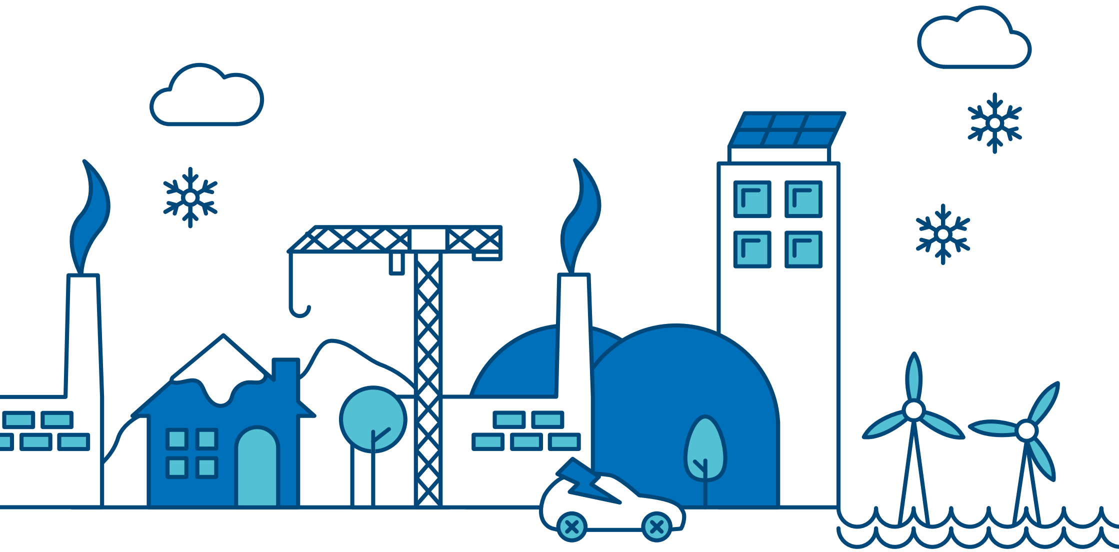
Winter **Review and Consultation**

2018



JUNE 2018

How to use this interactive document

To help you find the information you need quickly and easily we have published the *Winter Review and Consultation* 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 italics and underlined throughout the report. You can click on them to access further information.

Contents

Executive summary

The *Winter Review and Consultation* is our annual report comparing winter 2017/18 with our forecasts. The review is designed to help the energy industry to understand what happened and begin to prepare for the winter ahead. The purpose of the consultation is to gather valuable stakeholder insight, in order to inform our analysis for the 2018/19 *Winter Outlook Report*. The consultation closes on 19 July 2018.

Winter 2017/18 began as an average winter in terms of temperature. Both the gas and electricity networks delivered reliable sources of energy to meet demand. At the beginning of March, as winter drew to a close, temperatures in GB dropped with the arrival of an unseasonably cold weather front. This created operational challenges for both the gas and electricity networks. While the electricity network had sufficient generation to meet demand, the challenge was in transferring the energy from where it was produced to where it was needed. On the gas network, upstream supply losses and the highest demand seen for seven years, resulted in the release of a Gas Deficit Warning. Despite these challenges, both the electricity and gas systems responded well. In the report, we provide a case study which examines the challenges presented, and the tools used, to ensure there was sufficient supply and generation to meet demand.

This year, in addition to seeking your views of supply and demand for this winter, we have included two additional updates. The first provides information on changes to the GB electricity percentage margin formula. As part of last year's *Winter Review and Consultation*, we moved away from a transmission demand-based margin to a margin based on total underlying demand. We believe the update to the formula will present the margin in a more consistent manner in the future. We plan to introduce this formula in our 2018/19 *Winter Outlook Report* in October.

The second update invites your views on changes to gas notifications, specifically the Margins Notice and the Gas Deficit Warning. Since issuing the Gas Deficit Warning we feel it is important to review how effective it was in achieving its objectives. We would therefore like to open a discussion with the industry. Any proposed changes would need to be appropriately justified and balanced against implementation costs and any wider impacts. Within this discussion, we would also like to consider whether the gas market rules facilitate demand-side response.

