Department for
Energy Security
& Net Zero

Gas Supply Security Assessment

Proposed methodology for assessing medium range gas supply security

December 2023

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1. Introduction

1.1 Gas Supply Security

As set out in the Powering Up Britain: Energy Security Plan (ESP) in March 2023, natural gas will continue to play a critical role but different role in our energy system for decades to come. Even when we meet our net zero targets in 2050, the UK is still likely to require natural gas ('gas'). It will be vital in both delivering our energy security and supporting our transition to net zero. The UK benefits from diverse sources of gas supply and routes to market, including from our own UK Continental Shelf (UKCS), the Norwegian Continental Shelf (NCS), gas storage sites, three liquefied natural gas (LNG) terminals and two bi-directional interconnectors with Europe. This diversity of supply underpinned the security of our energy system over winter 2022/23, ensuring the UK remained well supplied and able to support international markets to respond to demand effectively.

The precise level of supply from each of these sources will likely change over time as we move towards our requirement to reach net zero emissions of greenhouse gases by 2050, and as production from the UKCS declines. During this transition in the coming decades, it will be important to understand our need for, and potential sources of, gas; informing the actions that government and industry must take to maintain the security of our gas supplies.

The forthcoming establishment of the Future System Operator (FSO), announced in the joint government and Ofgem consultation response in April 2022, provides an opportunity to strengthen our gas and electricity security of supply through the delivery of independent advice. The ESP confirmed that the FSO will deliver, annually, a new medium-range gas supply assessment ('the Assessment'), which considers gas supplies against a baseline seasonal normal and a peak demand scenario both 5- and 10-years' ahead.

This publication meets the government's commitment in the ESP to publish a proposed methodology for the Assessment. It has been developed with input from the Electricity System Operator (ESO), Ofgem, National Gas Transmission (NGT) - the Gas System Operator (GSO) - and academics. The government will continue this close engagement to further refine this proposed methodology, ahead of the FSO being formally established and taking on responsibility for the Assessment and this methodology.

Alongside this document, the government has also published an update on the future role of gas storage and other infrastructure-based flexible supply sources (the Update)[1]. It provides an update on the gas supply and demand picture, and the potential role of flexible sources in the medium to long term. The Update also sets out the government's intention to issue a Call for Evidence to look in greater detail at the role of flexibility by examining geological gas storage, LNG and interconnectors[2].

[1] https://www.gov.uk/government/publications/role-of-gas-storage-and-other-forms-of-flexibility-in-security-of-supply

[2] The two bi-directional interconnectors between GB and mainland Europe.

1.2 Future System Operator launch date and responsibilities

The FSO will be an expert, impartial public body with responsibilities across both the electricity and gas systems, driving progress towards net zero while maintaining energy security and minimising costs for consumers. It will take a whole system approach when planning and developing the energy network. The FSO will be independent – not only of other commercial energy interests, but also from government.

The overarching legal framework for the roles and responsibilities of the FSO, including its statutory duties, is set out in the Energy Act, which received royal assent on 26 October 2023. The FSO will be regulated by Ofgem[3], through its licence conditions, and funded by consumers via the price control arrangements.

The government's aim is for the FSO to be operational in 2024, subject to discussions on timelines with key parties.

1.3 Licence condition

The government committed in the ESP to publish a plan for implementing the Assessment. We plan for this to be implemented via FSO's licences, and Ofgem published its consultation on FSO's Day 1 licence conditions on 19 September 2023 and has now closed[4]. This contained a condition for the FSO to provide a Gas Supply Security Assessment to the Secretary of State and Ofgem and makes it publicly available.

The draft licence also sets out what will be required from the Assessment, including:

> Consideration of gas supplies according to availability, reliability and deliverability at 5- and 10-year intervals.
>
> Gas supplies judged against future scenarios and a peak aggregate demand scenario.
>
> Events and issues identified within those timeframes that may impact the conveyance or supply of gas.
>
> Any proposed mitigations and remediations that would prevent, or protect against, the events and issues identified.
>
> A requirement to consult with Ofgem and the Secretary of State, and to include data or information they reasonably request, and to consult with other parties the FSO deem appropriate.
>
> A requirement to publish a version of the Assessment on the FSO's website.

A further statutory consultation on FSO's Day 1 licence conditions will be held in 2024, ahead of the FSO's launch.

[3] https://www.ofgem.gov.uk/energy-policy-and-regulation/policy-and-regulatory-programmes/future-system-operation-fso
[4] https://www.ofgem.gov.uk/publications/future-system-operator-fso-draft-licences-consultation

1.4 Purpose of this document

This document sets out the proposed methodology for the Assessment. This is intended to leave sufficient flexibility for the independent FSO to adapt the Assessment before the first publication.

