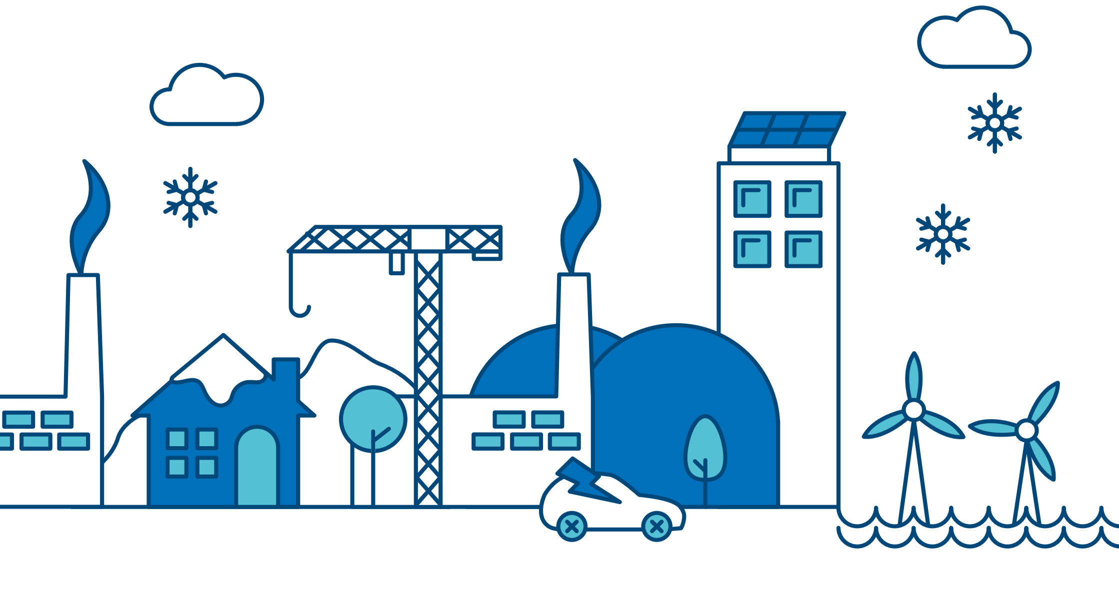
Winter **Outlook Report**

2016/17

nationalgrid



October 2016

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How to use this document

To help you find the information you need quickly and easily we have published the *Winter Outlook Report* as an interactive document.

Home
This will take you to the contents page. You can click on the titles to navigate to a section.

Arrows
Click on the arrows to move backwards or forwards a page.

A to Z
You will find a link to the glossary on each page.

Hyperlinks
Hyperlinks are highlighted in bold throughout the report. You can click on them to access further information.

Foreword

Phil Sheppard
Director of SO Operations

Welcome to our 2016/17 *Winter Outlook Report*. This report draws together analysis and feedback from across the industry to present a view of supply and demand for the winter ahead.

The responses we received to this year's *Winter Consultation* provided us with valuable insight on the winter ahead. I'd like to thank those companies and organisations that took the time to share their views, and have engaged with us throughout the year. Your views really are important to the development of this report and help to make sure we can provide a well-informed outlook to the industry.

Weather has a significant impact on how we balance the gas and electricity systems, now increasingly affecting available supply as well as demand. We have experienced a number of relatively warm winters over the last few years, with winter 2015/16 one of the mildest in almost sixty years. It is important that as an industry we are ready for winter 2016/17, whatever the weather. We have re-visited our winter preparedness plans to make sure that we have the appropriate skills and experience in place. We hope this report helps to inform and support you in your preparations.

Since publishing the provisional winter margin in July, additional electricity generation has been made available to the market. This has had a positive impact on the outlook for winter, increasing the margin between potential supply and demand. To make sure we have the right tools in place to effectively operate the electricity system, we have procured contingency balancing reserve services for winter 2016/17. This will be the last year that we procure these transitional services.

This winter you will see changes to some of the notices we use to communicate with the industry. October 2016 also marks the start of the transitional arrangements for the Capacity Market, developed by the UK Government as part of the Electricity Market Reform programme to ensure the future security of our electricity supply. This will bring with it new industry notifications. You can find out more about the different ways we communicate with the market in the operational toolbox chapter of this report. We hope it provides you with the knowledge you need to navigate the changing energy market.

We expect Great Britain to be well supplied with gas this winter. GB benefits from diverse and flexible supply sources, which support system security. We've assessed the potential impact of a range of supply and demand scenarios on the gas system and believe that the market is well placed to respond.

I'm pleased to say that following a successful trial in summer 2015, the gas demand side response mechanism went live on 1 October this year. This new mechanism will act as a route to market for large gas consumers, allowing them to bid to reduce the amount of gas they use during times of system stress in exchange for a payment. Thank you to those stakeholders who have engaged with us throughout its development. We believe that together we have been able to identify a cost effective solution that benefits the market.

The *Winter Outlook Report* is just one in a suite of documents from the System Operator exploring the future of energy. I encourage you to read our other publications. In them you can find out more about the evolution of the energy landscape, and how we're working with our stakeholders to build and operate the gas and electricity systems of the future. To find out more, and register for email updates, go to our **website**.

Thank you for taking the time to read this year's *Winter Outlook Report*. We want to make sure our publications are as useful to you as possible, so please let us know what you think. You can email your feedback to us at **marketoutlook@nationalgrid.com**, join the debate on Twitter using **#NGWinterOutlook** or subscribe to our **LinkedIn Future of Energy** page.

Executive summary

The *Winter Outlook Report* is an annual publication produced by National Grid, which presents our view of gas and electricity supply and demand for the coming winter. The analysis presented here is underpinned by the stakeholder insight we receive via the *Winter Consultation* and regular engagement with industry participants. The report is designed to inform the energy industry and support their preparations for the winter ahead.

Overview: Electricity winter 2016/17

We expect there to be sufficient generation and interconnector imports to meet demand throughout winter 2016/17. The electricity margin is similar to last year but includes a larger proportion of contingency balancing reserve services. We are confident that we have the right tools in place to help us balance the system.

Since publishing the *Winter Consultation* in July, additional generation capacity at Eggborough power station has returned to the market and an outage on the East West Interconnector has decreased expected exports to Ireland. These events have increased the de-rated margin for winter 2016/17 from approximately 2.9 GW to 3.4 GW, or 6.6% and a LOLE of 0.5 hours/year.

The last few winters have been mild, but we are not complacent. We have taken additional actions to improve the outlook for this winter and the de-rated margin includes the supplemental balancing reserve services that we have procured. We anticipate that we will use these services this winter to help us balance the system. This year, some of the units providing supplemental balancing reserve require longer than a day's notice before they can begin to generate. As a result, we will need to issue start up instructions to these generators up to 48 hours ahead. These instructions will be announced on **SONAR** and the **BM Reports website**.

We expect normalised transmission system demand to peak this winter at 52.0 GW in mid-December. Based on the data provided to us by generators on 6 October, normalised demand can be met in all weeks across the winter under three interconnector scenarios with low, medium and full interconnector imports from Continental Europe. As the difference between demand and the generation expected to be available changes throughout the winter, we encourage the industry to regularly check the **BM Reports website** for the latest information.

Our analysis of forward electricity prices suggests that there will be net imports of electricity from Continental Europe to Great Britain (GB) at peak times during winter 2016/17. Outside of peak times, there may be some variation in interconnector flows due to an increase in Continental European prices closer to winter and the impact of weather on prices. Due to higher electricity prices in Ireland, we expect there to be net exports from GB during peak periods. These flows may reduce, or even switch to GB imports, if there is high wind generation output in Ireland. The outage on the East West Interconnector to the Republic of Ireland means that the overall volume of electricity flowing to and from Ireland will be reduced this winter.

Overview: Gas winter 2016/17

GB benefits from diverse and flexible sources of gas supply. We are confident that this range of supply sources will be sufficient to meet demand this winter.

Energy prices have fluctuated significantly over the previous 12 months, and may continue to do so over the winter. Our analysis of the latest forward fuel prices suggests that gas will be cheaper than coal for electricity generation this winter. However, from November onwards the price difference between gas and coal becomes narrower. This may increase competition between the two fuel types for the remainder of winter.

Based on seasonal normal conditions, gas demand for winter 2016/17 is expected to be lower than last year's weather corrected demand. We anticipate that demand for gas exports will be lower than 2015/16. The Corrib gas field is now capable of flowing at full capacity and so is expected to reduce Ireland's demand for GB exports. Gas exports to Continental Europe are also expected to be lower than last winter. In 2015/16, the mild weather in GB meant that the price differential resulted in exports to Continental European markets. This decrease in gas exports is likely to be partially offset by increased demand from gas-fired power stations. Total gas demand for the winter is forecast at 49.1 bcm, with a peak demand forecast for a 1-in-20 winter of 472 mcm/d.

We expect there to be sufficient gas available to meet this demand. The maximum potential non-storage supply (NSS) for winter 2016/17 is 473 mcm/d. When combined with a maximum storage deliverability of 129 mcm/d, this results in a total maximum supply potential of 602 mcm/d. Under this scenario, we would expect there to be a significant margin of 130 mcm/d between potential supply and peak demand.

Due to ongoing restrictions at the Rough long-range storage facility, there will be 1.3 bcm in storage at this site at the start of winter, compared to 2.8 bcm in October 2015. Imports from the Netherlands, via the BBL pipeline, may also be lower this winter due to tighter production restrictions at the Groningen field. As GB benefits from such a diverse range of supply sources, we anticipate that other sources, including Norway, LNG and the IUK pipeline, in addition to baseload supply from UKCS, are capable of delivering sufficient gas to meet the anticipated demand. Our stress test analysis shows that GB infrastructure can meet gas demand under severe cold weather conditions, even with a large infrastructure supply loss.

We continue to see changes to GB's gas supply and how it is used within the gas day. This changing landscape has an impact on how we configure and operate the transmission system. We're working with the industry to make sure that we can continue to manage variations in gas supply and demand while meeting the needs of all of our customers.

National Grid's role

National Grid owns and manages the gas and electricity networks that connect homes and businesses to the energy they need.

We own and manage the high voltage electricity transmission network in England and Wales. We are also the System Operator of the high voltage electricity transmission network for the whole of Great Britain, balancing the flows of electricity to homes and businesses in real time.

We don't generate electricity and we don't sell it to consumers. It is the role of energy suppliers to buy enough electricity to meet their customer's needs from the power stations and other electricity producers. Once that electricity enters our network, our job is to fine tune the system to make sure supply and demand are balanced on a second-by-second basis.

On the gas side, we own and operate the high pressure gas transmission network for the whole of Great Britain. We are responsible for managing the flow of gas to homes and businesses, working with other companies to make sure that gas is available where and when it is needed.

We do not own the gas we transport and neither do we sell it to consumers. That is the responsibility of the energy suppliers and shippers.

Together, these networks connect people to the energy they use.

Stakeholder engagement

The *Winter Outlook Report* provides our view of gas and electricity security of supply for the coming winter. It is informed by insight received from stakeholders across the energy landscape via the *Winter Consultation* and regular conversations with industry participants.

You've told us that you believe the outlook reports provide you with a well-informed, industry-wide view to support your preparations for the winter ahead. In particular you use our analysis of supply and demand, both for electricity and gas, to inform your winter strategy. You also told us that you use the outlook reports as a benchmark for your own forecasts.

Interest in our outlook reports continues to grow, with more people downloading the reports than ever before. We want to make sure that our reports continue to provide you with the information you need, both for long-standing readers and those who are new to the industry. In response to your feedback we've included a number of spotlights in this year's report, to help you understand changes to the energy market. We hope you will find these useful.

"National Grid's *Winter Outlook Report* is an important study which we primarily use to benchmark our own forecasts of energy supply and demand in order to challenge our assumptions and the appropriateness of our commercial strategies for the winter ahead."

Energy industry stakeholder

How we have engaged with you

We are able to deliver a credible and well-informed outlook for the winter ahead due to the involvement of our stakeholders. To shape our view for winter 2016/17, we have collected feedback in a number of ways.

1. Regular engagement with the energy industry

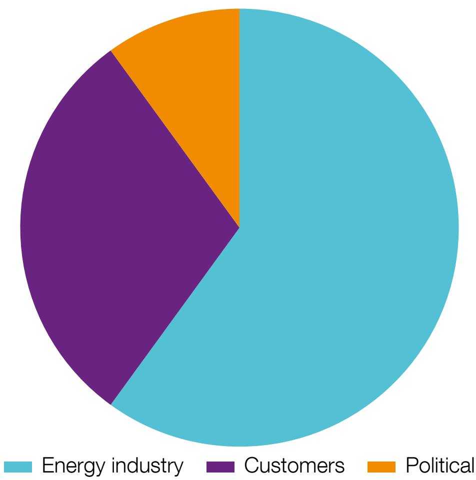
In our role as System Operator, we engage with and receive data from a range of market participants, including generators, interconnectors and gas shippers. The data we receive informs our analysis of supply and demand for the winter ahead. We also host industry events throughout the year to discuss the operation and performance of the gas and electricity systems, and debate important industry changes. You can find out more about our **gas** and **electricity** operational forums on our website.

2. Responses to the *Winter Consultation*

The responses we receive to the *Winter Consultation* provide us with valuable insight on the coming winter. We use your feedback to challenge and inform our assumptions, from our gas supply projections to the stress tests we undertake.

This year we received ten detailed responses to the consultation; five via email and five via the online survey. Respondents included energy suppliers, asset owners and large energy users. You can see a summary of who responded in figure 1.

Figure 1
Respondents to the *Winter Consultation* by stakeholder group



"We welcome the opportunity to respond to this year's *Winter Outlook Report*. We find the [outlook reports] very useful: they provide a review of how the previous winter out-turned against expectations and an opportunity to review and comment on National Grid's views and data for how the forthcoming winter may turn out."

Energy industry stakeholder

3. System Operator publications

The *Winter Outlook Report* is just one of the documents within our System Operator suite of publications on the future of energy. Each of these documents aims to inform the energy debate by highlighting a particular issue, and is shaped by engagement with the industry.

The starting point for our analysis is the *Future Energy Scenarios (FES)*. This document considers the potential changes to the demand and supply of energy from today out to 2050. To develop our 2016 scenarios, we consulted 362 organisations through workshops, webinars and bilateral meetings. The scenarios provide a starting point for much of the analysis in this report, such as our electricity winter view and analysis of gas demand.

The network and operability changes that might be required to operate the electricity system in the future are explored in the *Electricity Ten Year Statement*, *System Operability Framework* and *Network Options Assessment*.

For gas, these issues are considered in the *Gas Ten Year Statement* and *Future Operability Planning* publications. We share aspects of our analysis with the industry during the development of these documents to make sure that the proposed solutions meet the needs of our stakeholders.

You can find out more about any of these publications, and how they incorporate insight from our stakeholders, by clicking on the document front covers on the next page or by visiting our **Future of Energy webpage**.

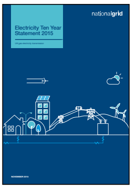
Key publications from the System Operator 2016/17

Future Energy Scenarios
July 2016

A range of plausible and credible pathways for the future of energy from today out to 2050.

Winter Outlook Report
October 2016

Our view of the gas and electricity systems for the winter ahead.

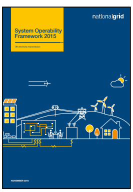


Electricity Ten Year Statement
November 2016

The likely future transmission requirements on the electricity system.

Gas Ten Year Statement
November 2016

How we will plan and operate the gas network, with a ten-year view.

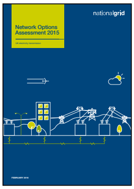


System Operability Framework
November 2016

How the changing energy landscape will impact the operability of the electricity system.

Future Operability Planning
November/December 2016

How the changing energy landscape will impact the operability of the gas system.



Network Options Assessment
January 2017

The options available to meet reinforcement requirements on the electricity system.

Summer Outlook Report
April 2017

Our view of the gas and electricity systems for the summer ahead.

Winter Review
May 2017

A comparison between the past winter's actual energy demand and supply and our forecast.

Winter Consultation
June 2017

An opportunity to share your views on energy demand and supply for the winter ahead.