Historically, we have provided a preliminary view of the forthcoming winter in this report. The probabilistic assessment of security of supply for the winter period helped inform the procurement of contingency reserve. Now that the Capacity Market is fully operational, we feel that including the margin would not add value or aid the consultation process. We have therefore not included specifics in this year's report. However, our initial assessment indicates that the margin is likely to be similar to last year.

Your responses to our consultation questions are important to us and help underpin the *Winter Outlook Report*. This year, we are particularly interested in knowing if the electricity analysis in our *Winter Outlook Report* needs to change and what your views and intentions are regarding customer demand management. For gas, we continue to seek your feedback on changes to gas demand patterns, along with your views of

Executive summary

any issues related to European supply and demand which you feel could have an impact on gas flows to and from the GB market over winter 2018/19.

Overview: Electricity winter 2017/18

	2017/18 Forecast	2017/18 Actual
Weather corrected transmission demand		50.0 GW
Peak transmission system demand	50.7 GW	50.7 GW
Minimum weather corrected transmission system demand	21.3 GW	20.1 GW
Customer demand management	2 GW	2 GW

- Throughout the winter there was a good electricity supply and comfortable margins.
- We continue to see the impact of distribution connected generation and strong winds through the lowering of demand on the transmission system.
- On 29 October we experienced the lowest overnight minimum demand seen during Greenwich Mean Time (the winter period). This was the result of high wind generation and warmer than normal temperatures.
- The weather was particularly mild until the end of February. The arrival of the unseasonably cold weather front brought sub-zero temperatures, which affected the availability of some generation assets.
- On 1 March during the cold snap, transmission system peak demand reached 50.7 GW. This was outside of the Triad period and therefore we did not observe any Triad-related customer demand management. This would normally have helped to reduce demand on the system.
- There was adequate margin during the cold snap, helped by high levels of wind.
- Coal-fired plant provided some of the baseload during the cold spell due to an increase in the gas price.

Overview: Gas winter 2017/18

	2017/18 Forecast	Weather corrected outturn
Total GB demand	51.4 bcm	53.4 bcm
	2016/17	**2017/18**
Total GB supply	52.0 bcm	54.1 bcm

- Two major events affected gas supply and demand during winter 2017/18. The first was the closure of the Forties pipeline in December, coinciding with low temperatures and high demand. The second was the unseasonably low temperatures during the cold snap on 1 March.
- Both incidents created operability challenges requiring different grid configurations to manage supply and demand.
- The weather on 1 March was the seventh coldest day since records began. It gave rise to the highest gas demand experienced in seven years.
- A Gas Deficit Warning was issued to the market on 1 March to draw attention to the supply and demand imbalance and to encourage market participants to take action.
- While both events were operationally challenging, at no time was security of supply compromised.
- Medium-range storage, LNG and interconnectors responded by increasing supply during both events.

Thank you for taking the time to read this year's *Winter Review and Consultation*. We want to make sure our publications are as useful to you as possible, so please let us know what you think. You can join the consultation by using the link on our website.

You can email your feedback to us at marketoutlook@nationalgrid.com, join the debate on Twitter using #winterreview or subscribe to our LinkedIn Future of Energy page.

Stakeholder engagement

Our *Winter Review and Consultation* is just one in a suite of documents from the System Operator exploring the future of energy. In them you can find out more about the evolution of the energy landscape, and how we are working with our stakeholders to build and operate the gas and electricity systems of the future.

Our Outlook reports present our short-term analysis of gas and electricity supply and demand. They are designed to stimulate a conversation with the energy industry. The feedback we receive from a broad range of stakeholders, underpins the development of our publications.

We want to make sure that our reports continue to improve and provide you with the right information to support your business planning. To do this we would like to know what you think of this report. You can share your feedback via the short survey on our website or by emailing us at marketoutlook@nationalgrid.com.

Our publications

The Outlook reports form part of a suite of publications from the System Operator on the future of energy. Each of the documents in this suite aims to inform the energy debate by identifying a particular issue and is shaped by engagement with industry.

The starting point for much of 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. 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.

You can find out more about any of these documents by clicking on their front covers or by visiting our Future of Energy webpage. To be the first to hear about publications and associated events, you can sign up to our mailing list via the website.