The government will use this document to engage with stakeholders from industry and academia, as well as continuing to work closely with Ofgem, NGT and ESO. The government is keen to gather views in order to refine this methodology, ahead of the FSO becoming operational and taking on responsibility for producing the Assessment.

2. Assessing security of supply

2.1 Existing assessments

Gas security of supply is currently assessed through NGT's Winter and Summer Outlooks[5] and the UK National Risk Assessment.[6]

Both assessments look at the capacity of the National Transmission System (NTS) and gas network infrastructure to meet different demand profiles. They do not forecast gas supply and assume that the market will deliver the necessary gas molecules. In the Winter Outlook, NGT use the 'N-1' standard calculation, which tests that the National Transmission System has been designed to meet a '1-in-20 year' peak day's demand[7] even with the failure of the single biggest piece of infrastructure[8]. However, the N-1 calculation is an infrastructure test, it does not assess whether or not the physical quantities of gas required to meet demand are available.

The new Assessment is intended to complement these existing measures. NGT will continue to hold the responsibility to develop, maintain and operate economic and efficient networks, and to facilitate competition in the supply of gas in Great Britain.

2.2 Changing context

The Energy Security Plan identified that the gas supply picture is already changing, with declining production of gas from the UK Continental Shelf[9] and, though more slowly, of gas from the Norwegian Continental Shelf. The North Sea Transition Authority (NSTA) publishes production and expenditure projections for the UKCS, which incorporate a 10% year-on-year rate of decline for gross natural gas production[10]. Whilst this will be balanced against a reduction in demand for natural gas as the UK's energy system decarbonises, domestic production of gas will fall more quickly than demand, making the UK more dependent on gas imports.

As the ESP set out, the government therefore needs to ensure that, where the UK still needs to import energy, those imports are built on relationships with strong, trusted partners and diversified sources of supply.

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[5] https://www.nationalgas.com/insight-and-innovation/summer-outlook

[6] Article 6 of retained EU regulation 2017/1938 requires us to have measures to ensure supply to protected customers during a 7-day period of 1-in-20 demand, a 30-day period of 1-in-20 demand and a 30-day period of n-1 disruption. https://www.legislation.gov.uk/eur/2017/1938/article/6

[7] '1-in-20 demand' is defined by NGT as a level of demand that would be exceeded in one out of 20 winters. The 1-in-20 peak day is calculated from a statistical distribution of simulated historical peaks days. It is not the highest demand in the last 20 years, nor is it the demand that would be expected in the cold weather experienced in the last 20 years. www.nationalgas.com/document/137156/download

[8] The largest supply point is Feeder 28. It connects the two Milford Haven LNG terminals to the NTS and provides around 72 mcm/d supply capacity, which assumes Pembroke Power Station is still supplied.

[9] https://www.gov.uk/government/publications/powering-up-britain/powering-up-britain-energy-security-plan#decisive-action-for-this-winter-and-next

[10] https://www.nstauthority.co.uk/media/ufbbsoya/nsta-medium-term-projections-sep-2023.xlsx

It is in this context that this new medium assessment will support strategic, longer-term decision making on gas security of supply and the future of the gas system.

2.3 A new assessment

Timeframes

The Assessment will be an annual process, and each assessment will project supply and demand in 5- and 10-years' time within a winter assessment period. This is currently understood as 1 October – 31 March, in line with the Winter Outlook publications produced by National Gas Transmission, though the FSO will have the authority to define a different period for each Assessment publication.

The 10-year time horizon provides a credible window to consider investment opportunities in infrastructure that increase security of supply, and the role of gas in the UK's transition to net zero. For example, the lead-in times for development of new storage capacity are substantial: industry consensus is that developing storage infrastructure in new underground salt caverns can take between 7 – 9 years from planning and consents through to construction (though this is site dependent).

The 5-year time horizon has been proposed as a mid-point to 10 years, to allow for better consideration of depletion in UKCS production. Additional time-horizons could be used if considered appropriate by the FSO.

De-rating factors for sources of supply

The Assessment will complement existing assessments to provide a holistic view on future gas supply security, and over a longer time frame, by considering the availability, deliverability and reliability of supply sources, as set out in the licence condition. The outcome will show whether there could be positive or negative margins in 5- and 10-years', based on expected supply sources, which will support strategic decision making on the future of the gas system.

The Assessment will calculate the expected maximum volume of natural gas in million cubic meters a day (mcm/d) that Great Britain can expect to receive over a stated timeframe. The expected maximum volume from each supply source will be assessed and adjusted based on its availability, reliability, and deliverability, alongside known future developments. This is a process we refer to as 'de-rating'.