Responding to your feedback

The outlook reports evolve each year as we respond to our stakeholders' feedback and try to create more useful tools for you. You can see the changes we've made to this year's report in table 1.

Table 1
How we have responded to your feedback

You said	We did
The interactive publication is easy to navigate and we can find the information we need quickly.	We have added more interactivity to this year's publication. You will find navigation buttons at the top of each page and hyperlinks embedded throughout the document to take you to sources of further information.
The presentation of the electricity analysis in the 2015/16 report was easier to read and didn't remove any information that was needed.	We have presented this year's electricity analysis in the same way. You will find the analysis in two sections; the winter view and the week-by-week operational view.
We would like to know more about the new electricity notifications this winter and how we should respond.	You will find an explanation of the industry notifications in the operational toolbox section of the report, along with how we would like the market to respond.
We would like to know more about the changing gas storage industry, and its impact on the market.	You will find a spotlight on storage in the gas supply section on page 49.

Improving our stakeholder engagement

Throughout 2017, we'll be working with our new customer and stakeholder teams to improve our engagement with you and make sure that our reports continue to meet your needs.

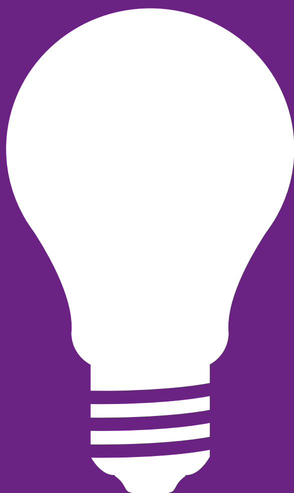
We will be exploring a wider range of engagement methods, with a programme of one-to-one meetings, National Grid events and greater online presence. The *Winter Consultation* for 2017/18 will be launched in summer 2017. To find out more and register for news and alerts, visit our **Future of Energy webpage**.

Electricity
Winter outlook

This chapter sets out our current view of the electricity system for winter 2016/17. It details our analysis of expected demand and available generation, and outlines the tools and notifications we have available to help us to balance the system.

The chapter contains the following sections:

- Winter view
- Operational view
- Interconnected markets
- Operational toolbox.



Winter view

Our winter view presents our assessment of security of supply for winter 2016/17. Based on this analysis, we believe we have the right tools in place to help us to balance the system.

Key messages

- **The de-rated margin for winter 2016/17 is 6.6%, with a loss of load expectation of 0.5 hours/year.**
- **Our assessment of the de-rated margin includes the 3.5 GW of contingency balancing reserve services that we have procured to help us balance the system.**
- **Since publishing the *Winter Consultation* in July, additional generation capacity at Eggborough power station has returned to the market and an outage on the East West Interconnector has decreased exports to Ireland. These events have had a positive impact on the outlook for the winter.**

Key terms

- **Generation margin:** the sum of generators declared as being available during the time of peak demand, minus the expected demand at that time and a basic reserve requirement. This is presented as a percentage.
- **Loss of load expectation (LOLE):** used to describe electricity security of supply. It is an approach based on probability and is measured in hours per year. It measures the risk across the whole winter of demand exceeding supply under normal operation. It does not mean that there will be a loss of supply for x hours per year. It gives an indication of the amount of time across the whole winter that the System Operator may need to call on a range of emergency balancing tools to increase supply or reduce demand. In most cases, LOLE would be managed without significant impact on end consumers.
- **De-rating factors:** these account for breakdowns, planned outages and any other operational issues that may result in power stations not being able to generate at their normal level. They are based on the historic availability of plant during peak periods.
- **Contingency balancing reserve:** these services have been developed to support system balancing by enabling National Grid to access additional reserve, held outside of the market. There are two types of reserve services; demand side balancing reserve (DSBR) and supplemental balancing reserve (SBR). For winter 2016/17, we have only purchased SBR services.

Overview

Our winter view is an assessment of security of supply for winter 2016/17. It is the starting point for our assessment of LOLE and de-rated margin. Our analysis is based on our *Future Energy Scenarios (FES)* 2016 and a wider credible range of sensitivities. The analysis for winter 2016/17 uses the No Progression scenario from FES. This is our base case as it is the scenario that has a LOLE closest to the average of all four scenarios; it is not the scenario that we think is most likely to occur.

De-rated margin and loss of load expectation

Since publishing our *Winter Consultation* in July, Eggborough power station announced that unit 4 will run in the wholesale market this winter, alongside the two units providing SBR services. This unit represents an additional 430 MW of de-rated capacity that will be available to the market. In addition, an outage on the East West Interconnector (EWIC) has decreased expected exports to Ireland by 250 MW. These events have had a positive impact on the outlook for winter.

The de-rated margin for winter 2016/17 has now increased to approximately 3.4 GW, or 6.6% and a LOLE of 0.5 hours/year. Based on this analysis, we expect the electricity margin to be tight but manageable this winter.

Although the EWIC outage has improved the de-rated margin, it has also removed the ability for GB to import electricity via this interconnector. Due to higher electricity prices in Ireland, GB typically exports to Ireland via EWIC in peak periods. However, these flows can reduce, or switch to imports to GB, in response to price signals, particularly during periods of high wind output in Ireland.

Our de-rated margin includes the 3.5 GW of contingency balancing reserve services that we have procured for the winter. These services allow National Grid to access additional capacity held outside of the market to help balance the system. The de-rated margin excluding contingency balancing reserve services is 1.1%, with a LOLE of 8.8 hours/year.

Our analysis is based on a de-rated generation capacity of 55 GW. The capacity margin assumes an average cold spell (ACS) peak demand of 52.7 GW and net interconnector imports of 2.0 GW.

Procurement of contingency balancing reserve

To make sure we have the right tools to help us balance the system, in December 2015 we identified a requirement to procure contingency balancing reserve services for winter 2016/17. The Volume Requirements Methodology[1], which uses our FES and a range of sensitivities approved by Ofgem[2], was used to determine the amount of reserve services to procure.

On 29 February 2016, we confirmed that we had procured 3.5 GW (de-rated) of SBR. Details of the units that have been awarded SBR contracts for winter 2016/17 are available on our **website**. This winter, some of the power stations providing SBR services may require up to 48 hours notice before they can begin to generate. As a result, we may need to issue start up instructions to these generators if there is a possibility that they will be required. These instructions will be announced on **SONAR** and the **BM Reports website**.

In August 2016, we announced that we would not be procuring DSBR for the winter ahead. DSBR was designed for consumers who do not already reduce their demand or run embedded generation during peak times in response to price signals. However, the tender responses we received indicated that there would be a minimal volume of DSBR available over the peak.

As a result, we decided that it would be uneconomic to procure this service for winter 2016/17.

Contingency balancing reserve services were designed as a transitional product to provide additional reserve in the mid-decade period. As we transition to the Capacity Market, this is the last year that we intend to run these services. We will therefore not be procuring SBR or DSBR services for winter 2017/18.

Assumptions

Demand

The ACS peak transmission system demand is expected to be 52.7 GW for winter 2016/17. In order to cover the largest in-feed loss, we add 0.9 GW of reserve to the peak demand. The total demand for winter 2016/17, including this reserve, is expected to be 53.6 GW. This demand excludes any interconnector exports.

Restricted ACS peak transmission system demand = 52.7 GW

The ACS transmission system peak demand is the demand we expect to see on our transmission network, excluding station load. We also add an assessment of demand met by distributed wind generation. This is because both transmission and distributed wind generation are modelled as available supply in our analysis.

[1] http://www2.nationalgrid.com/UK/Services/Balancing-services/System-security/Contingency-balancing-reserve/Methodologies/
https://www.ofgem.gov.uk/publications-and-updates/decision-201617-sbr-procurement-methodology-and-2016-18-volume-requirement-methodology
[2] https://www.ofgem.gov.uk/publications-and-updates/decision-contingency-balancing-reserve-sensitivities-winter-201617

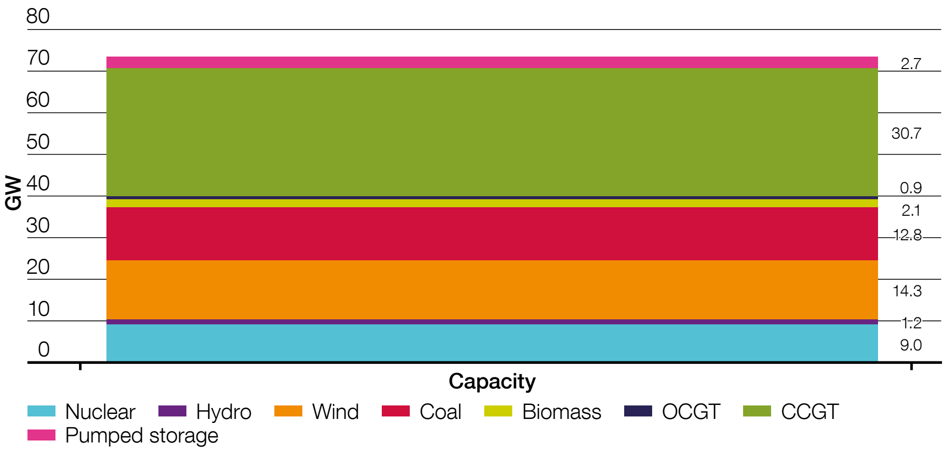
Generation

We have assumed a total maximum technical capacity of 73.7 GW of generation. This includes all of the transmission connected plant expected to be generating in the market, plant with SBR contracts and distributed wind capacity. Interconnectors, which are discussed in more detail below, are excluded from this total. Figure 2 shows the breakdown of this capacity by fuel type.

Our analysis allows for a reduction in generation capacity by applying a de-rating factor to the plant capacity. This accounts for breakdowns, planned outages and any other operational issues that may result in plant not being able to generate at their normal level. The de-rated generation capacity is 55 GW.

Table 2 shows the assumed availabilities for each type of power station. The de-rating factors for conventional generation are calculated based on historic availability on high demand days during the winter peak period[3]. The de-rating factor for wind is based on its equivalent firm capacity (EFC). The EFC is a measure of its overall contribution to security of supply over an entire winter. You can read more about EFC and how we use this in our analysis on page 23.

Figure 2
Generation capacity for winter 2016/17



[3] The winter peak period is between 7am and 7pm, Monday to Friday between December and February.

Table 2
Assumed availability for each type of power station

Power station type	Assumed availability
CCGT	88%
Coal and biomass	87%
Hydro	86%
Nuclear	84%
OCGT	94%
Pumped storage	96%
Wind EFC	21%

Interconnectors

We have assumed a total of 3.3 GW of interconnector capacity available for imports and 3.5 GW for exports. This reflects that since the publication of the *Winter Consultation*, the EWIC interconnector to the Republic of Ireland has announced that it will be on outage this winter.

Based on our analysis of GB and neighbouring energy markets, we have assumed 2.0 GW of net imports to GB for winter 2016/17. This is made up of 2.5 GW of imports from Continental Europe and 0.5 GW of exports to Ireland.

Operational view

Our operational view presents the current picture of operational surplus for each week of winter 2016/17, based on data provided to us by generators. We currently expect there to be sufficient generation and interconnector imports to meet demand throughout the winter.

Key messages

- **Based on current data, normalised demand is expected to peak in mid-December at 52.0 GW.**
- **Current information indicates that the week commencing 9 January will have the lowest level of operational surplus, due to the expected level of demand and planned generator outages.**
- **We expect there to be sufficient generation and interconnector imports available to meet normalised demand throughout the winter.**

Key terms

- **Operational surplus:** the difference between the level of demand and generation expected to be available, modelled on a week-by-week basis. This information helps to inform the market how much surplus is expected to be available. Generators are then able to take this into consideration when planning their outages.
- **Operational Code 2 (OC2) data:** information provided to National Grid by generators. It includes their current generation availability and known maintenance plans.
- **Transmission system demand (TSD):** demand that National Grid as the System Operator sees at grid supply points (GSPs), which are the connections to the distribution networks. It includes demand from the power stations generating electricity (the station load) and interconnector exports.
- **Normalised demand:** forecast based on a 30 year average of relevant weather variables applied to demand models.
- **Embedded generation:** any generation that is connected to the local distribution network, rather than to the transmission network. It also includes combined heat and power schemes of any scale. Generation that is connected to the distribution system is not directly visible to National Grid and therefore acts to reduce demand on the transmission system.

Overview

Our operational view is based on current generation availability data, otherwise known as Operational Code 2 (OC2) data. This data is provided to us by generators and includes their known maintenance outage plans. In our analysis we have used OC2 data provided to us on 6 October 2016. It is possible to access the latest OC2 data throughout the winter on the **BM Reports website**. This data is updated weekly.

In order to account for unexpected generator breakdowns, restrictions or losses close to real time, we apply a breakdown rate per fuel type to the OC2 data. We then compare this against forecast normalised and average cold spell transmission system demand plus our operational reserve requirement, across a range of interconnector flows. The operational view does not take into account any market response to higher demand or tighter conditions.

Assumptions

1. Demand

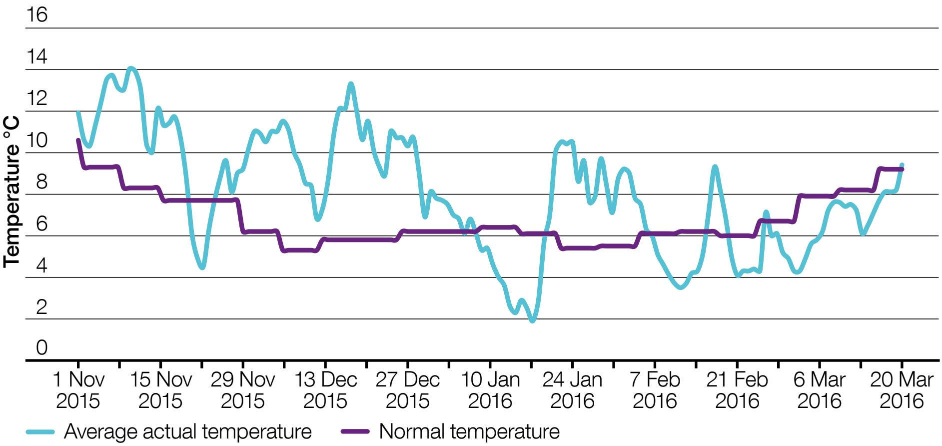
Our normalised peak for transmission system demand for winter 2016/17 is 52.0 GW. This is expected to occur in the week commencing 12 December.

Normalised transmission system demand (52.0 GW) =

national weather corrected peak demand (50.9 GW)
+ station load (0.6 GW)
+ interconnector exports (0.5 GW)

To help us to compare demands between years and identify long-term trends, we calculate normalised demand using normal weather. Normal weather is a weekly average of relevant weather variables, including temperature, wind speed and solar radiation, for the past 30 years. Figure 3 shows a comparison of normal and actual weather for winter 2015/16. To calculate normalised demand, the effect of the actual weather is removed. This helps us to take account of any unseasonable weather conditions. Normal weather is then applied to the underlying demand linear regression models. The demand forecast for 2016/17 has been calculated using normal weather. As this is based on historical average data, the actual demand on the transmission system may be different depending on the weather experienced this winter.

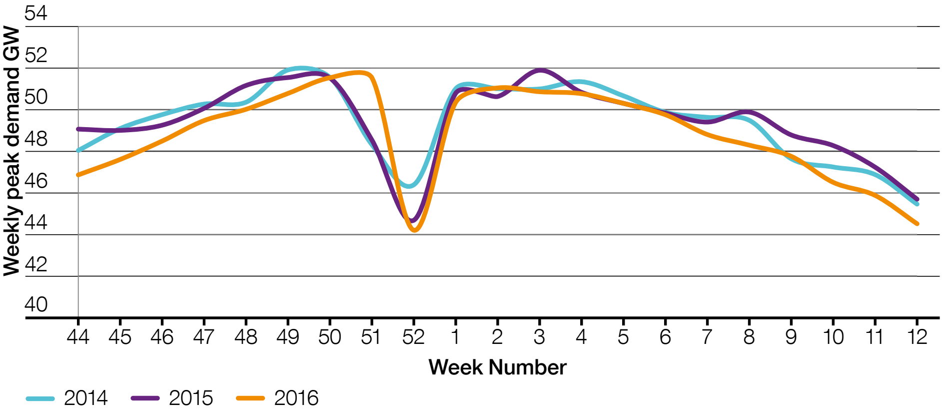
Figure 3
Actual and normal temperature for winter 2015/16



Embedded generation is not directly visible to National Grid but it continues to have an increasing impact on system operation, reducing the level of demand that materialises on the transmission system. Normalised demand forecasts are adjusted to take into account a standardised weekly amount of embedded wind and solar generation. As of summer 2016, embedded wind capacity was 4.6 GW and embedded solar increased to 11.4 GW. A monthly increase of 150 MW of solar capacity is factored into our forecasts. Wind capacity is not expected to significantly increase over the winter.