	Consultation questions for consideration
0.1	Does the *Winter Review and Consultation* meet your needs?
0.2	Is there anything you would like to see included in the report that would help you with your preparations for winter?
0.3	Is the level of detail contained within the report: a) just right? b) not enough? c) too much?
0.4	If you would like more detail, please let us know in what area.
0.5	On a scale of 1 to 10 (10 being the highest) how would you rate the *Winter Review and Consultation* report?

Figure 0.1
Key publications from the System Operator 2017/18

Network Options Assessment
January 2018

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

Summer Outlook Report
April 2018

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

System Needs and Product Strategy
April 2018

Our view of future electricity system needs and potential improvements to balancing services markets.

Winter Review and Consultation
June 2018

A review of last winter's forecasts versus actuals and an opportunity to share your views on the winter ahead.

Future Energy Scenarios
July 2018

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

Winter Outlook Report
October 2018

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

Electricity Ten Year Statement
November 2018

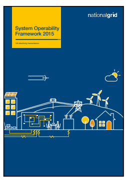
The likely future transmission requirements on the electricity system.

Gas Ten Year Statement
November 2018

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

Gas Future Operability Planning
November/December

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



System Operability Framework

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

National Grid's role

National Grid plays a vital role in connecting millions of people to the energy they use, safely, reliably and efficiently.

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 plan and operate 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 our connected customers 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.

Chapter one

Winter review – weather

This chapter provides an explanation of how the gas and electricity sectors model weather. The weather affects the gas and electricity demand in different ways. The two sectors have each developed their own methods for measuring the weather that give the best relationships between weather and demand.

Effect of the weather

Electricity

Normalised demand
Demand assessed for each week of the year based on a 30-year average of each relevant weather variable. This is then applied to a linear regression model to calculate what the demand would have been with this standardised weather.

Seasonal normal weather
The weather we would expect to see in any given week and at certain times of the day based on a 30-year average.

Weather corrected demand
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.

Gas

Composite weather variable
A single measure of daily weather. It is the combination of temperature and other weather variables, including wind speed. The purpose of composite weather variable (CWV) is to define a linear relationship between the weather and *non-daily metered* gas demand.

Weather corrected demand
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.

Seasonal normal weather
Seasonal normal weather is actually measured by way of a composite weather variable. Seasonal normal composite weather (SNCW) is the average weather conditions one would expect for a particular time of the year, and it is calculated on a daily basis. It is updated every few years to include the most recent years' data and to include climate change.

Chapter two

Winter review – electricity

This chapter sets out how actual electricity supply and demand in winter 2017/18 compared to our forecasts. It details our analysis of demand, generation and interconnector flows.

The chapter contains the following sections:

- Electricity operational view
- Europe and interconnected markets

Electricity operational view

This section provides an overview of the supply and demand experienced during winter 2017/18 on the electricity transmission system. All demand figures in this chapter are transmission system demands i.e. national demand + station load (600 MW) + actual interconnector *exports*.

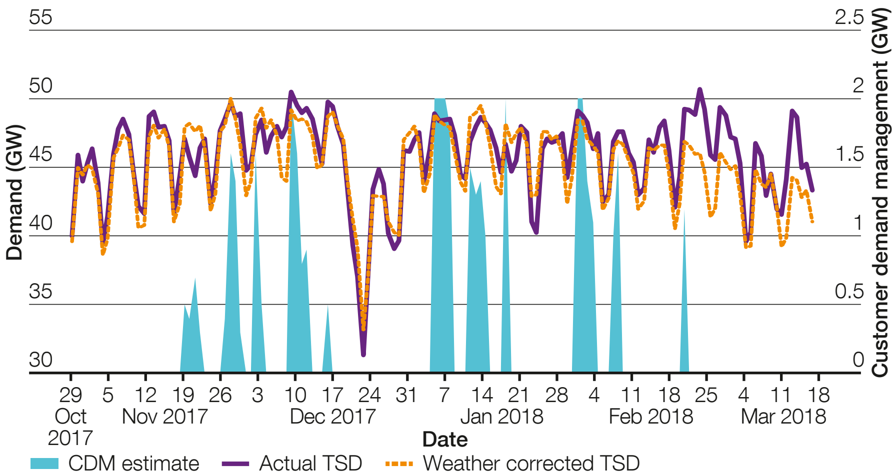
What we said in our *Winter Outlook Report*	What actually happened	Why was there a difference?
The Capacity Market is now fully operational. It has increased the amount of available supply in the GB market and is designed to deliver more supply or reduce demand during times of system stress.	The observed actual availability levels at peak demand were higher than in previous years.	Units without Capacity Market contracts remained open.
Peak transmission system demand forecast is 50.7 GW and is expected to peak in the week commencing 11 December. This is based on current data and seasonal normal weather.	Transmission system demand peaked at 50.7 GW on 1 March 2018.	The peak occurred outside the Triad period due to the unseasonably cold weather.
Both normalised and average cold spell (ACS) demand can be met in all weeks across the winter under all interconnector scenarios.	There was sufficient generation and interconnector imports to meet demand throughout the winter period.	
Demand forecasts for the coming winter are lower than weather corrected outturns in previous years. This is primarily due to an increase in distribution connected generation.	The weather corrected transmission system demand was 50.0 GW, 0.07 GW lower than our forecast.	This is primarily due to an increase in the distribution connected generation.