The de-rating factors that will be used, to estimate the de-rated maximum volume of supply, will be derived using the considerations set out below:

> **Availability:** Are the physical quantities of natural gas that GB will need available from supply sources, as predicted through the demand profiling outlined in Section 3?
>
> This will be assessed using data sets specific to each supply source, including independently completed and publicly available projections, or internal modelling that wherever possible uses open-source data.
>
> **Reliability:** Can these quantities be purchased by, and delivered to, GB market participants?
>
> This will be assessed by calculating each supply source according to the flexibility to supply GB and/or other gas markets. This will inform the 'merit order', set out below.

Deliverability: Is there sufficient infrastructure capacity to receive and transfer the quantities of natural gas required into the National Transmission System (NTS)?

This will be assessed by considering the current, and known future, infrastructure capacity or constraints for each supply source. For example, it is not technically possible for sources of supply to always deliver at maximum capacity. It is therefore necessary to calculate what could realistically be delivered.

A 'merit order' for sources of supply

To calculate whether a seasonal average, or peak, demand scenario could be met using supply sources, the Assessment will use a 'merit order'. Gas supply sources have unique characteristics, including sensitivity to price signals in the market, resulting in variability in potential supplies in difference scenarios.

The 'merit order' is therefore a ranking of particular supply, or supply type, based on historic supply patterns and observable trends. The 'merit order' will rank the least volatile - or 'baseload' - supplies (assumed to flow most reliably) at the top of the 'merit order'; with the most fluctuating - or 'flexible' - supplies (considered to be more price sensitive and likely only to flow at periods of high demand) at the bottom. This follows a similar approach to NGT's Ten-Year Statement[11].

For example, gas UKCS is generally considered to have a greater certainty of being delivered onto the NTS[12] system and would therefore be highest in the 'merit order'. By comparison, gas storage in GB is important for offering flexibility to the gas market, when other sources (UKCS or NCS) are more expensive or unavailable. Storage behaviour responds to price volatility, allowing shippers to utilise market opportunities throughout the year, and support security of supply. Supply sources that respond to price volatility are commonly referred to as flexible supplies and would therefore have a lower ranking than baseload supplies.

For the purpose of this proposed methodology, baseload supplies are UKCS and non-price sensitive NCS flow, flexible supply sources are gas storage sites, LNG terminals, interconnectors with Europe, and include price-sensitive flows from NCS. How and why NCS flows are calculated is explained in sections 4.3 and 4.6.

Overall approach for the Assessment

Using the approach set out in the 'merit order', the following steps set out how the different factors explained in this document will come together in the proposed methodology. In practice, the FSO will be able to use whatever process it sees fit, within the bounds of license condition, to produce the Assessment.

Step 1: Estimate GB gas demand volume expectations (explained in Section 3)

[11] National Gas Transmission, Transmission Planning Code 2019 National Gas Transmission, Transmission Planning Code, 2019 https://www.nationalgas.com/document/128221/download#:~:text=1%20The%20Transmission%20Planning%20Code,1.1%20Document%20scope&text=Gas%20is%20transported%20through%20steel,Networks%20connected%20to%20the%20system

[12] National Gas Transmission, Transmission Planning Code 2019 National Gas Transmission, Transmission Planning Code, 2019

Step 2: De-rate a realistic maximum of natural gas supply GB can expect from baseload sources over a stated time period, starting first with UKCS de-rating calculation (explained in 4.2) followed by non-price sensitive NCS (explained in 4.3).

Step 3: De-rate a realistic maximum of natural gas supply the GB can expect from price sensitive flexible supply sources over the same time period, starting with GB storage and then LNG imports.

Step 4: Evaluate price sensitivity assumptions between Title Transfer Facility (TTF, gas trading in Europe) with the Natural Balancing Point (NBP, gas trading in GB), to derate an assumed and realistic maximum of natural gas supply GB can expect from interconnectors and remaining NCS flows.

Step 5: Sum the total of expected gas supplies in order of judged flexibility according to a ‘merit order’ and then compare against the expected demand volumes to understand if they balance.

Step 6: Assess and advise whether proposed mitigations and remediations are necessary.

3. Estimating demand profiles

3.1 Future Scenarios

The FSO will have flexibility to determine the scenarios it deems most appropriate to represent the future demands placed on the GB gas system. This will, clearly, be affected by exogenous factors such as the weather and its duration as well as endogenous factors such as the rate of decarbonisation by both consumers and the wider energy system. Government recommends that the Assessment considers judging against high and low gas demand scenarios to provide a range of potential future demand on the gas system.