Figure 4 shows the normalised weekly peak demand forecast for winter 2016/17, compared to the actual normalised demand for winter 2014/15 and winter 2015/16. We expect 2016/17 normalised demand to be broadly in line with that of winter 2015/16, with similar levels of customer demand management (CDM). You can read more about customer demand management and the impact on demand in the spotlight on the next page.

Figure 4
Peak weekly normalised demands for winter 2014/15 and 2015/16, with a forecast for winter 2016/17



Customer demand management

Customer demand management (CDM) occurs when industrial or commercial users choose to change their pattern of energy consumption, typically to reduce energy use during peak periods. By avoiding these peak periods, they reduce their transmission and distribution charges. As discussed in our *Winter Review*, for the last few winters increased CDM over the peak periods has led to demand being lower than forecast.

Winter 2015/16 saw a significant increase in the level of CDM on both peak demand and TRIAD avoidance days. Our analysis indicates that during winter 2015/16, CDM typically ranged between 0.7 and 1.5 GW, reaching 2 GW on the highest demand days.

To manage their demand, users can either reduce their typical electricity demand or meet it using embedded conventional thermal generation. As this generation is embedded, it is not directly visible to us and acts to reduce the demand we see on the transmission system. We have seen an increase in embedded conventional thermal generation over recent winters. We are currently working with the industry to gain a better understanding of the generating behaviour of these units so that we can more accurately reflect them in our analysis and forecasting.

2. Generation

The OC2 data submitted by generators only includes their planned outages. Closer to real time, there may be unexpected generator breakdowns or availability reductions.

To account for this in our analysis, we apply a breakdown rate to each fuel type, shown in table 3. These rates are based on how the generators performed in peak demand periods[4] over the last three winters.

Table 3
Breakdown rates by fuel type

Power station fuel type	Assumed breakdown rate
Nuclear	11%
Hydro	10%
Coal and biomass	13%
Pumped storage	2%
OCGT	4%
CCGT	11%

For wind generation we assume an equivalent firm capacity (EFC) of 21 per cent. You can find out more about how we calculate this in the spotlight below.

The generation providing contingency balancing reserve services, in the form of supplemental balancing reserve (SBR), has also been factored into the total generation available in the weeks where these contracts are active. To access this additional capacity, which is held outside of the market, National Grid must issue a system margin notice ahead of real time. The generation in the operational view therefore reflects a situation where a notice has been issued.

[4] Peak demand periods are defined as the highest 20 per cent of demand half hours, during November to February, between 10am and 8pm Monday to Thursday.

Equivalent firm capacity

In order to estimate the amount of available wind generation that we may expect at peak, we use the EFC. This measures the entire wind fleet's contribution to security of supply. It represents how much conventional generation plant with an availability of 100 per cent would be needed to replace the entire wind fleet and leave security of supply unchanged. This approach to wind modelling combines the risks from wind variability with conventional system risks, such as high demand or low availability of conventional generation.

The wind EFC depends on several factors, including how much wind capacity is installed on the system. As installed wind currently makes up a small proportion of total generation, conventional risks remain the biggest threat to system security. As a result, the EFC is very close to the mean load factor for wind generation. In the future, as the proportion of installed wind capacity continues to increase, the risk that the variability of wind will have an impact of system security also increases. This will result in a decrease to the EFC.

3. Reserve

The System Operator has a requirement to carry operating reserve to regulate system frequency and respond to sudden changes in demand and supply. We have assumed a reserve requirement of 0.9 GW for each week of our analysis. This is shown by the blue bars in figure 5.

4. Interconnectors

Our analysis is based on three interconnector scenarios. All of the scenarios assume full exports to Ireland, which adds 500 MW to expected demand. This level of export has been adjusted to reflect the EWIC interconnector to Ireland being out of service this winter. Each scenario includes a varying level of import from Continental Europe:

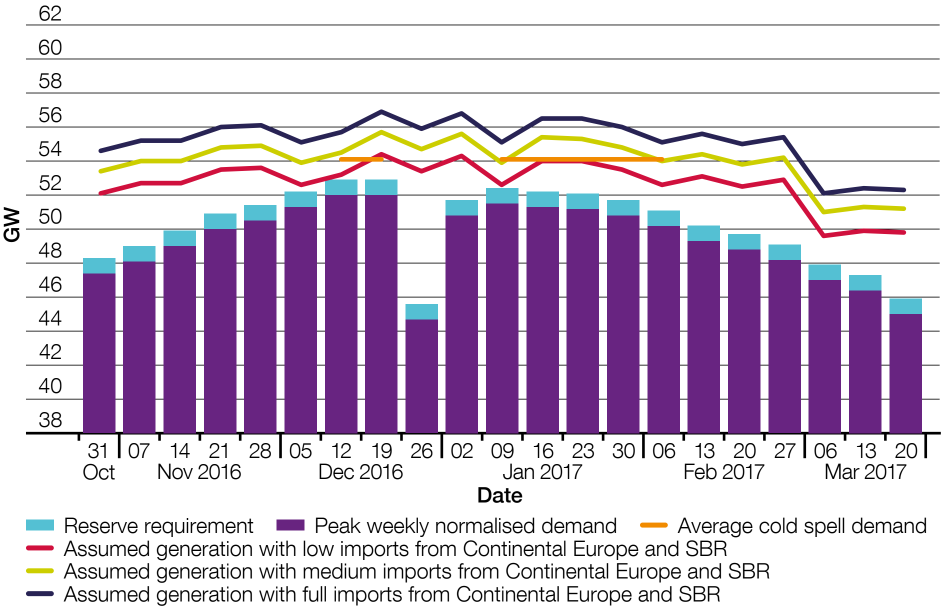
- low imports of 500 MW, resulting in net flows of 0 MW
- medium base case of 1,800 MW, resulting in net imports of 1,300 MW
- full imports of 3,000 MW, resulting in net imports of 2,500 MW.

The three interconnector scenarios are shown by the line graph in figure 5.

Results

Based on the OC2 data provided to us on 29 September, figure 5 below compares the expected weekly generation, with differing levels of interconnector flows, against the weekly normalised demand forecast for winter 2016/17.

Figure 5
Operational view 2016/17



Currently the week with the lowest level of operational surplus is the week commencing 9 January. This is because there are a number of generating units on planned outage and demand levels are higher during this mid-winter period. The level of operational surplus for this week may change closer to winter as generators update their outage plans in response to market signals. The graph shows that normalised demand is met in this week, and across the entire winter, under the low, medium and full interconnector import scenarios.

The orange line in figure 5 shows the average cold spell (ACS) peak demand, as defined and calculated in the winter view chapter. Historical analysis shows that ACS peak has never occurred before the first week in December, during the Christmas fortnight or after the first week in February. As a result, ACS demand is only shown outside of these weeks. In four of the weeks where ACS demand is calculated, this demand could be met by medium interconnector imports. In the remaining weeks, ACS demand could be met by low interconnector imports in the week commencing 19 December, and by full interconnector imports in the weeks commencing 9 January and 6 February.

Our operational view is based on the best data currently available to us. Changes to the notified generation and forecast demand will change this outlook throughout the winter, potentially increasing or decreasing the level of operational surplus. We encourage the industry to regularly view the latest OC2 data, which is published each Thursday on the **BM Reports website**.

Interconnected markets

Current forward prices indicate that there will be a net flow of electricity to GB from Continental Europe during peak periods. Outside of peak times, an increase in Continental European prices closer to winter and the impact of weather on prices may result in some variation in interconnector flows.

Key messages

- **Based on forward prices, we expect there to be net imports of electricity from Continental Europe to GB at peak times during winter 2016/17.**
- **We expect there to be a net export of electricity from GB to Ireland during peak times. These flows may reduce or switch to imports during periods of high wind in Ireland.**

Key terms

- **Import:** interconnectors flowing electricity into GB.
- **Export:** interconnectors flowing electricity out of GB.
- **Net import/export:** the sum of total generation flowing via interconnectors, either into or out of GB.

Overview

Interconnectors link the GB transmission system to Continental Europe and Ireland. The direction that electricity flows on these interconnectors is primarily driven by the difference in prices between these markets. Based on an analysis of historical price differentials between the markets from winter 2015/16 and forward electricity prices, we expect there to be a net flow of electricity from Continental Europe to GB during peak periods this winter.

With higher electricity prices in Ireland, we expect there to be net exports of electricity from GB in peak periods.

Due to an increase in renewable generation capacity and the impact of low temperatures on French electricity demand, weather is expected to have a significant impact on hourly electricity prices this winter. As a result, we expect occasional variations on the interconnector flows outside of peak periods, instead of the consistent flows we have seen historically.

European markets review

- **Day ahead market coupling in North West Europe has contributed to an increasing convergence of prices between continental markets. This trend is expected to continue this winter.**
- **Forward prices have recently increased in France as several nuclear power units are on outage for maintenance. The latest information suggests that these outages will continue until late December. However, the margin between available supply and demand is expected to remain adequate for any cold spells.**
- **In the Netherlands and Germany forward prices remain low. This is due to the continued increase in installed wind capacity and a gradual transition from older coal-fired power plants to modern gas-fired plants. German renewable capacity is expected to increase by an additional 5.8 GW by the end of 2016.**
- **Due to availability of nuclear power plants, there is more generation accessible in the Belgian market than in previous winters. This is expected to contribute to low forward prices in the European coupled market.**
- **A colder winter in Continental Europe could push up prices and reduce interconnector imports to GB. The French electricity market in particular is impacted by low temperatures due to the large proportion of electrical heating in French homes.**

Interconnector availability

France and the Netherlands

Interconnexion France Angleterre (IFA) is a 2,000 MW interconnector between France and GB. It is expected to be at full capability this winter, with the exception of a maintenance outage, which will reduce capacity to 1,000 MW until 21 October.

BritNed is a 1,000 MW capacity interconnector to the Netherlands. There are no technical restrictions to its capability for winter 2016/17.

Ireland

The Moyle interconnector to Northern Ireland is expected to be at its full capability of 500 MW throughout the winter. The East West Interconnector (EWIC) to the Republic of Ireland will be out of service this winter due to an unplanned outage. It is due to return to its full capability of 500 MW in late February 2017.

Prices

The North Western Europe (NWE) day ahead coupling regime introduced implicit trading in day ahead timescales. The regime has resulted in increasing price convergence between the Belgian, Dutch, French and German markets, and more recently Austria. This effect has not yet been seen in GB, and electricity prices remain consistently higher here than in Continental Europe, suggesting that the interconnectors will be importing to GB at peak times.

France, the Netherlands and Germany

Forward prices in France and the Netherlands are currently lower than those in GB. We therefore expect net imports to GB on IFA and BritNed throughout the winter.

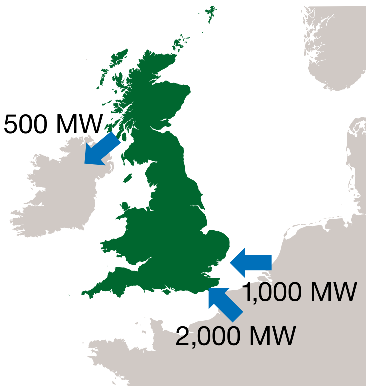
In France, forward prices have increased over the last few months due to the uncertainty around the availability and maintenance schedules of nuclear power plants. The recent introduction of a carbon price floor by the French government is also likely to result in a slight increase in prices. However, the margin between available supply and demand is expected to remain comfortable. Although forward prices have increased in France, they are expected to remain lower than in those in GB over the winter. As a result, we expect to see net imports to GB on IFA.

The forward electricity prices for winter 2016/17 remain low in the Netherlands and Germany. Modern gas-fired power stations are gradually replacing older coal-fired stations in the German baseload, while increasing renewable generation capacity and the previous mild winters continue to drive prices down.

Ireland

In winter 2015/16, the EWIC and Moyle interconnectors exported consistently to Ireland at maximum flows over the peak periods. We expect flows this winter on the Moyle interconnector to be similar, with net exports from GB to Ireland. However, flows are likely to reduce, or even switch to imports to GB, during periods of high wind output in Ireland due to lower prices in the Irish market and the technical restrictions on their system. The outage on EWIC means that the net flows of electricity to and from Ireland will be reduced this winter.

Figure 6
Forecast flows on the interconnectors during peak periods



Operational toolbox

Winter 2016/17 will see the introduction of new or updated industry notifications to allow us to communicate system conditions to the market. This section provides information to help the industry better understand the notifications that National Grid may issue this winter.

Key messages

- **This winter, Electricity Margin Notices (EMN) will replace Notifications of Inadequate System Margin (NISM). An EMN is designed to inform the market that the System Operator would like the margin between forecast demand and available generation to be greater. It is a signal for the market to take action by increasing generation or reducing demand.**
- **Following the start of the Capacity Market on 1 October, Capacity Market Notices (CMN) will be introduced for the first time this winter. These notices are automated alerts, issued four hours ahead of real time, to inform the market that the margin between supply and demand may decrease below a defined threshold.**

Key terms

- **Margin:** the difference between the level of demand and supply that is available to meet it.

Overview

The market is responsible for trading electricity up to the last hour before delivery. In the last hour and during real time, National Grid as the System Operator is required to ensure that the amount of electricity being generated is sufficient to meet demand, while maintaining system standards such as frequency response and voltage profiles.

We need to make sure that the market is aware of system conditions so that they can respond, for example by making more generation available or reducing demand levels. This winter will see the introduction of new or updated industry notifications to help us communicate system conditions to the market. It is important that the industry understand these notifications and how we would like them to respond, to make sure that we can continue to effectively balance the system.

Operational notifications

As the System Operator, National Grid can issue a range of operational notifications to alert the market to specific anticipated system conditions. These notifications are issued manually by our control room and are available to view on the **BM Reports website**.

The first level of operational notifications is an Electricity Margin Notice (EMN). This notice may be issued if we would like the margin between forecast demand and available generation to be greater. It is one of the routine tools that we have to communicate with the market, and is designed to inform the industry of the forecasted position and request additional capacity is made available. In most instances, the market will respond, enabling the notice to be withdrawn. This reaction shows the electricity market working as it should.

1. Electricity Margin Notice (EMN)

If the System Operator would like the margin between forecast demand and available generation to be greater, an EMN may be issued to generators, interconnected system operators, and suppliers. The purpose of this notification is to make these parties aware of the situation and request that reserve generation is prepared, and any additional capacity is made available. As an EMN is the first stage in the hierarchy of margin notifications available to National Grid, it will typically be issued up to a day ahead of when the additional capacity is required. Additional capacity is most often required for the evening peak demand period. In response to an EMN being issued, we would typically expect more plant to be made available to the market and existing plant to run more reliably. This would prevent the need for further action and allow the notification to be withdrawn via BM Reports.

An EMN replaces the previous Notification of Inadequate System Margin (NISM). Following consultation with the industry and approval by Ofgem, the name of this notification has now been changed and the Grid Code updated.

If the market does not respond when an EMN is issued, there are a number of further actions that the System Operator can take. This includes further signals to the market, dispatching the supplemental balancing reserve (SBR) services that we have procured, and working with our trading partners to bring in more electricity via the interconnectors. This winter, some of the power stations providing SBR services require up to 48 hours notice before they can begin to generate. As a result, we may need to issue start up instructions to these generators before an EMN is issued if there is a possibility that they will be required. You can find out more about these instructions in the spotlight on page 31.

If all market options have been exhausted and SBR dispatched, we are then able to utilise services such as maximum generation. This is a request made to power stations to generate at their highest possible output, in excess of normal technical and commercial parameters. Should these actions prove insufficient, it is possible to issue instructions to DNOs and transmission connected customers to request stages of voltage reduction to avoid the shortfall. This can make hundreds of megawatts available and in most cases is unnoticed by consumers.