Electricity operational view

Table 2.1
Peak and minimum transmission system demands for winter 2017/18

GW	Actual	Weather corrected
Peak demand	50.7	50.0
Minimum demand	18.6	20.1

Figure 2.1
Daily peak actual and weather corrected unrestricted transmission system demands (TSD) with customer demand management estimates



Customer demand management

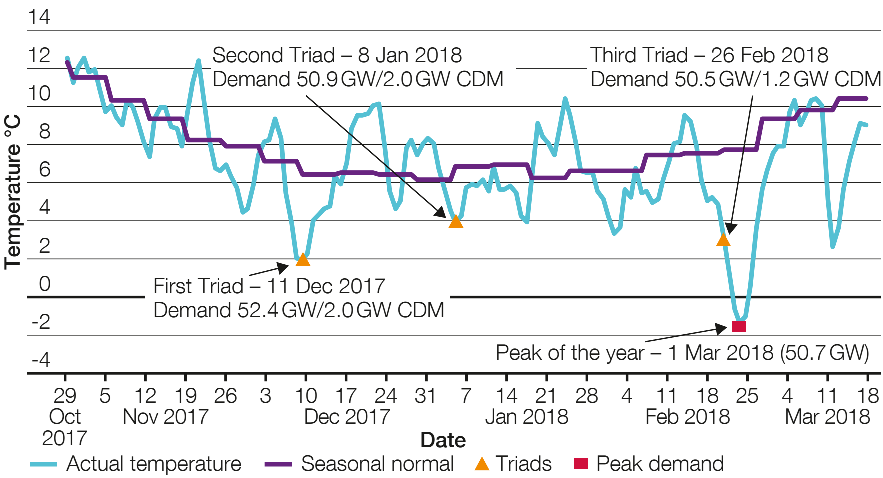
Figure 2.1 shows the daily actual and weather corrected unrestricted[1] transmission system demand and our estimates of customer demand management (CDM). This information is National Grid's best estimate of CDM based on the daily post-event analysis of peak demand, incorporating our expertise along with analysis of the drop in underlying peak demand. This estimate is not based on any demand reduction data provided to us by suppliers, customers or aggregators.

As forecast, maximum customer demand management was approximately 2 GW during winter 2017/18. This was similar to winter 2016/17 levels.

Triads

Triad avoidance acts to reduce the level of demand seen on the transmission system. Large industrial users can reduce their energy charges by reducing consumption over peak periods. As a result of low demand, the number of estimated Triad avoidance days decreased from 48 during winter 2016/17, to 33 in 2017/18.

Figure 2.2
Comparison of actual temperature during winter 2017/18 with seasonal normal temperatures



[1] Unrestricted demand includes estimated customer demand management (CDM).

Electricity operational view

Figure 2.2 provides a comparison between average actual observed temperature at 5pm during winter 2017/18 and weekly seasonal normal temperatures at 5pm.

On the three Triad days when demand peaked, temperatures were below the normal average.

	Consultation questions for consideration
2.1	In comparison to winter 2017/18, do you think that the peak level of customer demand management in winter 2018/19 will increase or decrease? What makes you believe this? How much generation (GW) would you expect to respond to periods of high demand?