3.2 Assessing Seasonal Normal and Peak Demand

Using different gas demand profiles, it will be possible to calculate different estimates of seasonal normal[13] which is average weather conditions one would expect for a given year, and peak demand (based on 1-in-20 year analysis) profiles[14]. All of which will be measured in million cubic meters a day (mcm/d). This means the FSO is expected to create four separate scenario calculations for each Assessment.

A key step to defining the volume of gas required from total supply sources in each demand scenario is deciding over what timeframe supply sources will judge against demand volumes and when within the winter assessment period that calculation takes place. This requires two separate calculations.

The first is the timeline of each scenario. This could be a single day within the winter assessment period, but it is better to judge, where possible, how different supply sources respond to periods of high demand. There are various conditions that can be used to define the length of this time-period including stressors on gas demand experienced through 'cold snaps'[15] when gas is under pressure for heating, or prolonged periods of low wind meaning gas is required for electricity generation.

Using both NGT's Winter Outlook publications and Composite Weather Variable (CWV)[16] calculations, below are three suggested time periods that the FSO could seek to judge demand against:

> **7-day cold snap:**[17] 90% of cold snaps defined as below zero according to the CWV are 7 days or less.[18]

[13] Seasonal Normal is defined by NGT here: https://www.nationalgas.com/document/133111/download#:~:text=Seasonal%20normal%20demand%20forecasts%20are,the%20annual%20demand%20forecasting%20process.&text=Cold%20and%20warm%20profiles%20give,be%20expected%20throughout%20the%20year

[14] www.nationalgas.com/electricity-transmission/document/132516/download

[15] A short period of cold weather

[16] CWV is used to define the relationship between the weather and 'non-daily metered' demand (where the main use is for heating). The CWV measures daily weather, combining temperature with other variables including effective temperature, wind speed and differences from average seasonal temperature.

[17] Gas Winter Outlook 2022/23, www.nationalgas.com/document/140921/download

[18] DESNZ analysis using data from National Gas Transmission

11-day cold snap: The longest cold snap using CWV since 1990 has been 11 days.

15-day cold snap: NGT's 2022/23 Winter Outlook used 15 days to define its peak demand scenario. This is representative of extreme cold weather events such as winter 2018, which resulted in some of the highest daily demand levels seen in the five years prior to the Outlook's publication.[19]

The government proposes the FSO use the 7-day cold snap for a peak demand scenario in assessing each supply source, on the basis that this encompasses the majority of cold weather periods since 1990. To compare how supply sources might act in both peak demand and seasonal normal scenarios, the expected demand volumes will be judged against the same timeframe. This means that if a peak demand volume profile is judged over a 7 day timeframe, then seasonal normal volumes will also be judged over a 7 day timeframe.

The second timeframe factor is to identify when the system will be least resilient within the winter assessment period. This is to ensure the Assessment considers demand during times of system stress[20]. In choosing a time period to judge peak demand against, key considerations include time required to draw from the different forms of storage, how full storage is expected to be at different periods of winter, availability of LNG to purchase and the time required for LNG cargo to respond to market signals and direction of interconnector flows.

For the purpose of this publication, the government has assumed that the calculation will use a time period when storage stocks are at their lowest and this is reflected in the proposed methodology in Section 4.5 below.

[19] Gas Winter Outlook 2023/24, www.nationalgas.com/document/144421/download

[20] This is a new term that the FSO will need to define, for the purpose of this publication it is understood as 'when one more of the five supply sources are at risk of not delivering at full expected capacity'. This is illustrated by the gas storage calculation below which assumes the availability of gas in storage is not 100% in-line with five-year averages in February and March.

4. Calculating supply profiles

Once the volume of gas demand over a timeframe has been established, the next stages of the Assessment are to estimate the de-rated volume of gas that can come from each potential supply source. This section sets out how this can be done for each.

4.1 UK Continental Shelf

The UKCS has provided a reliable baseline level of gas supply each year, especially during winter. Supply from the UKCS can be estimated, with relative accuracy, due to the infrastructure delivering gas direct to the GB gas network.

The government proposes that the FSO use the following calculation to determine a daily de-rated winter supply value from the UKCS:

$$A = (Q * R * G) / 182$$

Where:

A = De-rated winter supply value from the UKCS (mcm/d

Q = North Sea Transition Authority (NSTA) supply projection (for each assessment year) (mcm/y)

R = Adjustment of projection for unplanned shortfalls

G = Seasonality factor

Each element of the proposed formula is considered below:

North Sea Transition Authority supply projection (Q): The total volume of gas the UKCS is projected to supply in a given year. Projections currently expect a decline in UKCS supply of 10% year-on-year, according to the NSTA's annual projections (out to 2050). As a result, the Assessment proposes using these projections, rather than historic flows.

