Sea Transition Authority plans to launch another licensing round in the autumn, taking into account the forthcoming climate compatibility checkpoint and the need for energy security.

Access to LNG

The UK is well positioned to receive LNG imports. Across Europe, the UK has the second largest regasification infrastructure, with around 48.1bcm of import capacity (see Table 2 above). Only Spain has higher import capacity, at around 61bcm in 2022.[14]

Continental Europe continues to demand robust volumes of LNG to reduce dependence on Russian piped flows and to fill storage in time for winter. However, it is constrained by a lack of regasification infrastructure in Northwest Europe, where dependence on Russian flows is most acute. To mitigate this and to enable greater volumes of LNG to flow, member states plan on expanding their regasification capacity by 40bcm by the end of 2023.[15] Currently, Europe imports gas from the UK via the INT and BBL interconnectors to meet gas demand, this includes LNG that is imported into the UK and then re-exported.

Natural and Social

During 2020-2022 unprecedented conditions have affected global energy markets. These began with the COVID-19 pandemic in early 2020 with knock-on effects into 2021 with the UK's domestic autumn 2021 fuel disruption. In 2022, this uncertainty continued with the Russian invasion of Ukraine, increasing inflation, and this was followed by heatwaves across the UK and continental Europe. Many of these events have put upward pressure on wholesale gas prices and contributed to price volatility.

There is an annual risk of industrial action in the Norwegian gas sector. Strikes in Norway, if and when they occur, have the potential to affect supply to the UK. The impact of these on UK security of supply is generally low, however. When strikes do occur (historically in summer when demand is lower), they tend to be short in duration with the Norwegian Government holding powers to intervene under certain circumstances. The strikes can impact the price of gas traded in GB and European hub markets, though this is dependent on broader supply and demand fundamentals at the time. To mitigate risks, His Majesty's Government engages with key Norwegian shippers, UK and Norwegian Gas Transport Operators and the Norwegian Government.

[12] Business Outlook 2022, Offshore Energies UK
[13] Investment on the UKCS, NSTA - https://www.nstauthority.co.uk/about-us/investing-on-the-ukcs/investment-on-the-ukcs/
[14] Regasification data is from Rystad Energy, 2022.
[15] Ibid

Gas transmission and distribution networks within the UK are highly resilient. However, certain natural events, such as extreme weather, can, rarely, cause disruption to gas supply. For example, severe or sustained flooding can cause underground gas pipelines to become exposed, which can, in extreme circumstances, cause localised disruptions to the network or impair the ability of network operators to carry out repairs due to the inaccessibility of some sites.

Risk Analysis and Assessment

Risk analysis suggests that UK infrastructure can meet gas demand across a range of scenarios, including a combination of exceptional demand caused by severe weather conditions and the failure of the largest single piece of infrastructure on the gas network.

This section provides an assessment of the risks relevant to gas supply infrastructure. It tests the ability of the gas system to meet gas demand in the event of extreme weather conditions and the loss of a significant proportion of import infrastructure over the course of a day, week, month and entire winter.

Demand under extreme weather conditions is estimated as the level of demand expected under a 1-in-20 baseline. That is, the level of demand that, in a long series of winters, with connected load held at the levels appropriate to the winter in question, would be exceeded in one out of 20 winters, with each winter counted only once.

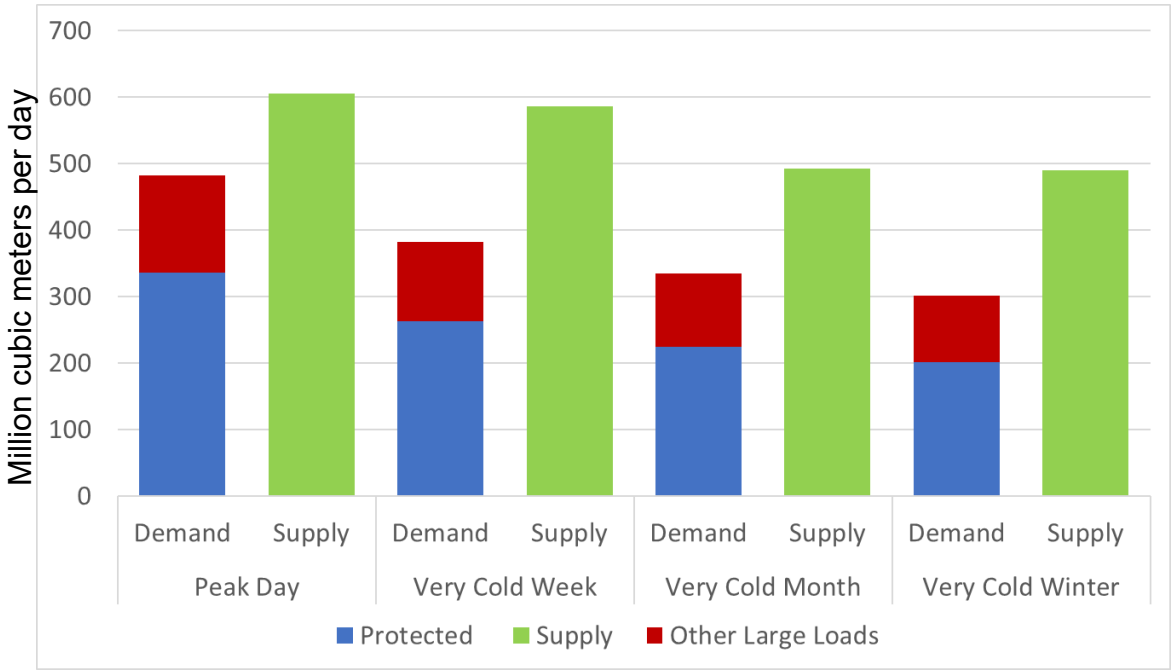
The supply shock considered is equivalent to the loss of the largest single piece of gas supply infrastructure. This is consistent with the calculation of the N-1 value.