Peak demand

In winter 2017/18, we experienced something unique on the electricity transmission system; we saw the *darkest peak (DP)* demand fall outside the Triad period for the first time since records began in 1976/77. This happened on 1 March 2018 when GB temperatures fell with the arrival of a cold easterly front. The national average temperature was -1.5°C. This was 9°C colder than the seasonal normal average of 7.5°C. As this occurrence was outside the Triad period we did not observe any Triad related CDM. We explore the events of 1 March in the case study on page 41.

Lowest GMT demand

During winter 2017/18, we experienced the lowest overnight minimum demand during Greenwich Mean Time (the winter period) ever to be seen on the electricity transmission system. Demand dipped to 18.6 GW on 29 October 2017. This was caused by very high distribution connected wind generation and warmer than seasonal normal temperatures.

Weather corrected electricity demand (TWh)

During winter 2017/18, a total of 127.8 TWh of electricity was transmitted. This was 2.8 per cent (3.7 TWh) lower than winter 2016/17. This downward trend in demand continues as we see milder weather and reductions in transmission *underlying demand* due to the continued increase in distribution connected generation.

	Consultation questions for consideration
2.2	Did your organisation, either directly or as part of an aggregator group, participate in demand management in winter 2017/18? What factors influenced your decision to do this? What is your size and can you provide data? Did you do this by generating on site or by shifting your demand?
2.3	Do you expect your organisation, either directly or as part of an aggregator group, to participate in demand management during winter 2018/19? What factors will influence your decision? Will you do this by generating on site or by shifting your demand?
2.4	Do you use the demand analysis in our *Winter Outlook Report*? What do you use this analysis for?

Interconnector flows

Interconnector flows were closest to the base case imports scenario of 1,800 MW, resulting in a net import of 800 MW to the GB market.

Further information on this can be found in the Europe and interconnected markets section.

Generator output

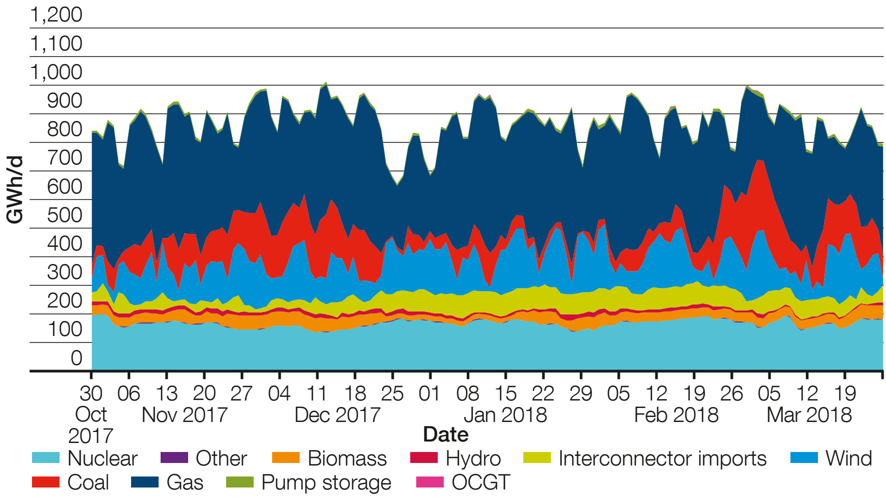
Across the winter, GB benefited from reliable electricity generation. Figure 2.3 provides the generation output. In summary:

- Gas-fired plant provided 42 per cent of the energy output. This is a reduction of 3 per cent compared to the previous winter. This could be related to the increase in wind generation.
- Coal-fired plant provided just 12 per cent of the energy output. This was as a result of the higher production costs for coal compared with gas for much of the winter.
- Interconnector imports were generally the same as last year at 6 per cent. Imports dropped to 5 per cent during winter 2016/17 because of the French nuclear issues. In previous years imports have been around 8 per cent.
- Wind generation increased to 14 per cent, compared with 10 per cent in winter 2016/17.