Adjustment of projection for unplanned shortfalls (R): Gas projections can be susceptible to unforeseen future shocks such as international events, unplanned maintenance, and market conditions. The methodology recognises this by adjusting projections downwards using recent maximum observed shortfalls between projections and supply. The methodology uses the largest maximum shortfall in the most recent five years in order to incorporate recent trends, as well as the impacts from any recent external 'shocks'; deriving from these a single adjustment factor.

Seasonality factor (G): To estimate expected daily supply in the winter period, the annual projections need to be apportioned between the winter assessment period (1 October to 31 March) and the summer assessment period (remaining months) using a weighting factor. Historically, supply has tended been higher in winter than summer because producers and upstream transporters carry out maintenance when weather is more settled, and the price of gas is typically lower. Due to the projected decline in UKCS supply the degree of difference between summer and winter production has changed in recent years, therefore the estimated

seasonality factor may change between each Assessment. The FSO will need to determine this part of the calculation each year, based on NTSA projections.

182 days: To produce a daily figure from the projected winter assessment period supply that can be by judged against each day in the demand profile the outcome of the bracketed calculation will be divided by the total number of days between 1 October – 31 March.

4.2 Non-Price Sensitive Norwegian Continental Shelf

The Norwegian Continental Shelf (NCS) contains substantial gas reserves, located in a number of Norwegian gas fields, capable of collectively producing up to around 350 mcm/d[21]. The technical maximum capacity of pipelines for transporting Norwegian gas to GB means that GB can receive up to 141 mcm/d[22], subject to market conditions and production levels.

Some of these Norwegian gas fields (Alvheim Hub, Edvard Grief, Ivar Aasen and Martin Linge fields) are known as the Shell Esso Gas and Associated Liquids (SEGAL) system, and feed directly into UKCS offshore systems, with maximum observed flows of up to 25 mcm/d[23].

Norway also shares substantial supply infrastructure with the rest of Continental Europe, with various pipelines to the European mainland. Subject to market conditions and production levels, there is technical capacity of 250 mcm/d of gas from NCS to Europe. For the purposes of de-rating NCS flows, the Assessment assumes that, based on unfavourable market conditions, NCS is flowing at technical capacity to Continental Europe.

By understanding the volumes of gas supplied to GB via the SEGAL pipelines and the technical maximum capacity to Europe, it is possible to estimate the total de-rated supply from the NCS to the GB which is non-price sensitive. The methodology separately assesses a “price sensitive” proportion of the NCS to GB and is set out in section 4.6.

The year-on-year rate of decline for the NCS is forecast to be much lower than the UKCS and, as a result, the calculation uses a 7-day rolling average for a single day, rather than a single future day. This is because the NCS will decline at a more gradual rate, its flows are less volatile than UKCS. This means the government considers a 7-day rolling average from Gassco as a reliable projection in 5- and 10-years’ time. (The volatility of UKCS production means, conversely, we need to take a yearly projection, and apply an adjustment factor).

The proposed calculation is shown below:

To develop an illustrative 7-day peak supply profile that accounts for the Norwegian fields which flow directly into UKCS offshore systems, the following formula will be used:

$$B = ((J + H) * K) - I$$

Where:

B = De-rated winter supply value for non-price sensitive NCS (mcm/d)

[21] Internal DESNZ analysis using https://umm.gassco.no/ch/. Gassco is responsible as operator for transporting Norwegian gas to continental Europe and GB through its network of pipelines.
[22] //www.nationalgas.com/document/144421/download
[23] Internal DESNZ analysis using https://umm.gassco.no/ch/

J = Maximum average 7-day SEGAL flows (mcm/d)

H = Maximum 7-day rolling average of Gassco exit nominations excluding SEGAL flows (mcm/d)

K = Projected NCS supply decrease factor (for each assessment year)

I = Technical capacity flows to Europe (mcm/d)

Each element of the formula is considered below:

Maximum average 7-day SEGAL flows (J): As outlined above, SEGAL fields flow directly to GB and as a result, it is important to separate the 7-day assessment period for SEGAL in the calculation. The maximum 7-day average flows observed in the winter 2021/22 assessment period were 19.58 mcm/d and 24.1 mcm/d in the 2022/23 winter assessment period. In line with the UKCS calculation, it will take the lower of the two numbers and the 7-day average flows observed in the winter 2021/22 period would be used (19.58 mcm/d)[24].