Demand modelling – severe conditions with no supply disruption

Figure 4 below shows the results of the risk analysis for exceptional weather and demand conditions under the following scenarios:

- Peak Day
- Very Cold Week
- Very Cold Month
- Very Cold Winter

Figure 4: Risk Analysis with no supply disruption



The chart shows the level of demand and supply estimated for each scenario. The demand value is broken down into two components:

- Protected demand: the expected value for the demand segments defined as protected in the Regulation;
- Other large loads: remaining demand not captured by the definition of protected in the Regulation, including (but not limited to) electricity generation.

Demand decreases in each scenario as the period considered gets longer. This is a consequence of the way the severe condition is defined. A very cold week could have each of the seven days below freezing and, consequently, particularly high demand for each. A very cold month of comparable severity would not have each day below freezing, as this would be incredibly severe. As such, individual daily demand is lower on average.

The supply estimates are made up of three summed components:

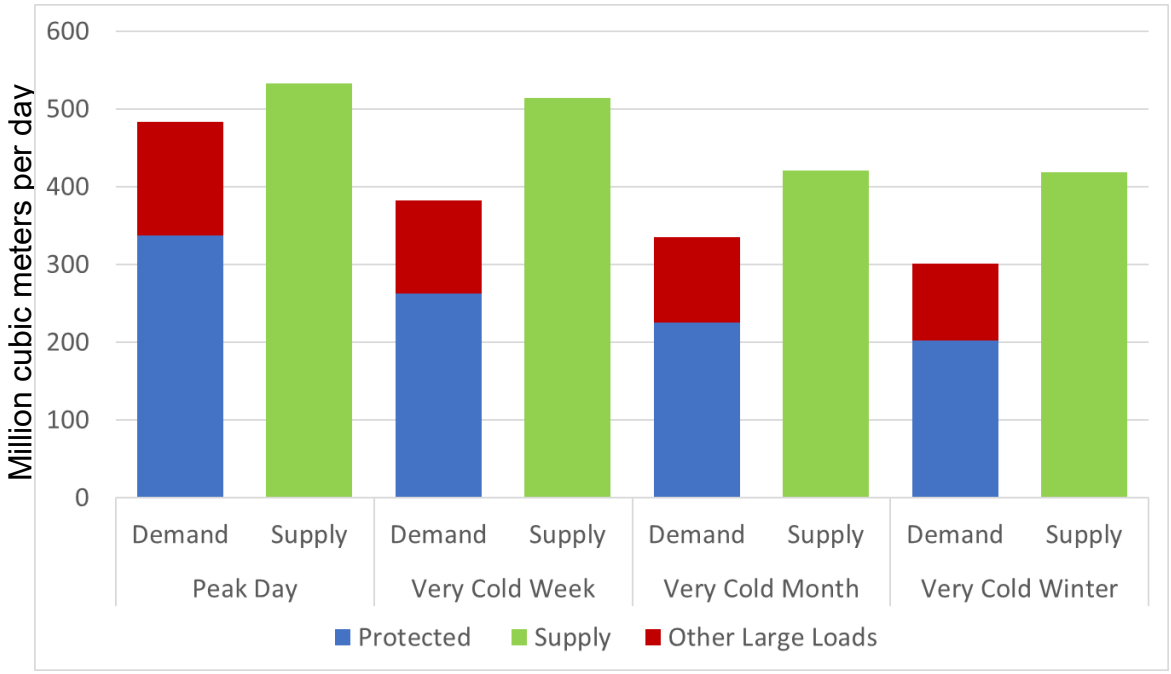
- NSS (non-storage supply): supply from UK production, Norwegian imports, European imports and imports of LNG. This represents the expected level for the given conditions.
- Storage: the maximum of available UK gas storage facilities for the period modelled, which declines for longer durations.
- NSS Upside: the maximum available from non-storage supplies. This corresponds to the additional imports which could be available if the pipelines and LNG terminals deliver at their maximum level.

For all durations, total supply potential is sufficient to meet total demand.

Demand modelling – severe conditions with supply disruption

Figure 5 below replicates the analysis as outlined in the previous sections assuming a supply disruption equivalent to the loss of Milford Haven-Felindre pipeline.

Figure 5: Risk analysis with supply disruption



Under all scenarios total supply potential is sufficient to meet total demand despite the failure of the UK's single largest piece of gas infrastructure.

Conclusion

The UK gas system is supported by the established mechanisms of market flexibility and dynamic price signalling. Market flexibility is essential to promoting global, and UK, security of supply. It ensures that gas is delivered where it is most needed and continued balancing of supply and demand is facilitated by adjustments in wholesale contract prices. The transportation of gas to and within the UK is facilitated by robust infrastructure, with excess capacity able to absorb more than the loss of the largest piece of the network.

The analysis in this Risk Assessment shows that the UK is able to pass the N-1 Calculation with a result of 110%. This, alongside the demand modelling explored, demonstrates the resilience of UK security of gas supply.

Despite the resilience of the UK's security of gas supply, the UK Government is not complacent and will continue to work with industry, the Transmission System Operator, and the Regulator to monitor, assess risks and mitigate where appropriate, particularly in light of supply pressure in Europe as a result of Russia's aggressive action in Ukraine.

This publication is available from: www.gov.uk/government/publications/uk-national-risk-assessment-on-security-of-gas-supply-2022

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