Chapter two

Electricity operational view

Figure 2.3
Winter 2017/18 generation output by fuel type



Breakdown rates

Plant reliability was lower or equal to assumed breakdown rates for all generation types except nuclear. In summary, these are the breakdown rates for winter 2017/18:

- CCGT generation, which made up almost half of the energy contribution during winter 2017/18, was slightly lower than our assumption.
- Nuclear generation was higher than our assumption because of a delay in the return of a large nuclear unit from a planned outage.
- Coal-fired generation was in line with our expectations.

Table 2.2 provides more detail on the energy contribution of each fuel type, as well as our assumed breakdown rates forecast in our *Winter Outlook Report*. These are compared with the actuals observed during peak demand periods[2].

These forecast breakdown rates are applied to the operational data provided to us by generators. They account for restrictions and unplanned generator breakdowns or losses close to real time. The rates are based on how generators performed on average by fuel type during peak demand periods (between 7am and 7pm) over the last three winters. The actuals exclude planned outages already notified at the beginning of winter.

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

Table 2.2
Winter 2017/18 energy contribution, assumed and actual breakdown rates of generation plant

Power station type	Energy contribution	Assumed breakdown rate	Actual breakdown rate
Nuclear	19%	7%	10%
Hydro generation	1%	5%	3%
Coal + biomass	12% + 4%	11%	10%
Pumped storage	1%	3%	3%
OCGT	0%	3%	3%
CCGT	42%	9%	5%

The differences in breakdown rates had minimal impact on the overall supply forecast as they were offset by each other. The major impact came from unplanned outages affecting interconnector flows which are addressed in more detail in the next chapter.

	Consultation questions for consideration
2.5	If your company has transmission-connected generation, what generation type is it? Is it currently available to the market? If not, what might lead you to return it to service and how long would it take you to do so?
2.6	If your generator has a proportion of its capacity at long notice, do you expect to change this in the future? What factors would influence your decision?

Europe and interconnected markets

Interconnection between both Continental Europe and Ireland allows the flow of electricity to and from the GB network. This chapter examines the factors that affected flows during winter 2017/18.

What we said in our *Winter Outlook Report*	What actually happened	Why was there a difference?
For winter 2017/18 we expect there to be a net flow of power from Continental Europe to GB at peak times, occasionally not at full import.	Net flows of power from Continental Europe to GB when the margin was reduced and the GB price was higher. GB was occasionally exporting to France until mid-December.	Occasional exports from GB to France were largely due to reduced margin in France caused by a delayed return from outage of French nuclear plants. This increased prices in Continental Europe.
Based on the current price spread, we expect there to be a net flow from GB to Ireland during peak times, but this may be reversed in cases of high wind levels in Ireland and during periods of system stress in GB.	As forecast.	
All interconnectors are expected to be at full availability during the winter period.	BritNed and Moyle were at full availability during the winter period. EWIC and IFA both had unplanned fault outages.	Unplanned faults impacted interconnector availability as seen in figure 2.5.
The growth in renewable energy installed capacity in Continental Europe, especially Germany, increases the potential for hourly electricity price fluctuations in Continental Europe. As a result, we would expect occasional variations on the interconnector flows, especially outside of peak periods.	Observed day-ahead price variation was almost ±150 per cent when wind output was above 35 GW in Germany. See page 24.	

All the electrical links between GB and other markets (France, the Netherlands and Ireland) are high voltage direct current (HVDC) interconnectors. The total capacity of the four interconnectors is 4 GW. Flows on the interconnectors are driven by the electricity price differential between markets on either side of the interconnector.

Net flow from Continental Europe

In general we saw a net flow of electricity from Continental Europe to GB across the winter period when margins were tighter and the price in GB was higher. However, until mid-December, GB was exporting to France across the peak demand periods as shown in figure 2.4.