Maximum 7-day rolling average of total Gassco exit nominations, excluding SEGAL flows (H):

Calculation for maximum 7-day rolling average of total Gassco exit nominations to GB and Europe:

Due to a range of factors, including maintenance requirements and market conditions, the maximum volume capacity through the Norwegian pipeline network known as 'Gassled' has not been maintained, even during peak demand. To establish a credible maximum supply 5- and 10-years' in the future, the prosed methodology uses the 7-day rolling average throughout each assessment period, identifies the maximum within each year and then, in line with the UKCS calculation, use the lower of the maximum figures observed.

Calculation for excluding SEGAL pipelines:

As set out above, there are Norwegian fields that feed directly into UKCS offshore systems, reported and referred to as the SEGAL system. To understand the total volumes of NCS which could flow to Europe and GB, at this stage in the calculation, it is necessary to remove SEGAL pipeline volumes (using the observed rolling 7-day maximum supply). By removing SEGAL flows, this provides total volumes of gas that could flow to both GB and Europe. For example, the observed rolling maximum supply through the SEGAL infrastructure is 25 mcm/day observed in December 2022.[25]

For example, the maximum 7-day rolling average supply from Gassco nominations, without SEGAL infrastructure, from the first winter assessment period (winter 2021/22) is 332.8 mcm/d. The maximum 7-day rolling average from the second winter assessment period (winter 2022/23) is 326.9 mcm[26]. The Assessment would therefore use the winter assessment 2022/23 period.

[24] Internal DESNZ analysis using https://umm.gassco.no/ch/
[25] Internal DESNZ analysis using https://umm.gassco.no/ch/
[26] Internal DESNZ analysis using https://umm.gassco.no/ch/

Projected NCS supply decrease factor (K): The projected decrease in NCS supply by the time of the assessment year, using the Norwegian Petroleum Directive's production forecasts, which are published out to 2032[27].

Technical capacity flows to Europe (I): This is the technical capacity of flows from Norway to Europe and is approximately 250 mcm/d. This calculation assumes that Gassco will flow at maximum volumes to take a conservative view that flows to Europe will always be maximised. By subtracting this value from the maximum 7-day rolling average of total Gassco exit nominations excluding SEGAL fields, this produces theoretical non-price sensitive volumes that could flow to the GB through Gassled.

4.3 Liquefied natural gas

Over the past few decades, LNG has become an increasingly important method of moving natural gas from source to consumer. LNG imports are flexible and the level of imports into GB is dependent on a range of factors including global supply and demand, and price differentials between different international markets. It is therefore challenging to determine the availability, reliability and deliverability of LNG five and ten years in the future.

GB has one of the largest LNG import infrastructures in Europe, with three LNG terminals providing an aggregate annual import capacity of around 51 bcm/y[28] and peak daily supply of 150mcm/d[29]. Expansion projects, at two of the three LNG terminals, will increase this import capacity further. However, the volumes of injection onto the NTS are dependent on the levels of gas in the storage associated with these terminals, and the timeframe and likelihood of additional vessels arriving; which is dependent on the difference in market prices reflecting expected GB demand versus expected demand in the other countries.

The proposed methodology will estimate a possible level of future LNG inflow in two steps:

(1) Estimate the quantity of LNG available to purchase on the international market within the year being assessed. This will rely on historic trends, future demand and supply projections, and known infrastructure developments which will change supply availability and demand profiles over time.

(2) Estimate reliability and deliverability by considering the realistic maximum quantity of natural gas that can be injected from GB's LNG import infrastructure into the NTS.

The de-rated supply for stage 2 of the LNG estimation is:

$$C = L * U$$

Where:

C = De-rated LNG supply

L = Maximum historic LNG injections rate into NTS (%)

[27] https://www.npd.no/globalassets/1-npd/publikasjoner/rapporter/ressursrapporter/2022/en/resource-report-2022.pdf
[28] https://www.nationalgas.com/insight-and-innovation/gas-ten-year-statement-gtys (to be published December 2023)
[29] www.nationalgas.com/document/144421/download

U = Expected future technical maximum LNG supply capacity (mcm/d)

Each element of the formula is considered below:

Maximum historic LNG injections rate into NTS: The LNG maximum will initially be estimated using historic daily maximum injection levels (December 2019- March 2023) expressed in percentage terms of technical capacity. This is currently estimated as 97%[30] and the FSO will need to reassess this assumption annually as more observed data becomes available as import capacity increases.

Expected future technical maximum LNG supply capacity (mcm/d): Technical maximum capacity is currently 150 mcm/d. The FSO will need to account for known capacity increases due to infrastructure projects being publicly announced, that are likely to increase peak LNG import capacity in coming years4. This includes terminal upgrades at Isle of Grain, and the Western Network Upgrade Project facilitating greater maximum flows through Felindre, which serves the Milford Haven LNG terminals.