SBR warming notices

SBR services allow National Grid to access additional capacity held outside of the market to help balance the system. This winter, for the first time, coal power stations will be providing SBR services. These power stations may require up to 48 hours notice before they can begin to generate. As a result, if forecasts indicate that there is a possibility that these services will be required, we may need to issue start up instructions to these generators before an EMN is issued, in line with the SBR operational methodology. This will ensure that these power stations are 'warmed' and ready to generate if they are needed. These warming notifications will be issued to the industry up to 49 hours in advance via SONAR and BM Reports.

As we approach real time, we will continue to assess the forecast demand and available generation. If we believe that SBR services are no longer required, the warming notices may be withdrawn.

You can find out more about SBR services on our website.

2. High Risk of Demand Reduction (HRDR)

A High Risk of Demand Reduction (HRDR) provides early notification of an increased risk of demand reduction. It also provides additional information to DNOs and transmission connected customers about the location of a potential reduction. Recipients are required to prepare their demand reduction arrangements.

3. Demand Control Imminent (DCI)

A Demand Control Imminent (DCI) notification may be issued to provide short-term notice when a demand control instruction is expected in the following 30 minutes. It must be cancelled or re-issued within the next two hours. The notification is sent only to the DNOs and transmission connected demand that will receive a Demand Control Instruction.

4. Demand Control Instruction

In the event of a system margin shortfall National Grid may issue a Demand Control Instruction as a last resort to the DNOs and transmission connected demand. The instruction contains the level of reduction required to avoid the shortfall and specifies the demand control action required, including stages of voltage reduction and, only in extreme cases, demand disconnection.

The Capacity Market

This winter sees the introduction of the Capacity Market (CM), developed as part of the government's Electricity Market Reform programme to ensure the future security of our electricity supply. With 20 per cent of the UK's current generating capacity projected to close over the next decade, the CM has been developed to encourage the industry to invest in flexible generating capacity to replace it. The CM gives capacity providers of all sizes, from demand side participants to major power stations, the opportunity to bid via auctions for electricity supply contracts. These contracts provide steady and predictable revenue streams, and allow long-term investment decisions to be made with confidence. In return, contract providers have to be ready to deliver energy to the network at short notice to support it at times of system stress, when there is an insufficient cushion between demand and supply.

The first electricity supply contracts for the CM began on 1 October 2016. For the first 12 months, the CM will operate in a transition phase, with less than 2 per cent, or 0.8 GW, of the market's generation capacity included. This first year will involve small assets up to 20 MW, including demand side aggregators and generators not connected to the transmission system. From October 2017, 54 GW of capacity, including large power stations, will be contracted via the CM.

Capacity Market Notices

With the start of the CM, there will be new notifications introduced this winter. A Capacity Market Notice (CMN) is an automated alert to signal to the market that the margin between supply and demand may decrease below a defined threshold. This threshold is determined by the UK Government and is initially set at 500 MW above the sum of expected demand and an operating margin, as shown in figure 7. We will be working with the government throughout the CM transition phase to determine if this threshold is appropriate and provides the desired signal to the market.

A CMN will typically be issued four hours ahead of the margin potentially decreasing below the threshold. It will include the time the notification commences, details of the circumstances that triggered it, and the projected transmission demand and supply capacity.

A CMN will be published via a new dedicated **website**. All industry participants and observers will be able to view this website, and can subscribe for automated email and SMS alerts to be kept up-to-date with the latest information.

Figure 7
The threshold to trigger a CMN

A CMN is not an operational dispatch signal, or one of the operational notifications described on page 30 that the control room will continue to issue. CMNs are triggered automatically, using data provided by industry participants that is not yet final. This data will be updated closer real time, which may result in changes to the margin between supply and demand. The control room will continue to assess the situation, conducting their own analysis based on existing knowledge and experience, and could issue additional operational notifications if appropriate.

Following the publication of a CMN, industry participants are advised to make themselves aware of system information, operational notifications and other data available to the industry.

Fuel prices

This chapter sets out our latest analysis of fuel prices. Trends in prices have an impact on both the electricity and gas systems, influencing the fuel used for electricity generation and how we operate the gas transmission network.

Fuel price analysis

Analysis of forward fuel prices helps us to understand changes in energy demand and supply, and trends in electricity generation. Current coal and gas prices indicate that gas-fired generation is likely to have a cost advantage over coal-fired generation in winter 2016/17. This means that gas-fired units are likely to feature ahead of coal units in the electricity generation merit order as they will be more economic to dispatch.

Key messages

- **Based on forward prices, gas-fired generation is expected to have a cost advantage over coal-fired generation in October 2016.**
- **From December, the price difference between gas and coal becomes narrower for the remainder of winter 2016/17. This may increase competition between the two fuel types, although gas-fired generation is still expected to have a cost advantage.**

Key terms

- **National balancing point (NBP) gas price:** the wholesale gas market in Britain has one price for gas, irrespective of where it has come from. This is called the national balancing point of gas. It is usually quoted in pence per therm.
- **Combined cycle gas turbine (CCGT):** a power station that uses the combustion of natural gas or liquid fuel to drive a gas turbine generator to produce electricity. The residual heat from this process is used to produce steam in a heat recovery boiler. This steam then drives a turbine generator to generate more electricity.
- **European Emissions Trading Scheme (ETS):** an EU wide system for trading greenhouse gas emission allowances. The scheme covers more than 11,000 power stations and industrial plants in 31 countries.

Overview

Fuel prices can have a significant effect on energy demands and are analysed to help understand changes to energy supply patterns. Uncertainty in prices over short time periods, such as for the winter ahead, has a significant impact on the type of electricity generation that runs. In contrast, prices for end users are generally based on tariffs that respond to longer term trends in wholesale prices. As a result, we concentrate on the impact of prices on electricity generation in the outlook reports.

Energy prices have fluctuated significantly over the previous 12 months, and may continue to do so over the winter. The current forward prices for coal, gas and carbon suggest that gas is likely to be the lower cost fuel for winter 2016/17 and therefore gas-fired generation will be dispatched ahead of coal. However, from December 2016 onwards, the price differential between coal and gas becomes much narrower. This means that a small change in prices could increase competition between the two fuel types.

Results

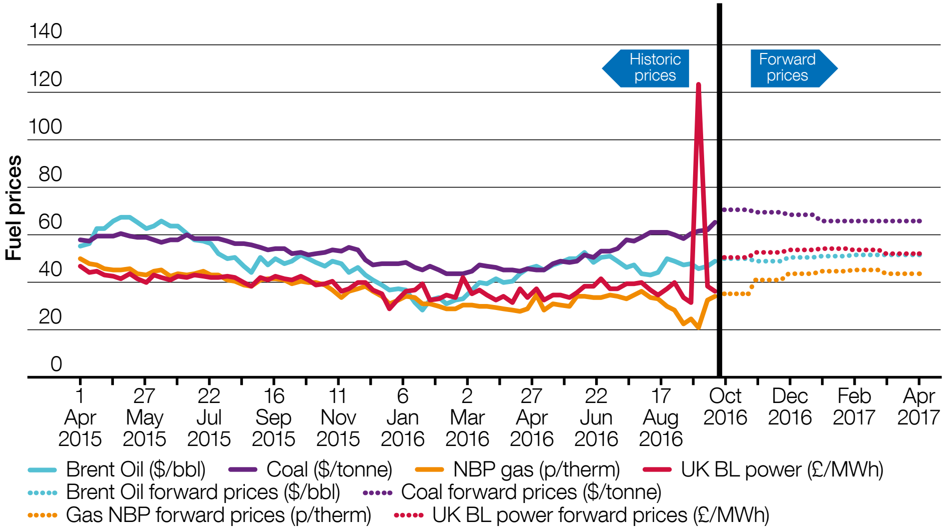
Figure 8 shows how energy prices have fluctuated over the previous 12 months and the latest forward prices for the winter ahead.

Between October 2015 and January 2016, oil prices decreased by over 40 per cent. They have gradually recovered throughout 2016 to October 2015 prices. Coal prices have increased by around 24 per cent since October 2015. Forward prices indicate that there will be little movement in coal prices over the winter. However, Sterling currency exchange rates have decreased substantially since summer 2016. This will have caused coal imports, which are internationally priced in US dollars, and EU ETS carbon, priced in Euros, to be more expensive for companies based in GB.

Gas prices have decreased by approximately 14 per cent and baseload electricity prices by approximately 12 per cent since October 2015. Figure 8 shows that gas prices have fluctuated throughout 2016. This is in response to fluctuating oil prices, the value of Sterling and announcements about the operation of the Rough long-range storage facility. In June, the announcement by Centrica Storage Limited of a 42 day shutdown of the storage facility contributed to increasing NBP prices. NBP prices continued to rise when it was believed that the facility would not be available for winter 2016/17. However, when it was announced in August that 20 out of 29 wells would return for withdrawal from 1 November, this contributed to the decreasing NBP price. You can read more about storage and the Rough facility on page 49.

The latest NBP gas forward prices show a 20 per cent increase for November from current prices. This is in response to the beginning of winter. It also reflects market uncertainty about whether the Rough storage facility will return as scheduled on 1 November and the levels of BBL interconnector flows that can be expected this winter due to the ongoing restrictions at the Groningen field.

Figure 8
Fuel prices since 1 April 2015

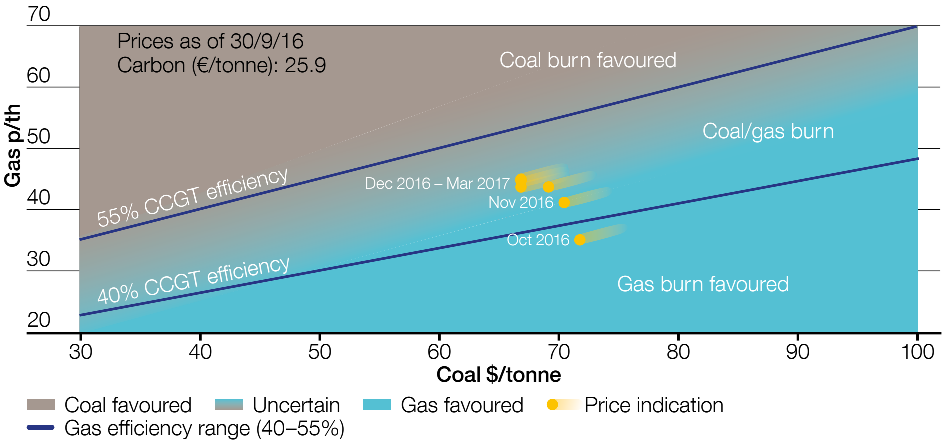


Data source: LiveCharts.co.uk, EEX, ICE

Our analysis of the response of the electricity generation market to fuel prices is shown in figure 9. The chart shows how the prices of coal and gas impact the type of electricity generation that runs. It includes the effect of the carbon price and the different efficiencies of coal and gas-fired plant.

In October, the yellow markers on the chart shows that the forward prices strongly favour gas as the preferred fuel for electricity generation. For the remainder of winter 2016/17, gas is still likely to be the preferred fuel, particularly in the case of the higher-efficiency combined cycle gas turbines (CCGTs). However, from December the price differential becomes much narrower, particularly for lower-efficiency CCGTs. This is a closer price position for the two fuels than has been seen throughout 2016. This is mainly due to an increase of around 8p per therm in the forward gas prices over winter 2016/17.

Figure 9
Coal and gas prices and the impact on electricity generation



Data source: ICE

Gas-fired power station efficiencies are assumed to be approximately 40% for Open Cycle Gas Turbines (OCGTs) or Combined Cycle Gas Turbines (CCGTs) operating in open cycle mode. CCGTs operating in combined cycle are assumed to be in the range of 50–55% efficient.

Gas
Winter outlook

This chapter sets out our current view of the gas system for winter 2016/17. It details our analysis of supply and demand, and the preparations we have made to make sure we are ready for the winter ahead.

The chapter contains the following sections:

- Gas demand
- Gas supply
- Security assessment
- System operation
- Safety monitors.

Gas demand

Gas demand for winter 2016/17 is expected to be lower than the 2015/16 weather corrected demand. Lower gas exports to Ireland and Continental Europe represent the biggest differences to last year.

Key messages

- **Gas exports to Ireland are expected to be lower than last winter. This is because the new Corrib gas field is now capable of flowing at full capacity.**
- **Gas exports to Continental Europe are expected to be lower than winter 2015/16, when the mild weather meant that the price differential resulted in exports from GB.**
- **Gas demand for electricity generation is expected to be higher than last winter, as forward prices indicate gas will be cheaper than coal for electricity generation.**

Key terms

- **Non-daily metered (NDM) demand:** a classification of customers where gas meters are read monthly or at longer intervals. These are typically residential, commercial or smaller industrial consumers.
- **Daily metered (DM) demand:** a classification of customers where gas meters are read daily. These are typically large-scale consumers.
- **Weather corrected demand:** demand calculated with the impact of the weather removed. This is sometimes known as 'underlying demand'. Weather is one of the main drivers of the difference in demand from one day to the next. We take out the impact of weather to understand other important underlying trends.
- **Seasonal normal conditions:** a set of conditions representing the average that we could reasonably expect to occur. We use industry agreed seasonal normal weather conditions. These reflect recent changes in climate conditions, rather than being a simple average of historic weather.

Overview

Based on seasonal normal conditions, we expect gas demand for winter 2016/17 to be lower than the weather corrected demand of winter 2015/16. This is largely a result of lower projected gas exports. With the Corrib gas field west of Ireland now capable of flowing at full capacity, there is likely to be less gas exported from GB to Ireland over the winter. Based on seasonal normal conditions for winter 2016/17, we also expect less gas to flow to Continental Europe compared to the previous mild winter. In 2015/16, the mild weather in GB meant that the price differential resulted in exports to Continental European markets. These reductions are counteracted to an extent by a higher gas demand for electricity generation due to favourable economics for gas-fired power plants.

Forecast gas demand

Figure 10 shows the forecast gas demand for winter 2016/17 based on seasonal normal weather conditions. These conditions represent the average conditions that we might reasonably expect to occur this winter. In addition, the chart also shows cold and warm weather demand; these represent the typical influence of weather, rather than any demand changes associated with, for example, power generation economics.

Figure 10
Forecast gas demand winter 2016/17

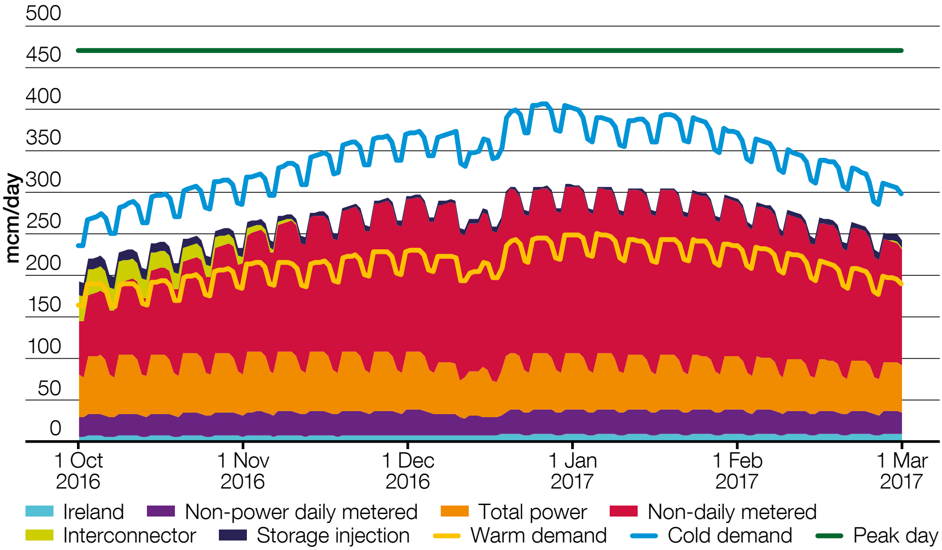


Figure 10 shows seasonal normal demand peaking at around 300 mcm/d. Peak winter demands may be higher than this as temperatures can be colder than average seasonal normal conditions. The peak day forecast demand of 472 mcm/d is significantly higher than the cold demand curve. This is because the peak day assumes extreme weather, leading to higher demand from weather sensitive sectors (i.e. residential, other buildings and industrial), and includes NTS power station demand of 88 mcm/d.