Figure 2.4
Net flow from Continental Europe to GB at peak demand periods during winter 2017/18

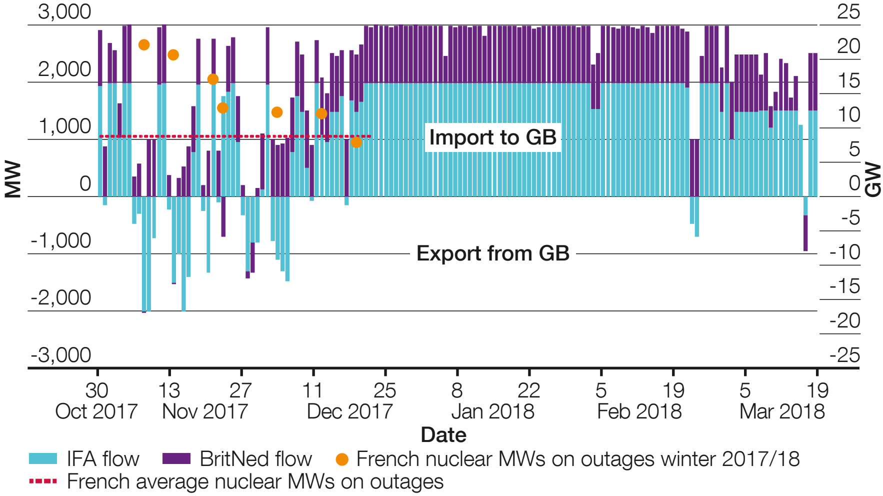
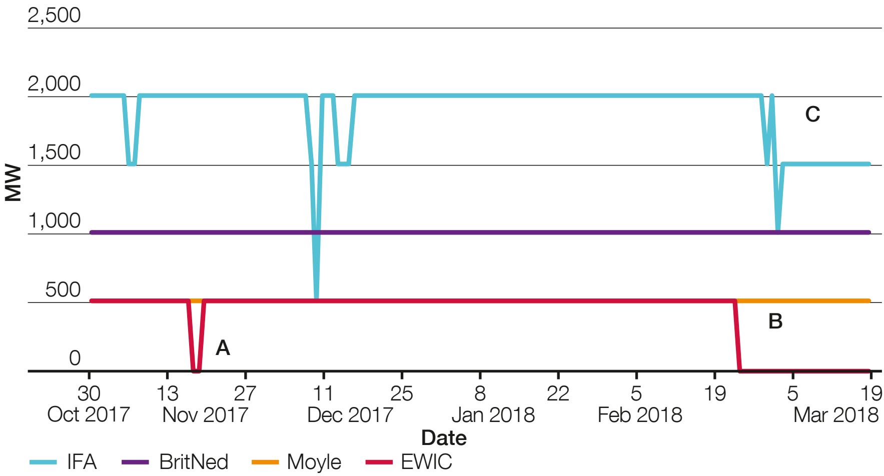


Figure 2.4 illustrates net flows from Continental Europe. To summarise:

- Net flows varied between imports and exports during November and early December. This was due to the delayed return of French nuclear plants from outages; increasing French prices and attracting imports into France.
- During December and March, there were mainly imports into GB via Interconnexion France–Angleterre (IFA) and BritNed.
- The reduction in capacity across the French nuclear fleet in November and early December coincided with high output from GB wind generation. This helped to reduce prices in GB to a level below French market prices. The combination of these fundamental drivers delivered higher than forecast exports via IFA from GB to France.

Europe and interconnected markets

Figure 2.5
Interconnector capacities during GB peak demand periods in winter 2017/18



Interconnector performance

The BritNed and Moyle interconnectors were at full availability throughout the winter.

Between 18–19 November, the EWIC interconnector had a planned outage for routine maintenance (see A in figure 2.5). A fault at the interconnector converter station in Wales also resulted in 0 MW capacity, between 28 February and 29 March (see B in figure 2.5).

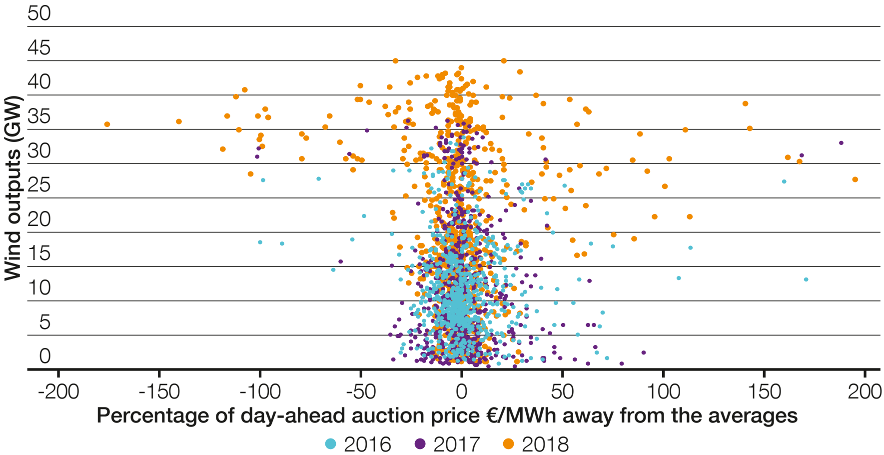
There were a number of short monopole or bipole fault outages on the IFA. A longer fault outage on Pole 4 at Les Mandarins station in France resulted in a 500 MW capacity reduction from 7 March. This returned to full service 4 May (see C in figure 2.5).