For example, using previous observed maximum utilisation and applying this to future technical maximum capacity (with known infrastructure changes), instead of current technical maximum capacity, the de-rated calculation increases from 137 mcm/d to 145.5 mcm/d[31].

4.4 Storage

GB storage helps to flexibly balance fluctuations in supply and demand. As set out in section 3.2, we have assumed the 'period of least resilience' for the Assessment is when storage stocks are at their lowest. Unless the FSO decide to assess the requirement of a 'period of least resilience' differently, storage availability should therefore be assessed conservatively.

Noting this period of least resilience may change each year, the government proposes storage stocks at the start of the 7-day period are assumed to be at the five-year average for February and March. This is instead of using an average for the whole winter, which risks being overly optimistic given stocks would likely be depleted in a period of low resilience.

The volume of gas that can be extracted from storage on a day (storage deliverability) depends on the volume of gas that is held in storage on that day (storage availability). De-rating storage deliverability across the 7-day period therefore relies on completing two calculations, outlined below. The first uses historic data from the last five years to identify the relationship between the volume of gas in storage (storage stocks, or storage availability) and the amount of gas that can be delivered from that storage (deliverability). The second calculation applies that relationship to whatever the assumed level of storage stocks are for day 1 of the assessment scenario to estimate deliverability. It then iterates for each day of the time period to account for the availability of stocks, and consequently deliverability, decreasing each day.

Modelling uses a linear regression of the deliverability rate of gas storage on gas storage stocks:

$$Y_t = \beta X_t$$

[30] Internal DESNZ analysis using www.nationalgas.com/document/140921/download
[31] Internal DESNZ analysis using https://umm.gassco.no/ch/

Where:

Y_t= storage deliverability on day t (mcm/d)

X_t= storage stocks on day t (mcm)

β = regression coefficient giving the relationship between storage stocks and storage deliverability

The intercept[32] is assumed as zero in this linear regression, as there would be no gas storage deliverability where gas storage stocks are zero.

This historic relationship between storage stocks and deliverability is then applied to assumed storage stocks at the start of the 7-day period, to estimate storage deliverability.

Storage deliverability will change over the 7-day period, as storage stocks are depleted. As such, daily storage deliverability during the 7-day period is estimated using the following approach:

$$D(z) = (M(z) * \beta)$$

Where:

D(z) = storage deliverability on day z (mcm/d)

Z = the day of the proposed seven-day period, where z = 1 to 7

M(z) = Storage stocks on day z (mcm)

On day 1 of the cold snap, storage stocks, M(1), are set to the five-year mcm average for February and March.

For all subsequent days, z>1, storage stocks are estimated by taking the previous day's storage stocks, M(z-1), and subtracting the previous days storage deliverability, D(z-1).

The government has also provided an update on the future role of gas storage and other flexible sources alongside this publication, including our intention to issue a Call for Evidence to look in greater detail at storage, as well as LNG and interconnectors.

4.5 Interconnectors and price sensitive NCS Supplies

The final supply sources to de-rate are the shared interconnectors with Europe and price-sensitive supply from the NCS. If there continues to be unmet demand after all other sources have been estimated, then interconnector flows and remaining price sensitive NCS flows will be separately de-rated and then added together to complete the supply profile. Given their sensitivity to market drivers and price, it is less simple to estimate the de-rated supply from the interconnectors and the proportion of NCS supplies that are not directly connected to the NTS and can be directed to either Continental Europe or the GB depending on price signals from the market.

[32] A necessary term in linear regression for where the relationship crosses the y-axis when x-axis is at 0. Ie. in this instance, the level of storage deliverability when storage availability is at 0.

For this reason, interconnectors and the price sensitive portion of NCS supplies will be included in the final stage of the assessment. This will allow the assessment to consider the likelihood of the GB being able to attract sufficient gas over these sources, including if needed in a scenario in which the Title Transfer Facility (TTF, gas trading in Europe) has a strong premium over the Natural Balancing Point (NBP, gas trading in GB), and it is not possible to attract imports. Example calculations are set out below.

Interconnectors

GB benefits from shared interconnection with Europe. NGT's 2023 Winter Outlook establishes the maximum technical bi-directional capacity is 125 mcm/d[33]. As set out above, flows are price sensitive, and it is therefore challenging to estimate future availability in the same way as other sources of supply, such as UKCS.

As a result, the proposed starting assumption to derate interconnector supply is that availability is equal to zero which is representative of the observed recent float (meaning little or no flows in either direction) or a price incentive for flows from NBP to TTF.