Flows to Ireland, shown by the light blue line in figure 10, have decreased this year as Corrib, a new gas field west of Ireland, increased flows to its full capability. Corrib coming online has the potential to reduce export demand from GB by up to 9mcm/d.

Figure 11 shows the forecast demand for winter 2016/17 by sector, compared against the actual and weather corrected demand for winter 2015/16.

Figure 11
Forecast gas demand by sector

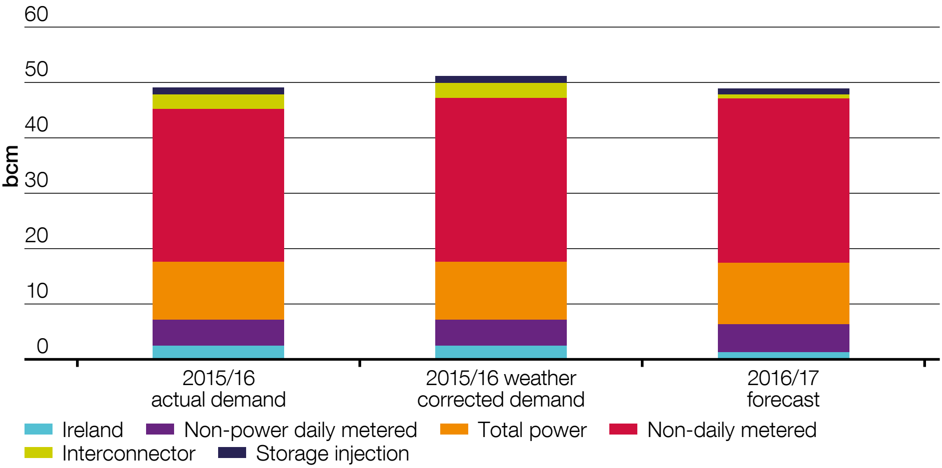


Figure 11 includes the 2016/17 export demand for Ireland and Continental Europe via the IUK pipeline. The total export demand is expected to be slightly lower than 2015/16 and, as shown in table 4, represents a decrease of 3.1 bcm.

Last winter, additional gas was used for electricity generation compared to the previous year as falling gas prices caused it to be favoured over coal for fuel. This year, forward prices indicate that gas is again likely to be favoured. You can read more about how this may impact the electricity generation market in the fuel prices section on page 35.

Winter 2015/16 actual non-daily metered (NDM) demand was significantly lower than the weather corrected demand. NDM demand includes residential heating, which is reactive to weather, and so removing the impact of this through weather correction has a significant impact. The mild winter weather conditions in GB last winter led to lower actual demand. We expect NDM demand to be similar to the weather corrected demand for winter 2016/17.

Table 4 summarises the forecast for winter 2016/17, and as a comparison, shows the historic actual and weather corrected demand for previous winters.

The table highlights the effect of cold weather on NDM demand. Last winter was particularly mild with demand 2 bcm lower than a seasonal normal winter. This lower demand, combined with consistent supply from Norway and LNG terminals, meant that IUK was exporting to move this supply from GB to Europe. IUK exported well into February 2016, when we would normally see this interconnector switching to imports to GB far earlier in the winter. Assuming a typical demand and supply scenario for winter 2016/17, we would expect IUK exports to be less than last winter.

Table 4
Forecast gas demand October to March[5]

October to March winter	2013/14		2014/15		2015/16		2016/17
bcm	Actual	Weather corrected	Actual	Weather corrected	Actual	Weather corrected	Forecast
NDM	28.1	29.0	29.3	29.3	27.7	29.6	29.5
DM + Industrial	5.1	5.2	4.9	4.9	4.6	4.7	5.0
Ireland	2.9	2.9	2.9	2.9	2.6	2.6	1.4
Total power	7.9	7.9	8.7	8.7	10.4	10.4	11.1
Total demand	**44.2**	**45.1**	**45.9**	**46.0**	**45.5**	**47.5**	**47.1**
IUK export	0.6	0.6	1.5	1.5	2.7	2.7	0.8
Storage injection	1.8	1.8	0.9	0.9	1.2	1.2	1.2
GB Total	**46.6**	**47.5**	**48.3**	**48.3**	**49.4**	**51.4**	**49.1**

Daily demand

Having set out the overall forecast for winter 2016/17, we now consider the daily demand forecast. Table 5 shows the 2016/17 forecast, compared to the daily average demand for last winter. To provide a view of daily demand under seasonally normal winter conditions, the table is based on the mid-winter months of December to February.

[5] Values in this table are rounded to one decimal place.

Table 5
Forecast daily gas demand December to February[6]

December to February winter	Daily average		Actual range			Forecast range	
mcm/d	2015/16 actual	2015/16 weather corrected	2016/17 forecast	2015/16 low	2015/16 high	2016/17 low	2016/17 high
NDM	172	188	189	101	231	107	336
DM + Industrial	25	26	28	17	30	19	36
Ireland	13	14	8	7	18	6	10
Total power	**57**	**57**	**60**	**28**	**87**	**19**	**90**
Total demand	269	286	287	174	361	189	452
IUK export	10	10	0	0	31	0	30
Storage injection	3	3	5	0	34	0	45
GB Total	**282**	**299**	**292**	**218**	**369**	**191**	**452**

The ranges shown, both for the historic actual and forecast demands, highlight the considerable variation that exists for all demand sectors. The largest range is in the NDM sector, which includes residential demand. This range is so large because gas is the major fuel for heating, and heat demand varies significantly based on weather conditions.

The forecast range is determined differently for each component to reflect the behaviours of each sector. For weather sensitive loads, including NDM, daily metered (DM) and industrial, the low forecast in the range is set according to the demand expected on a warm late winter day. Ireland, IUK and storage demands are based on low historic observations. Power uses low gas-fired generation assumptions.

The high forecast in the range for weather sensitive loads is based on a very cold January day. Ireland is set according to our peak day forecast, while IUK and storage demands are based on high historic observations. Power uses high gas-fired generation assumptions.

[6] The total values shown in this table are not calculated by adding together the forecast range for each sector. This is because the high and low days for each sector do not necessarily occur on the same day. Therefore, the day of the highest GB total will most likely not be on the same highest day as its component parts.

Peak demand

We consider peak demands as a stress test for the standard to which the gas transmission network must be built. Figure 12 and table 6 show the highest ever day of demand in January 2010 and the 1-in-20 peak day demand forecasts for winter 2016/17. The 1-in-20 peak day demand is the level of daily demand that would be exceeded in 1 out of 20 winters.

Diversified peak demand is the demand that could be expected for the country as a whole on a 1-in-20 cold winter day. Undiversified peak demand is the peak day demand calculated for each offtake independently, and then added together. Obligated demand is the total amount of capacity that National Grid is required to make available on every day of the year so customers may flow gas on the network.

Figure 12
1-in-20 peak day gas demand 2016/17

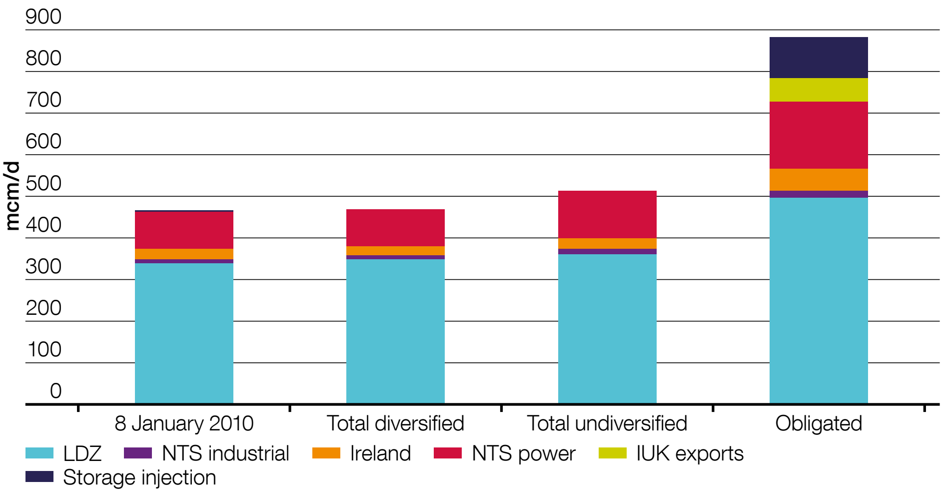


Table 6
1-in-20 peak day gas demand[7]

mcm/d	8 January 2010	2016/17 forecast		
		Total diversified	Total undiversified	Obligated
LDZ	341	350	361	498
NTS industrial	8	7	12	15
Ireland	26	25	25	54
NTS power	87	88	116	160
IUK exports	1	0	0	59
Storage injection	2	0	0	98
Total[8]	**465**	**472**	**514**	**884**

[7] Demand data can differ between different sources for a number of reasons including classification, CV and close-out date. Power generation classifications are: in tables 4 and 5, the LDZ connected power stations at Shoreham, Barry, Severn Power and Fawley are included in the total power category; but in table 6, they are included in Local Distribution Zone (LDZ) demand. Grangemouth and Winnington NTS offtakes are included in total power in 4 and 5 but NTS industrial in 6. Immingham is classified as NTS power stations for all tables.

[8] Shrinkage is included in this total.

Gas supply

Our analysis suggests that there will be sufficient gas available to meet winter 2016/17 demand. GB's gas demand is expected to be met from a wide and diverse range of sources.

Key messages

- **We expect there to be sufficient gas available from a range of sources to meet winter 2016/17 demand.**
- **Tighter production restrictions at the Groningen field in the Netherlands means that there may be less gas flowing via the BBL interconnector.**
- **Due to ongoing restrictions at the Rough long-range storage facility, there will be less gas in storage at the start of winter than in previous years. We expect there be 1.3 bcm of gas in storage at the Rough facility, compared with 2.8 bcm in October 2015 and a five year average of 3.4 bcm.**

Key terms

- **UK Continental Shelf (UKCS):** made up of the areas of the sea bed and subsoil beyond the territorial sea over which the UK exercises sovereign rights of exploration and exploitation of natural resources.
- **BBL:** a gas pipeline running between Balgzand in the Netherlands and Bacton in the UK.
- **IUK:** the Interconnector (UK) Limited is a bi-directional gas pipeline connecting Bacton in the UK and Zeebrugge in Belgium.
- **Liquefied natural gas (LNG):** natural gas that has been converted to liquid form for ease of storage or transport. It is formed by chilling gas to -161 °C so that it occupies 600 times less space than in its gaseous form.
- **Non-storage supply (NSS):** all gas supplies to the national transmission system (NTS), excluding medium and long-range storage.

Overview

Our analysis indicates that there will be sufficient gas available to meet demand this winter, despite the unique position we will begin the winter from. Technical problems at the Rough long-range storage facility mean that there will be less gas in stock at the beginning of the winter, and that the rate that this gas can be withdrawn is reduced. In addition, there may be less gas flowing via the BBL interconnector due to ongoing production restrictions at the Groningen field in the Netherlands. Although it is difficult to predict precisely how supply sources will respond, we believe that Norway, LNG and IUK, in addition to our baseload supply from UKCS, are capable of making up any potential shortfall.

What is storage?

Storage makes up an important element of GB's gas supply. There are now two types of storage connected to the national transmission system (NTS); medium-range storage (MRS) and long-range storage (LRS). National Grid does not own or operate any storage facilities.[9] The holding capacity of a storage facility is referred to as 'space', while the rate at which gas can be withdrawn is known as 'deliverability'.

There are currently eight MRS sites connected to the NTS. These are owned and operated by a variety of companies. The largest MRS sites can hold around 300 mcm, while the smallest hold less than 100 mcm. Gas can be injected into these sites at rates between 2 mcm/d and 22 mcm/d, while the deliverability ranges from 2 to 31 mcm/d. Total space in the MRS sites this winter is 1.35 bcm, with a total deliverability of 99 mcm/d. With short injection and withdrawal times, MRS sites can react quickly to changing demand, injecting when demand or prices are lower and withdrawing when they are higher. MRS sites typically cycle between injection and withdrawal many times in the course of a winter, and can even cycle during a gas day. The majority of the MRS sites store gas in underground salt caverns, but depleted gas fields are also used.

Long-range storage is used to provide additional seasonal gas supply. Shippers inject gas throughout the summer when the gas price is expected to be lower, and withdraw it in the winter when gas prices are expected to be higher. In recent years the spread between summer and winter prices has been much lower than has been the case historically. This makes the economics of seasonal storage more challenging.

[9] National Grid formerly operated five short-range LNG storage facilities. The last of these, Avonmouth, closed in April 2016.

Rough long-range storage facility

Rough, a depleted offshore gas field, is the only long-range storage site connected to the NTS. It is located in Easington in Lincolnshire and is owned and operated by Centrica Storage Limited. When working to its design capacity, Rough can hold approximately 3.7 bcm, more than twice as much as the MRS sites combined. Gas can be injected into the storage facility at around 28 mcm/d, and can be withdrawn onto the NTS at a maximum rate of around 45 mcm/d. Rough can supply gas into the NTS for around 90 days. However, it is worth noting that when the facility is less than one third full, the deliverability begins to fall and less gas can be withdrawn per day. In contrast to MRS sites, it can take up to 10 hours to change operations at Rough from withdrawal to injection.

In March 2015, Centrica Storage Limited announced a reduction to the capacity of the Rough facility for up to six months as a precautionary measure, while investigative work was undertaken. In June 2016, an additional issue was discovered. As a result, all injections and withdrawals were suspended for an initial period of at least 42 days. Following a period of further investigation, Centrica Storage Limited now aim to make 20 (from a total of 29) wells available for withdrawal by 1 November 2016, with maximum deliverability of around 37 mcm/d[10]. No increase in well pressure will be possible while work continues, so no injection will be possible before the start of winter 2016/17. There is currently around 1.3 bcm in stock at Rough. Last year, for comparison, there was 2.8 bcm in stock at the start of October, rising to a peak of 3 bcm by mid-November.

Gas supply by source

Table 7 summarises the supply range and our supply forecast for a 'cold day'. The cold day demand is taken from day 1 on the average load duration curve. Load duration curves are published every year in our *Gas Ten Year Statement*. The cold day demand for this winter is 402 mcm. In table 7 we show a cold day assumption for each component of the non-storage supply (NSS) at high demand levels. This analysis is used to assess whether a Margins Notice[11] should be issued to the industry. A Margins Notice provides the industry with a day ahead notification of a potential imbalance between supply and demand, highlighting it in sufficient time for market participants to take effective action.

The actual 2014/15 and 2015/16 ranges for the six month period are also shown in table 7. The forecast ranges are based on observations of maximum flows over recent winters.

There is no precedent for starting the winter with Rough storage reduced by this amount. Total deliverability will be reduced by at least 5 mcm/d. Withdrawal curves published by Centrica Storage Limited[12] show that deliverability will fall as soon as gas is withdrawn and pressure in the facility falls. This is not unexpected; under normal conditions deliverability can only be maintained at a maximum 45 mcm/d when the stock level is higher than the 1.3 bcm that is currently in stock.

[10] http://www.centrica-sl.co.uk/regulation/remit/2015-33
[11] http://www2.nationalgrid.com/uk/industry-information/gas-transmission-system-operations/balancing/gas-deficit-warnings-and-margins-notices/
[12] http://www.centrica-sl.co.uk/sites/default/files/csl_withdrawal_curve_scenarios_040816.pdf

With the reduction in supply from Rough, we expect other supplies from other sources to be higher. We discuss the individual supply components below.

With the restricted stock at Rough storage, we have limited historical experience on which to base our analysis for winter 2016/17. For example, will shippers continue to cycle medium-range storage between injection and withdrawal, or will there be a tendency to hold more gas in anticipation of colder weather and higher prices? Will the stock in Rough be conserved until later in the winter?

In the absence of evidence we have retained the NSS cold day supply at 352 mcm/d for the start of the winter, though we have changed some of the components. If we set the NSS level too low there is a danger that the Margins Notice trigger level will be reached too easily, leading to possible market actions when none are warranted. On the other hand, if we set the level too high it is possible that the Margins Notice trigger level will not be reached in a situation when action from the market is needed. We will continue to review performance throughout the winter and will revise the NSS level if necessary, based on observed flows and the latest market intelligence.

Table 7
Supply components

(mcm/day)	2014/15	2015/16			2016/17	
	Observed range	Observed range	Cold day	350+ range	Forecast range	Cold day
UKCS	70–100	73–118	100	104–112	70–118	107
Norway	55–136	55–118	110	99–109	60–136	115
BBL	1–36	0–33	40	22–31	0–45	35
IUK	0–15	0–14	45	0	0–74	45
LNG	5–56	6–59	50	33–35	5–100	50
Total NSS			**345**			**352**
Storage	0–97	0–98		82–98		

United Kingdom Continental Shelf

The forecast range for UKCS flows shown in table 7 is based on experience from winter 2015/16. The Laggan field in the West of Shetland area started production in January 2016 and so was available for the coldest part of the winter. The maximum flow of 118 mcm/d seen in winter 2015/16 was significantly higher than the highest flow of 101 mcm/d from the previous winter.

The cold day forecast is based on information received from producers as part of our annual *Future Energy Scenarios* stakeholder engagement process.[13]

Norwegian supplies

The maximum supply from Norway in winter 2015/16 was slightly lower than we expected. However, we don’t believe this reflects a significant change in operation, as supplies for 2016 to date have been higher than the same period in 2015. As a result, we have set the range of Norwegian supply based on the higher levels previously seen in winter 2014/15. With restricted supplies from Rough, there is scope for Norwegian supplies to be higher in conditions of increased demand. We have therefore raised the cold day supply by 5 mcm/d.

[13] http://fes.nationalgrid.com/

Continental imports

Continental imports to GB flow through two pipelines into the Bacton terminal. BBL brings imports from the Netherlands, while IUK flows in both directions between GB and Belgium. Overall, supplies via BBL in winter 2015/16 were lower than in previous years. However, despite the mild weather conditions and low demand, the maximum flow observed was 33 mcm/d. In the *Winter Consultation* we asked our stakeholders for their views on imports through BBL, following the tightening of restrictions on production at the Groningen field in the Netherlands due to seismic activity. Responses showed that many of our stakeholders thought that BBL flows might be lower in winter 2016/17, and that our value of 40 mcm/d for the cold day assumption was too high. In response, we have lowered the cold day assumption to 35 mcm/d.

Gas flowed from GB to Belgium via IUK for most of winter 2015/16. The maximum flow to GB was only 14 mcm/d. Flows through IUK have historically shown very good correlation to the gas price differential between the GB and Belgian markets. Forward prices for Zeebrugge and the GB's national balancing point (NBP) at the time of writing suggest that the price differential in early 2017 may be enough to support greater flows from Belgium to GB.

In winter 2012/13, in a period of high demand in GB and limited supplies from other sources, gas flowed from Belgium to GB at the maximum physical capacity of 74 mcm/d. We have set the maximum in our forecast range to this level.

LNG

LNG flowed at rates of between 6 and 59 mcm/d in winter 2015/16. Flows on the coldest days were between 33 and 35 mcm/d, which is much less than the maximum flow. LNG deliveries to North West Europe are driven, to a large extent, by the world gas market. If the price in Asian markets is higher than in Europe, non-contracted LNG cargoes will tend to go to Asia. The period of highest demand in GB last winter coincided with the greatest gas price premium in the Japanese market, which was higher than GB's NBP price. It is likely that this contributed to lower LNG flows into the GB market last winter. The current forward prices for early winter suggest that the price spread between GB's NBP and Asian markets will be small. This might lead to higher LNG flows in winter 2016/17. More LNG liquefaction capacity has come on line around the world since last winter and there is an expectation that LNG availability in NW Europe will remain high.

Storage

Storage, and particularly long-range storage at Rough, has been discussed in the spotlight on page 49. Table 8 shows the detail of the aggregated space, deliverability and injection for winter 2016/17. We are expecting all medium-range storage sites to be available this year, in contrast to winter 2015/16 when Hornsea was unavailable. There is no short-range storage in table 8 as the last of these storage sites, at Avonmouth, closed in spring 2016.

Table 8
Aggregate storage data

	Space (mcm)	Injection (mcm/d)	Deliverability (mcm/d)
Medium-range (MRS)	1350	99	99
Long-range (Rough)	1258	0	38
Total	**2608**	**99**	**137**

Gas supply by location
To complete our discussion of flows for the coming winter, table 9 shows the maximum flow expected at each gas terminal, together with the expected flow on a cold day. The changes that we have made to the cold day values, including reducing BBL by 5 mcm/d and increasing Norway by the same amount, may not be immediately apparent in this table. For example, although BBL flows have been reduced, the total flow to Bacton has increased by 5 mcm/d compared to our winter 2015/16 forecast. This is because other supplies to the terminal have increased.

Table 9
Forecast supplies by terminal

	Maximum flow 2016/17 (mcm/d)	Cold day (mcm/d)
Bacton	160	115
Barrow	7	6
Easington	79	74
St Fergus	100	82
Teesside	20	19
Theddlethorpe	5	5
Grain	60	5
Milford Haven	86	45
Storage	129	129

Gas security assessment

Based on our analysis, we believe that GB infrastructure can meet gas demand under severe weather conditions for a prolonged period, even with a failure of the single largest piece of infrastructure or supply loss.

Key messages

- **Based on a 1-in-20 peak day demand, our analysis suggests that there would be a significant potential excess of supply of 130 mcm/d.**
- **Our analysis suggests that there is sufficient supply capability to cope with a significant supply loss during a severe winter.**
- **We believe that the market is well placed to cope should storage stocks at Rough become unavailable, in conjunction with a disruption to a significant gas supply source.**

Key terms

- **Margin:** the difference between the level of demand and the supply that is available to meet it. In our gas stress tests, we consider the margin between potential supply and demand for a 1-in-20 peak day.
- **N-1:** a test to ensure that there is sufficient gas infrastructure to meet demand in the event of the failure of the largest single piece of infrastructure. This test is used by the European Commission to test gas security of supply across all of its member states.
- **Non-storage supply (NSS) upside:** in most of our calculations we assume that individual supply sources will not be running at their maximum physical capacity. The NSS upside represents flows closer to maximum capacity, in response to higher demand or gas price.

Overview

In order to prepare for winter, we consider a range of possible scenarios that may impact gas security of supply. Over the last few years, winter weather has been mild. Should we experience a sustained cold winter in 2016/17, our analysis suggests that there is sufficient supply capability to meet demand.

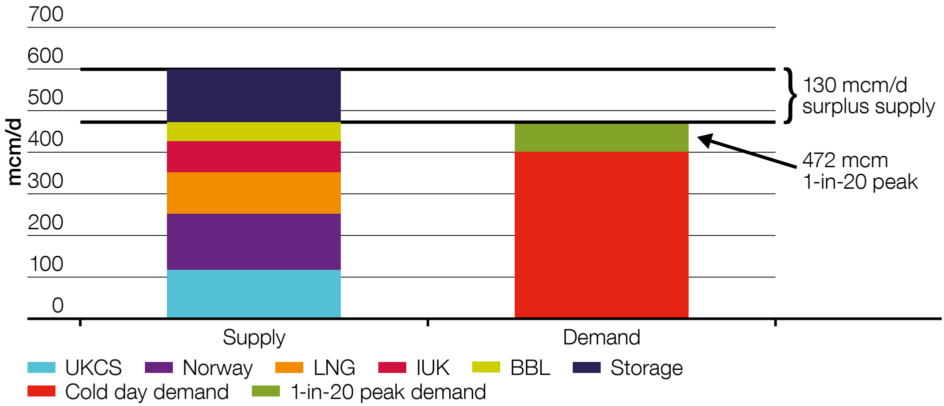
Our stakeholders have told us that they are concerned about the impact the restrictions at the Rough storage facility may have on supply, particularly if this is combined with a further unexpected significant supply loss. Based on our stress test analysis, we believe that with a range of supply sources, GB's gas market is well positioned to meet demand in this scenario. As a prudent System Operator, we will continue to review the latest information throughout the winter and update the industry if it is appropriate to do so.

Peak day supply margin

To understand the supply options for GB at all levels of demand, we consider the margin between demand and potential capacity for a 1-in-20 peak day. Demand for a 1-in-20 peak day is calculated as 472 mcm, as discussed in the gas demand section on page 43. Potential supply is made up of both NSS and total storage deliverability. The maximum NSS potential is assumed to be 473 mcm/d. This is consistent with the upper end of the ranges defined in table 7. To account for the low stock levels at the Rough storage site, we have not applied the maximum potential level of withdrawal of 37 mcm/d. To reflect that it is likely stocks will be reduced when a peak day occurs, we have assumed a maximum deliverability of 30 mcm/d. This represents the deliverability when the stock level has fallen by just over 50 per cent since the start of winter, and is taken from the Rough withdrawal curve scenarios published by Centrica Storage Limited[14]. This results in a total storage deliverability of 129 mcm/d. When combined with NSS, this gives a total potential supply of 602 mcm/d. As shown in figure 13, within this scenario there would be a significant margin of 130 mcm/d between supply and demand.

[14] http://www.centrica-sl.co.uk/sites/default/files/csl_withdrawal_curve_scenarios_040816.pdf

Figure 13
Potential supply margin



Severe winter

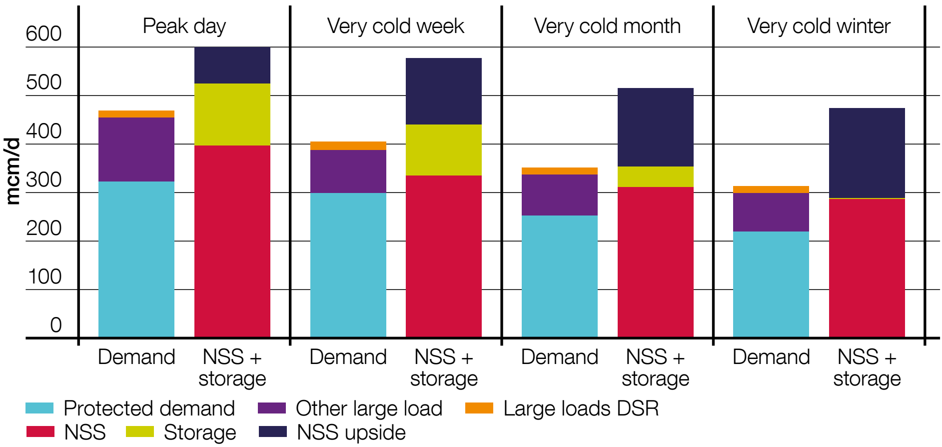
To further assess the security of the gas system for winter 2016/17, we have considered how demand could be met through a sustained cold spell during a severe 1-in-50 winter. In this scenario, demand is split into protected demand[15], other large loads and potential demand side response (DSR)[16].

The supply in figure 14 shows NSS at the expected levels for a severe winter, with potential extra flow, or upside, approaching the maximum physical capacity.

The available storage declines as the winter progresses as stocks are depleted. As this stress test is based on a persistent cold spell lasting three months, no refill of storage is modelled.

As shown in figure 14, for all durations of a severe winter there is sufficient capability to meet demand. Protected demand can be met for all durations without the need to utilise any DSR or NSS upside. Only in the case of a prolonged three month cold spell, labelled as a very cold winter in figure 14, would it be necessary to utilise DSR or NSS upside to meet demand.

Figure 14
Supply/demand analysis under severe conditions



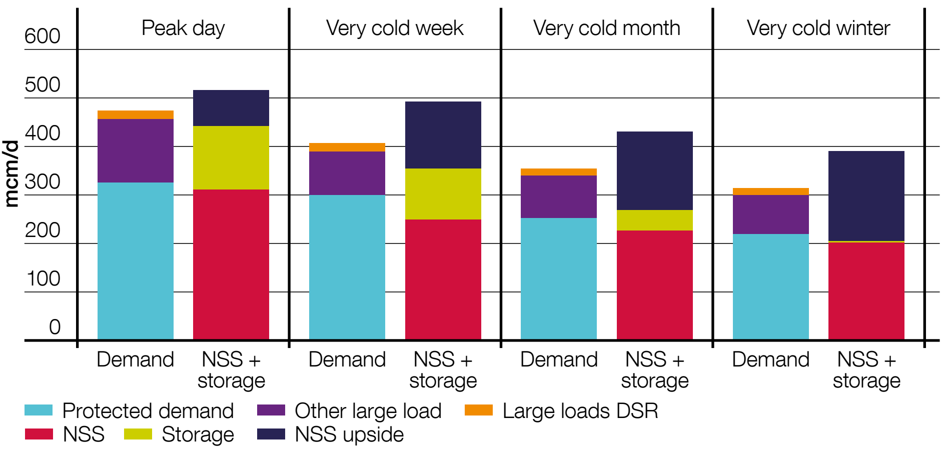
[15] Protected demand represents domestic customers, other non-daily metered (NDM) customers and other customers who cannot be safely isolated from the gas system.
[16] DSR is assumed to be 15 mcm/d based on previously observed levels.

Severe winter with an infrastructure loss

To fully assess the capability of the GB market, we have extended our severe 1-in-50 winter analysis to include the loss of the largest single piece of gas supply infrastructure. This is consistent with the N-1[17] test used to assess gas security by the European Commission (EC).

Under these conditions, a further response would be required from the market, in the form of DSR and NSS upside, to meet demand for all of the severe winter periods considered. We would expect the market to provide the required signals to ensure security of supply is maintained. This is consistent with the results of our analysis for winter 2015/16.

Figure 15
Supply/demand analysis under severe conditions with infrastructure loss



[17] The N-1 test is defined under regulation (EU) 994/2010 of the European Parliament and of the Council of 20 October 2010 concerning measures to safeguard security of supply. This regulation repeals the Council Directive 2004/67/EC.

Impact of supply uncertainties

In order to assess the impact of potential supply disruptions, we have carried out a stress test to understand the capability of the GB gas market. After consulting with our stakeholders, we have considered two potential supply loss scenarios:

- unavailability of the Rough storage site for the whole of winter 2016/17
- a disruption to supplies of Norwegian gas.

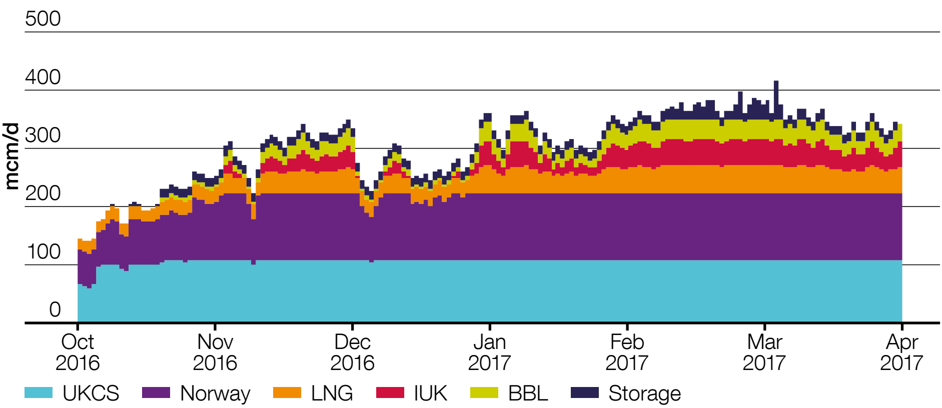
Our analysis is based on the weather pattern for 1985/86, which represents a 1-in-14 cold winter with a cold February. This year was chosen as it allows our stakeholders to compare the results from previous assessments, and because a cold February tests the impact of lower storage stocks.

Impact of Rough being unavailable

As explained in the spotlight on page 49, there have been a number of operational restrictions at the Rough storage site over the last 18 months. While we anticipate that the site will be available for winter 2016/17, we felt it was prudent to test the capability of the market if this were not the case.

Our analysis assumes that the NSS levels are consistent with our cold day assessment, as defined in table 7. Figure 16 shows that under these conditions, there is sufficient capability to meet demand without the requirement for any additional market action.