If the FSO re-evaluates the starting assumption and concludes that a price incentive will exist from TTF to NBP, then a similar calculation can be used as for LNG. For example, by taking a historic maximum flow from the interconnector. An example calculation is set out below:

$$E = N$$

E = de-rated interconnector supply

N = Maximum historic transfers in the five years prior to the assessment which has been observed to be 106 mcm/d during March 2018[34].

Price-sensitive NCS flows

Taking a similar approach to de-rating interconnector supply, the Assessment assumes that the difference between de-rated NCS flows and technical deliverable supply and technical capacity is also zero. If the FSO changes this starting assumption, then the remaining possible NCS flows can be calculated using the below formula. This builds on the NCS flow de-rating calculation above:

$$F = P - B$$

Where:

F = Maximum price sensitive NCS flows (mcm/d)

P = Maximum aggregate entry capacity of Norwegian imports to GB (mcm/d)

B = 7-day rolling average supply profile for NCS flows directly into UKCS offshore systems (calculated above in section 4.2)

Max aggregate entry capacity of Norwegian imports to GB (P): In its 2022 Gas Winter Outlook NGT assumed maximum capacity of total NCS flows that can only go to GB is 141 mcm/d. This includes flows that can only go to GB, and those that can go to both the GB and

[33] www.nationalgas.com/document/144421/download
[34] DESNZ internal analysis

Europe which is explained in section 4.2. The de-rated figure will therefore be estimated by subtracting from assumed remaining infrastructure after de-rated SEGAL pipelines have been removed from the calculation.

The highly price sensitive nature of flows mean that any change of assumption to a price incentive resulting in TTP to NBP flows can only happen for individual days throughout the winter assessment period or timeframe of peak demand. This could be expected to happen if there is evidence GB is unlikely to meet expected peak-demand flows using all other sources.

4.6 Assessing de-rated gas supply against demand profiles

To assess the extent to which total supply from de-rated sources will be sufficient to meet demand the Assessment will rank each supply source in a ‘merit order’ as set out in section 2.3. The Assessment will produce a de-rated estimate of daily supply for each supply source, and this will be “stacked” in line with the ‘merit order’ and estimated against the demand profile for each day within the proposed timeline.

This is informed by historic patterns of supply, but this could change and should continually be reviewed over time.

If future developments mean alternative sources of gas will meaningfully contribute to the GB’s demand profile, the FSO will assess how an individual de-rating calculation can be developed and integrated into the proposed methodology.

5. How the Assessment will be used and next steps

Once brought together, the Assessment will provide an estimate of how of the UK's diverse sources of gas supply compare with peak demand in 5- and 10-years' time. This will give government and industry insight into the likely future balance and challenges to our gas supply. Key issues it will help government consider include: where we are likely to depend on particular sources of gas supply; how confident we might be in those sources; whether we have the necessary infrastructure to allow gas to be delivered to GB shores; the balance between more secure 'baseload' gas supply and where we are reliant on price sensitive markets to deliver the gas we need; and the key pressure points that might face disruption to our gas supply mix. The FSO will also have a responsibility to propose any mitigations and remediations it considers are necessary to protect against any issues that might threaten our gas supply.

The Assessment is intended to be an annual process, so will show how these considerations are expected to evolve. It will be a regular source of independent analysis and advice that will inform government's actions to protect our energy security. Alongside this methodology the government has published an update on the future role of gas storage and other sources of flexibility in the UK's gas security. The Assessment will help develop the government's policy thinking in this important area, by delineating how these different sources of flexible supply relate to each other as our energy security needs develop.

This publication is the first step in producing the Assessment, and the government will use this document to engage with industry and academics - alongside Ofgem, ESO, and NGT and, once established, the FSO - to refine this methodology ahead of the first Assessment.

We will work with the current ESO (prior to the establishment of the FSO), to ensure it has sufficient knowledge and expertise to take on responsibility for this Assessment. Subject to agreeing timelines with key parties, our aim continues to be for the FSO to be operational in 2024. Timings for the first Assessment will be set out in detail in due course.

As set out in Section 1, Ofgem has now consulted on the draft Day 1 Licence Conditions for the FSO, including detail on the implementation of the Assessment. A statutory consultation on the Licence Conditions will be held in 2024 ahead of the FSO's launch.

Once established, the FSO will be able to amend this methodology as it considers appropriate, and in response to changing demand and supply profiles in the gas transition, within scope of the Licence Condition.

This report is available from: www.gov.uk/government/publications/medium-range-gas-supply-security-assessment-methodology

If you need a version of this document in a more accessible format, please email alt.formats@energysecurity.gov.uk. Please tell us what format you need. It will help us if you say what assistive technology you use.