Figure 16
Cold winter with Rough unavailable



Impact of Rough being unavailable and an outage to Norwegian supplies

While there is nothing to suggest an outage to Norwegian supplies is likely for winter 2016/17, our stakeholders requested that we test the impact of a significant supply loss, in addition to further issues being experienced at Rough. As the largest importer of gas to the GB market, we selected a loss of Norwegian supplies for this stress test.

Our supply scenario assumes:

- 107 mcm/d UKCS – consistent with our expectations for the duration of the winter
- 60 mcm/d Norway – a reduction of 65 mcm/d to simulate the loss of the Langeled pipeline
- 90 mcm/d LNG – an additional 40 mcm/d above our assessment under normal conditions but within the range expected for the winter
- 35 mcm/d BBL – in line with our cold day assessment
- 45 mcm/d IUK – in line with our cold day assessment.

Figure 17
Cold winter with Rough unavailable and a Norwegian outage

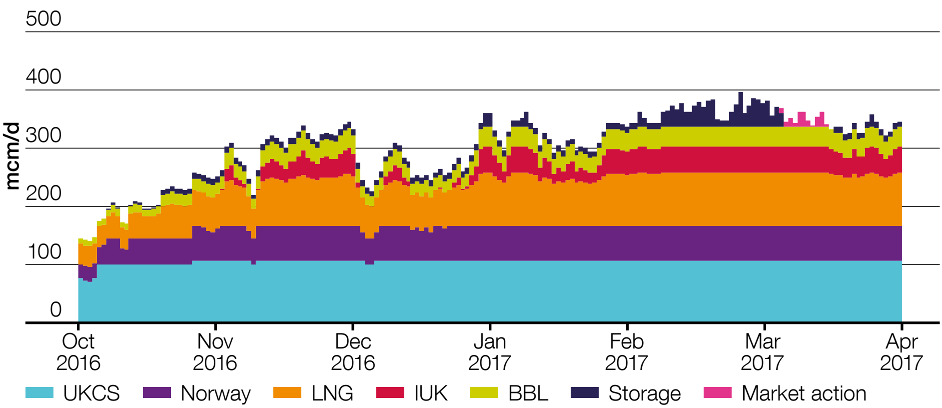


Figure 17 shows that under these conditions there is a requirement for 140 mcm of further market response, with the maximum daily requirement of 25 mcm/d. This response could be met by increasing either of the remaining import sources. There is a potential upside of 42 mcm/d available from Europe or up to 55 mcm/d available if LNG terminals were fully utilised. In addition to these sources, if MRS was preserved at lower levels of demand, by increasing NSS supplies, there would be sufficient stocks to cover this requirement. Given the relatively low level of the additional requirement, any one of these sources would ensure GB demand could be met without the need for DSR.

Gas system operations

We continue to see changes to sources of GB's gas supply and how it is used within the gas day. Facilitating the movement of gas to where it is needed within shorter timescales has an impact on how we operate the system.

Key messages

- **We expect to see increasing within-day changes to gas demand this winter as customers respond to movements in GB and European gas and electricity prices.**
- **With a diverse range of sources of gas supply, the ability to predict daily supply patterns is becoming increasingly challenging. This is particularly the case when supply sources vary within day in response to changing prices.**
- **It is important that we continue to work closely with our customers to understand how the provision of better information can allow us to respond to the flexibility required by the market.**

Key terms

- **Profiling:** the rate at which gas is put into or taken off the transmission system during the gas day. A flat profile corresponds to a consistent rate across the day.
- **Gas day:** the gas day starts at 05:00 and ends at 04:59. Users of the transmission system are incentivised to balance supply into, and demand from, the network by the end of the gas day.
- **Transit gas:** gas that enters and exits the national transmission system without being consumed in GB.

Overview

Historically, GB's gas demand was met predominantly by supplies from the UK Continental Shelf (UKCS). This UKCS gas was supplied and consumed predictably throughout the gas day. The national transmission system (NTS) was built to transport gas based on this consistent flat profile of supply and demand, with compressor stations configured to move gas from where it entered the network in the north, to where it was needed throughout GB. Over the last few years, we have seen changes to where GB's gas comes from and how it is consumed. This changing landscape has an impact on how we operate the transmission system. We're working with the industry to make sure that we can facilitate the transport of gas from where it enters the NTS to where it is needed on the network so that we continue to meet the needs of our customers.

Gas demand

As a result of more variable patterns of energy supply and demand, users of the NTS are increasingly seeking to be responsive to GB and European energy market price movements. This creates a more variable demand profile from a range of customers, including CCGTs, storage and interconnectors, on an NTS designed to transport gas based on a flat profile throughout the gas day. Many of these requests are now at shorter notice periods and higher ramp rates than those envisaged when the market rules were originally developed. This creates a need for a more agile network that is able to respond to customer needs, without impacting other users of the NTS.

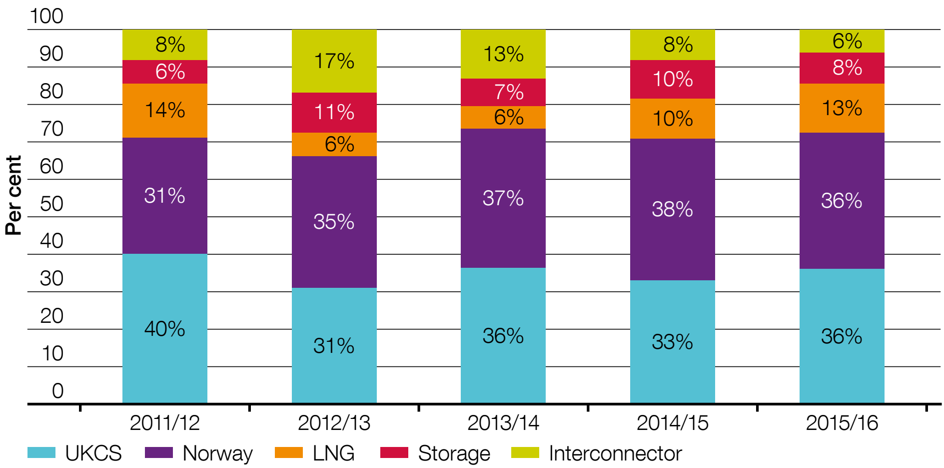
A good example of this variability in demand is from CCGTs. These gas-fired power stations want to respond to changes in the electricity market where the notice periods can be shorter, and the ramp rates higher than the equivalent in the gas market. Other customers, including medium-range storage and interconnectors, may also want to respond quickly to within-day gas price movements in both GB and European markets. These changing requirements can lead to revisions of within-day operational and commercial strategies so that the NTS can be configured to transport gas to where it is needed.

Gas supplies

As gas supplies from the UKCS have declined, GB now benefits from a more diverse range of supply sources. As shown in figure 18, over the last five winters we have seen variable levels of GB's gas supply sources. Although this supply diversity benefits GB gas security, it can reduce the predictability of flows on the system. In addition, we are increasingly seeing the GB transmission network being used to move gas between European markets. The increasingly high volume of EU transit gas that moves through the GB network creates additional operational challenges for the NTS and its assets.

As well as being more varied, supply options are becoming increasingly price sensitive and can change their behaviour within day in response to price fluctuations. This is particularly true of mid-range storage, which is able to switch quickly between injection and withdrawal during the gas day. Due to the restrictions at the Rough long-range storage facility, the supply from this source will be reduced. This could impact the behaviour of mid-range storage facilities this winter and represent a change from historic supply patterns. Any unpredicted changes will require National Grid to become more operationally reactive to facilitate the requirements of our customers.

Figure 18
Winter supply patterns 2011/12 to 2015/16



How we're responding

National Grid has a range of operational and commercial tools available to facilitate the movement of gas from supply to demand points on the network and make sure that we can continue to meet the needs of our customers. Operational solutions include network reconfiguration and strategies around the use of compressors. A result of facilitating these requirements may be that our customers experience some variations in pressure at both entry points and system offtakes within and between gas days. However, pressures will remain within the safe maximum operating limits and we will continue to work with our customers to ensure either assured or agreed pressures are maintained. At times, these operational actions may be insufficient and commercial tools, such as restriction of network flexibility, locational balancing or demand side response may be required. You can find out more about the new demand side response mechanism in the spotlight below.

To help us facilitate the movement of gas, it is essential that the information provided to the System Operator is timely and accurate, with market participants operating in accordance with the information they have submitted. This allows us to plan the most efficient and cost-effective network, and take fewer operational or commercial actions to balance the system. As the energy landscape continues to change and our customers use the network within day in different ways, we are continuing to monitor and engage with our customers to better understand the level of flexibility required. You can find out more on our **industry information website** or at one of our regular **operational forums**.

A new commercial tool: The demand side response mechanism

Following a successful trial in summer 2015, the new demand side response (DSR) mechanism went live on 1 October this year. This service allows large gas consumers to offer to reduce the amount of gas they use during times of system stress in exchange for a payment. It is designed as a cost effective way to reduce the likelihood, potential severity and duration of a gas deficit emergency by making additional gas available for system balancing.

The DSR methodology was developed by National Grid in conjunction with industry representatives, including end users and shippers. It allows large gas consumers to submit offers to shippers to reduce their gas offtake. Shippers then submit this volume through the on the day commodity market. National Grid as the System Operator will accept demand side response offers based on the national requirement and most efficient price.

You can find out more about demand side response on our website.

Safety monitor

The safety monitor is an amount of gas that needs to remain in storage to support the safe operation of the gas transmission system. The safety monitor level for this winter has been set at a similar level to winter 2015/16. We believe that this level is unlikely to be breached this winter.

Key messages

- **The winter 2016/17 safety monitor has been set at 717 GWh of space, with 526 GWh/d of deliverability.**
- **The 2016/17 safety monitor equates to 2.5 per cent of total storage space. The 2015/16 safety monitor would have equated to a similar 3.0 per cent of this space.**
- **We have updated the method for calculating the safety monitor this year to reflect the most up-to-date view of non-storage supplies on the transmission system. This has increased the non-storage supply assumption by 60 mcm compared with our existing methodology.**

Key terms

- **Safety monitor:** assesses and ensures that sufficient gas supplies remain in storage to support those gas consumers whose premises cannot be physically and verifiably isolated from the gas network within a reasonable time period, should there be an event that impacts security of supply. It defines the requirements for both space and the deliverability for the highest demand day. It is made up of two elements; protected by monitor and protected by isolation.
- **Protected by monitor:** this applies to sites that cannot be safely isolated from the gas network. Their gas demand is determined over a cold winter. The amount of gas required is compared to the non-storage supply (NSS) for the winter. Where there is not enough NSS to meet this demand, this is the volume of gas that needs to be available in storage.
- **Protected by isolation:** this applies to sites that could be safely isolated from the gas network, but not instantaneously. As a result, there is an additional gas demand associated with the isolation process. The time and associated gas demand required to isolate them is established via the results of emergency exercises.

Overview

The safety monitor is an amount and deliverability of gas that needs to remain in storage in order to supply those customers that cannot be safely or instantaneously isolated from the gas network. The safety monitor calculates how much gas is required to supply these customers across the whole of a severe 1-in-50 winter. As the name suggests, it exists to maintain the safety of the system by maintaining adequate pressures on the network, rather than support security of supply. There has not been a breach of the safety monitor level since it was introduced in 2004.

The space requirement of the safety monitor is made up of the 'protected by monitor' and 'protected by isolation' elements. The total space requirement is then apportioned equitably across all storage types and facilities, including those sites with high cycling rates. We also calculate the deliverability requirement of the safety monitor, based on the amount of gas being held in storage. Defining space and deliverability helps market participants to plan for the winter ahead and helps to indicate the likelihood of a safety monitor breach.

The safety monitor level for this year has been set at 717 GWh of space, with 526 GWh/d of deliverability. This represents 2.5 per cent of available storage space. This is similar to 2015/16, which would have equated to 3.0 per cent of this year's storage space. The relatively low safety monitor level reflects the continued view that NSS can adequately supply the demands protected by the safety monitor.

Protected by monitor methodology

The protected by monitor element of the safety monitor is based on demand and supply assumptions. The demand assumptions are taken from National Grid's demand statements. Demand statements are published each year in our *Gas Ten Year Statement*, which you can download from our **Future of Energy webpage**. The supply assumptions are based on analysis of the last five years of historical NSS, combined with our latest projections for the winter ahead. As detailed in the gas supply section, we have assumed a NSS availability of 352 mcm/d, at a demand level of 402 mcm/d.

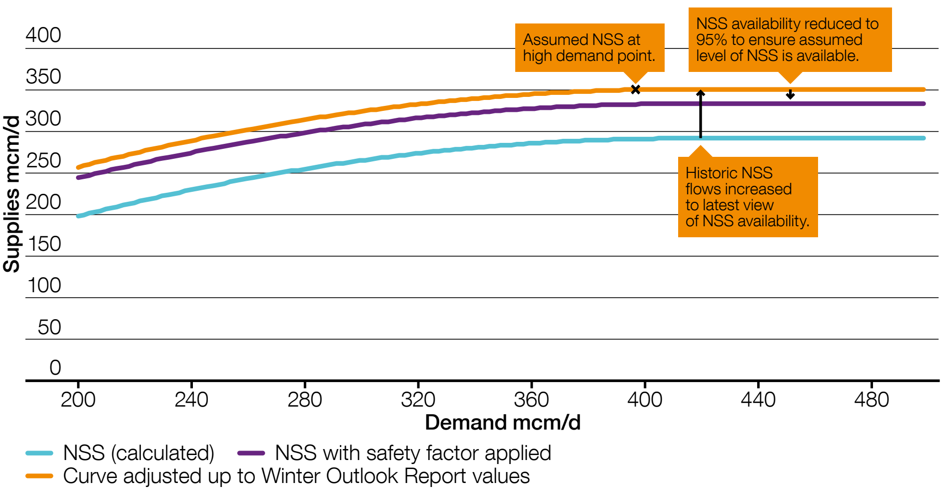
This year we have updated the protected by monitor methodology to better align with the most up-to-date view of NSS for winter 2016/17. In previous years, a purely historical approach has been used to determine available NSS based on the actual flows seen. However, over the last few years, a reduction in overall gas demand has resulted in seasonal storage withdrawals occurring at increasingly lower levels of demand. This has reduced NSS flows at these lower levels of demand, but NSS availability has not reduced at a similar rate. As a result, looking at historical NSS flows compared to demand is no longer an accurate indicator of actual NSS availability.

To better reflect NSS availability in our analysis, we have added two additional steps to our protected by monitor methodology this year. The three stages are:

1. Establish the historical NSS for varying demand levels, based on the last five winters. This creates a profile curve showing how NSS supply varies with demand.
2. Adjust this profile to reflect our latest view of NSS on a high demand day. This stage is shown in figure 19. For winter 216/17, this increases the profile curve by 60 mcm. The NSS availability is then reduced by a safety factor of 5 per cent, based on historic analysis of potential supply losses.
3. Adjust the profile to incorporate any likely NSS disruptions in the coming winter. This is called the winter risk factor. For winter 2016/17, we have used a risk factor of zero as there are no specific sites we feel are at high risk of a prolonged outage this winter.

Further details of the updated protected by monitor methodology can be found in the safety monitor method document, which is published on the **Joint Office website**.

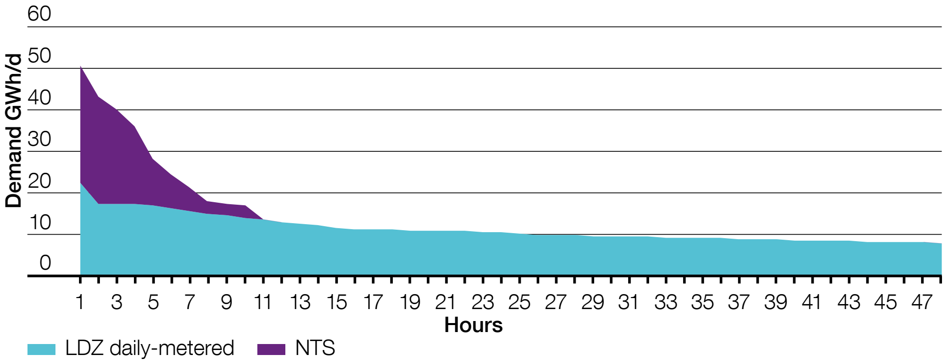
Figure 19
Adjustments applied to historic NSS supply to establish NSS availability



Protected by isolation methodology

For those consumers protected by physical isolation from the network, there is additional gas demand associated with the isolation process. To estimate this gas demand, our methodology uses the results of operational exercises. We assume that isolation will take 48 hours, with the demand reducing over this time period. An estimated demand profile for the isolation process is shown in figure 20. We have not changed our protected by isolation methodology for winter 2016/17.

Figure 20
Estimated demand profile for the isolation process



Results

The safety monitor levels for winter 2016/17 are detailed below. The safety monitor levels, and associated winter profiles, are also published on the **Joint Office website**.

- 2016/17 assumed storage space = 28,688 GWh
- 2016/17 safety monitor space = 717 GWh (compared to 859 GWh for winter 2015/16)
- 2016/17 safety monitor deliverability = 526 GWh/d (compared to 558 GWh/d for winter 2015/16).

We have considered how the restrictions at the Rough long-range storage facility might impact the safety monitor for winter 2016/17. The restrictions have no impact on the safety monitor level, as it is a comparison of NSS against demand. However, our analysis suggests that it does impact the likelihood of a safety monitor breach occurring. The restrictions increase the likelihood of a breach occurring, but the likelihood still remains low. It is National Grid's responsibility to keep the safety monitor under review, both ahead of and throughout the winter. We will continue to monitor the situation and make adjustments to the safety monitor if it is appropriate to do so.

Glossary

Word	Acronym	Section	Description
Average cold spell	ACS	Electricity	A particular combination of weather elements that gives rise to a winter peak demand, which has a 50 per cent chance of being exceeded as a result of weather variation alone.
Baseload		Various	The permanent minimum load that a system experiences.
BBL	BBL	Gas	A gas pipeline between Balgzand in the Netherlands and Bacton in the UK. You can find out more at **www.bblcompany.com**
billion cubic metres	bcm	Gas	A unit of volume used in the gas industry. 1 bcm = 1,000,000,000 cubic metres
BritNed		Electricity	BritNed Development Limited is a joint venture of Dutch TenneT and British National Grid that operates the electricity link between Great Britain and the Netherlands. It is a bi-directional interconnector with a capacity of 1,000 MW. You can find out more at **www.britned.com**
Capacity Market	CM	Electricity	The Capacity Market (CM) has been developed to ensure the future security of our electricity supply. It forms part of the government's Electricity Market Reform programme. The CM gives capacity providers of all sizes the opportunity to bid via auctions for electricity supply contracts.
Capacity Market Notice	CMN	Electricity	An automated alert to signal to the market that the margin between supply and demand may decrease below a defined threshold. This threshold has been initially set at 500 MW above the sum of expected demand and an operating margin requirement.
Combined cycle gas turbine	CCGT	Various	A power station that uses the combustion of natural gas or liquid fuel to drive a gas turbine generator to produce electricity. The exhaust gas from this process is used to produce steam in a heat recovery boiler. This steam then drives a turbine generator to produce more electricity.
Composite weather variable	CWV	Gas	A single measure of daily weather. It is the combination of temperature and other weather variables, including wind speed. The purpose of CWV is to define a linear relationship between the weather and non-daily metered gas demand.
Compressor		Gas	Compressors are used to move gas around the transmission network through high pressure pipelines. There are currently 68 compressors at 24 sites across the country. These compressors move the gas from entry points to exit points on the gas network. They are predominately gas driven turbines that are in the process of being replaced with electric units.
Contingency balancing reserve	CBR	Electricity	Services developed to support system balancing by enabling National Grid to access additional reserve held outside of the market. There are two types of reserve services: demand side balancing reserve (DSBR) and supplemental balancing reserve (SBR).
Customer demand management	CDM	Electricity	This occurs when industrial or commercial users change their pattern of energy consumption, typically to reduce energy use during peak periods. By avoiding these peak periods, users can reduce their charges for using the transmission and distribution systems.
Daily metered	DM	Gas	A classification of customers where gas meters are read daily. These are typically large scale consumers.
Demand side balancing reserve	DSBR	Electricity	Demand side balancing reserve (DSBR) is a service that has been developed to support National Grid in balancing the system. DSBR provides an opportunity for large consumers or owners of small embedded generation to earn money through a combination of upfront payments and utilisation payments by contracting to reduce demand or provide generation when required. We have not procured DSBR services for winter 2016/17.

Word	Acronym	Section	Description
Demand side response	DSR	Various	A deliberate change to an industrial and commercial user's natural pattern of metered electricity or gas consumption, brought about by a signal from another party.
De-rating factors		Electricity	These factors account for breakdowns, planned outages and any other operational issues that may result in power stations not being able to generate at their normal level. They are based on the historic availability of plant during peak periods. Peak periods are between 7am and 7pm, Monday to Friday between December and February.
East West Interconnector	EWIC	Electricity	A 500 MW interconnector that links the electricity transmission systems of Ireland and Great Britain. You can find out more at **www.eirgridgroup.com/customer-and-industry/interconnection/**
Electricity Margin Notice	EMN	Electricity	Electricity Margin Notices (EMNs) will replace Notifications of Inadequate System Margin (NISMs). An EMN, which may be issued up to a day ahead of any period, is designed to inform the market that the predicted margin between forecast demand and available supply is reduced. It is a signal to the market to take action by increasing generation or reducing demand.
Electricity Market Reform	EMR	Electricity	A government policy to incentivise investment in secure, low-carbon electricity, improve the security of Great Britain's electricity supply, and improve affordability for consumers.
Embedded generation		Electricity	Power generating stations/units that don't have a contractual agreement with the national electricity transmission System Operator (NETSO). They reduce electricity demand on the transmission system.
Equivalent firm capacity	EFC	Electricity	An assessment of the entire wind fleet's contribution to security of supply. It represents how much of 100% available conventional plant would be needed to replace the entire wind fleet and leave security of supply unchanged. You can read more about how we calculate the EFC on page 23.
EU Emissions Trading Scheme	ETS	Gas	An EU wide system for trading greenhouse gas emission allowances. The scheme covers more than 11,000 power stations and industrial plants in 31 countries.
European Union	EU	Various	A political and economic union of 28 member states that are located primarily in Europe.
Future Energy Scenarios	FES	Various	The FES is a range of credible futures which has been developed in conjunction with the energy industry. They are a set of scenarios covering the period from now to 2050, and are used to frame discussions and perform stress tests. They form the starting point for all transmission network and investment planning, and are used to identify future operability challenges and potential solutions. You can find out more at **http://fes.nationalgrid.com/**
Generation margin		Electricity	The sum of generators declared as being available during the time of peak demand, minus the expected demand at that time and a basic reserve requirement. This is presented as a percentage.
Gigawatt	GW	Electricity	A measure of power. 1 GW = 1,000,000,000 watts.
Great Britain	GB	Various	A geographical, social and economic grouping of countries that contains England, Scotland and Wales.
Grid supply points	GSP	Electricity	A connection point between the transmission system and the distribution system.
Interconnector (UK) Limited	IUK	Gas	A bi-directional gas pipeline between Bacton in the UK and Zeebrugge in Belgium. You can find out more at **www.interconnector.com**
Interconnector		Gas	Gas interconnectors connect gas transmission systems from other countries to the national transmission system (NTS) in England, Scotland and Wales. There are currently three gas interconnectors that connect to the NTS. These are: ■ IUK interconnector to Belgium ■ BBL to the Netherlands ■ Moffat to the Republic of Ireland, Northern Ireland and the Isle of Man
Interconnector		Electricity	Electricity interconnectors are transmission assets that connect the GB market to Continental Europe. They allow suppliers to trade electricity between these markets.

Word	Acronym	Section	Description
Interconnector exports		Various	The flow of energy, either gas or electricity, out of GB.
Interconnector imports		Various	The flow of energy, either gas or electricity, in to GB.
Interconnexion France-Angleterre	IFA	Electricity	The England-France Interconnector is a 2,000 MW link between the French and British transmission systems. Ownership is shared between National Grid and Réseau de Transport d'Electricité (RTE).
Linepack		Gas	The volume of gas within the national transmission system (NTS) pipelines at any time.
Linepack swing		Gas	The difference between the amount of gas in the system at the start of the day and at the lowest point during the day.
Liquefied natural gas	LNG	Gas	Natural gas that has been converted to liquid form for ease of storage or transport. It is formed by chilling gas to -161˚C so that it occupies 600 times less space than in its gaseous form. You can find out more at **www2.nationalgrid.com/uk/Services/Grain-lng/what-is-lng/**
Load		Various	The energy demand experienced on a system.
Long-range storage		Gas	There is one long-range storage site on the national transmission system; Rough, situated off the Yorkshire coast. Rough is owned by Centrica Storage Limited. The site mainly puts gas into storage ('injection') in the summer and takes gas out of storage in the winter.
Loss of load expectation	LOLE	Electricity	A measure to describe electricity security of supply. It is an approach based on probability and is measured in hours per year. It gives an inidication of the amount of time across the whole winter that the System Operator may need to call on a range of emergency balancing tools to increase supply or reduce demand.
Market coupling		Electricity	The integration of electricity markets to create a European internal electricity market.
Medium-range storage		Gas	Medium-range storage sites have short gas injection and withdrawal times. This means that they can react quickly to demand, injecting when demand or prices are lower and withdrawing when they are higher.
Megawatt	MW	Electricity	A measure of power. 1 MW = 1,000,000 watts.
Million cubic meters	mcm	Gas	A unit of volume used in the gas industry. 1 mcm = 1,000,000 cubic metres
Moyle		Electricity	A 500 MW bi-directional interconnector between Northern Ireland and Scotland. You can find out more at **www.mutual-energy.com**
N-1		Gas	A security of supply gas established by the European Commission. Total supply, minus the largest single loss, is assessed against total peak demand.
National balancing point (NBP) gas price	NBP	Gas	Britain's wholesale NBP gas price is derived from the buying and selling of natural gas in Britain after it has arrived from offshore production facilities. The wholesale market in Britain has one price for gas, irrespective of where it has come from. It is usually quoted in pence per therm. You can find out more at **https://www.ofgem.gov.uk/gas/wholesale-market/gb-gas-wholesale-market**
National electricity transmission system	NETS	Electricity	High voltage electricity is transported on the transmission system from where it is produced to where it is needed throughout the country. The system is made up of high voltage electricity wires that extend across Britain and nearby offshore waters. It is owned and maintained by regional transmission companies, while the system as a whole is operated by a single System Operator (SO).
National transmission system	NTS	Gas	A high pressure gas transportation system consisting of compressor stations, pipelines, multijunction sites and offtakes. Pipelines transport gas from terminals to offtakes and are designed to operate up to pressures of 94 barg.
Non-daily metered	NDM	Gas	A classification of customers where gas meters are read monthly or at longer intervals. These are typically residential, commercial or smaller industrial consumers.
Non storage supply	NSS	Gas	All gas supplies to the national transmission system excluding short, medium and long-range storage.
Non-storage supply upside	NSS upside	Gas	The NSS upside represents flows close to the maximum capacity of supply sources, in response to higher demand or gas price.

Word	Acronym	Section	Description
Normal weather		Electricity	A weekly average of relevant weather variables, including temperature, wind speed and solar radiation, for the past 30 years.
Normalised demand		Electricity	Demand assessed for each week of the year based on a 30 year average of each relevant weather variable. This is then applied to linear regression models to calculate what the demand would have been with this standardised weather.
Notification of Inadequate System Margin	NISM	Electricity	A routine notification issued to generators, interconnected system operators and suppliers to advise there is a likelihood that there will be an inadequate margin of reserve capacity available. The purpose is to make the recipients aware and request that additional reserve capacity is made available. NISMs have now been replaced by Electricity Margin Notices.
Office of Gas and Electricity Markets	Ofgem	Various	The UK's independent national regulatory authority, a non-ministerial government department. Their principal objective is to protect the interests of existing and future electricity and gas consumers. You can find out more about the work that they do at **www.ofgem.gov.uk**.
Open cycle gas turbine	OCGT	Various	Gas turbines in which air is first compressed in the compressor element before fuel is injected and burned in the combustor.
Operational Code 2 data	OC2	Electricity	Information provided to National Grid by generators. It includes their current generation availability and known maintenance outage plans. You can access the latest OC2 data throughout the year on the BM Reports website at **www.bmreports.com**.
Operational surplus		Electricity	The difference between the level of demand and the generation expected to be available, modelled on a week by week basis. This information helps to inform the market how much surplus is expected to be available.
Peak		Various	The maximum requirement of a system at a given time, or the amount of energy required to supply customers at times when need is greatest. It can refer either to a given moment (e.g. a specific time of day) or to an average over a given period of time (e.g. a specific day or hour of the day).
Profiling		Gas	The rate at which gas is put into or taken off the transmission system during the gas day. A flat profile corresponds to a consistent rate across the day.
Residual balancer		Gas	Users of the gas system are incentivised to balance supply into, and demand from, the network. If this balance is not expected to be achieved on any given day, the System Operator (National Grid), as residual balancer, will enter the market and undertake trades (buys or sells) to seek to resolve any imbalance.
Safety monitor		Gas	As assessment to ensure that sufficient gas supplies remain in storage to support those gas consumers whose premises cannot be physically and verifiably isolated from the gas network within a reasonable time period, should there be an event that impacts security of supply. It defines the requirements for both space and deliverability for the highest demand day.
Seasonal normal conditions		Gas	A set of conditions representing the average that we could reasonably expect to occur. We use industry agreed seasonal normal weather conditions. These reflect recent changes in climate conditions, rather than being a simple average of historic weather.
Short-range storage		Gas	Short range-storage is able to respond quickly to fluctuations in demand but has limited stock. The only short-range storage site on the national transmission system during winter 2015/16 was at Avonmouth, near Bristol. This onshore site stored liquefied natural gas that had been condensed from the transmission system, not delivered by ship. When needed, the liquid gas was re-vaporised and delivered to the transmission system. The Avonmouth facility closed in April 2016.
Station load		Electricity	The onsite power station requirement, for example for systems or start up.

Word	Acronym	Section	Description
Storage		Gas	Storage facilities hold gas in underground salt caverns or depleted gas fields. The holding capacity of a storage facility is referred to as space, while the rate at which gas can be withdrawn is known as deliverability. There are two types of storage sites connected to the national transmission system (NTS); medium-range storage and long-range storage.
Supplemental balancing reserve	SBR	Electricity	Supplemental balancing reserve (SBR) is a service that has been developed to support National Grid in balancing the system. Contracts are set up between National Grid and generators to make their power stations available in winter, where they would otherwise be closed or mothballed.
System Operator	SO	Various	An entity entrusted with transporting energy in the form of natural gas or electricity on a regional or national level, using fixed infrastructure. The SO may not necessarily own the assets concerned. For example, National Grid operates the electricity transmission system in Scotland, which is owned by Scottish Hydro Electricity Transmission and Scottish Power.
Transmission system demand	TSD	Electricity	Demand that National Grid as the System Operator sees at grid supply points (GSPs), which are the connections to the distribution networks. It includes demand from the power stations generating electricity (the station load) and interconnector exports.
Triad		Electricity	Triads are the three half-hourly settlement periods with the highest system demand. Triads can occur in any half-hour on any day between November and February. They must be separated from each other by at least ten days.
Underlying demand		Electricity	A measure of demand that removes the effect of weather and the day of the week.
UK Continental Shelf	UKCS	Gas	The UK Continental Shelf (UKCS) comprises those areas of the sea bed and subsoil beyond the territorial sea over which the UK exercises sovereign rights of exploration and exploitation of natural resources.
United Kingdom of Great Britain and Northern Ireland	UK	Various	A geographical, social and economic grouping of countries that contains England, Scotland, Wales and Northern Ireland.
Weather corrected demand		Electricity	The demand expected or outturned with the impact of the weather removed. A 30 year average of each relevant weather variable is constructed for each week of the year. This is then applied to linear regression models to calculate what the demand would have been with this standardised weather.
Weather corrected demand		Gas	The demand expected with the impact of weather removed. Actual demand is converted to demand at seasonally normal weather conditions, by multiplying the difference between actual CWV and expected CWV by a value that represents demand sensitivity to weather. As weather is one of the main drivers of the difference in demand from one day to the next, we take out its impact to understand other important underlying trends.

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