Market and renewable energy

Figure 2.6 shows the price variations in the German market when overlaid against wind output in Germany over the past three years. What is evident is that when wind outputs increased, there was a higher percentage variation in the day-ahead auction price compared with the average market price. The increased output could either be the result of growth in installed capacity or higher wind speeds. This was especially so in 2018, when the day-ahead price variation was almost ±150 per cent when wind output was above 35 GW.

A similar pattern can be observed when considering solar photovoltaic (PV) output during the summer months. This would appear to support the expectation that there tends to be more price fluctuations resulting from the growth of renewable energy.

Figure 2.6
Price variations vs. wind output in Germany



	Consultation questions for consideration
2.7	How would you expect further changes to the generation mix in Continental Europe to affect the flow on the interconnectors to GB?

Chapter three

Winter review – gas

This chapter sets out how gas supply and demand in winter 2017/18 compared to our forecast. It details how we are managing the flexibility requirements of our customers.

The chapter contains the following sections:

- Gas operational view
- System operability
- Winter case study

Gas operational view

This section provides an overview of gas supply and demand during winter 2017/18.

We explore the variable sources entering GB, particularly how gas supplies from flexible sources responded and the effect of price on interconnector flows.

What we said in our *Winter Outlook Report*	What actually happened	Why was there a difference?
Gas demand		
We expect gas demand for winter 2017/18 to be lower than the demand for winter 2016/17.	Gas demand in winter 2017/18 was higher than winter 2016/17.	The weather in winter 2017/18 was colder, leading to an increase in non-daily metered demand.
We expect the biggest reduction in demand to be from gas for electricity generation.	The biggest fall was in gas for electricity generation.	
Less gas is expected to be exported through IUK.	Slightly less gas was exported through IUK.	
Gas supply		
We expect there to be sufficient gas available from a wide range of sources to meet winter 2017/18 demand.	Demand was met on all days, even with disruption to the Forties pipeline in December and cold weather in late February and early March.	
Supplies from Norway are expected to be high, similar to last year.	Deliveries from Norway over the winter were high, similar to last year; 21 bcm down from 21.6 bcm in winter 2016/17.	
We are expecting imports through IUK to be high.	IUK deliveries were much higher than last winter; 4.7 bcm in winter 2017/18 compared with 2.5 bcm in 2016/17.	
There is capacity for imports through BBL to increase beyond last winter's values in response to high prices.	Flows through BBL increased to 46 mcm, close to the maximum capacity, in December. This was in response to the Forties pipeline shutdown. Flows in January were in excess of 35 mcm/day rising to 44 mcm/day in early March.	

Gas operational view

What we said in our *Winter Outlook Report*	What actually happened	Why was there a difference?
LNG flows respond to conditions in the global market, which makes forecasting deliveries to GB challenging.	Deliveries of LNG were lower than last year.	Gas was delivered instead to Asian markets where it attracted a higher price. There were three cargoes from the new Russian terminal at Yamal and one from the US.
Rough storage will be available for withdrawals from early October 2017.	Withdrawal of gas from Rough started in September. In January, Rough was formally classified as a producing field rather than a storage site.	
Similar to winter 2016/17, we expect continued cycling of gas into and out of medium-range storage (MRS).	Gas from medium-range storage sites was cycled more than observed in winter 2016/17.	

Summary tables

Table 3.1
Gas demand for winter 2016/17 and 2017/18

	Winter 2016/17		Winter 2017/18		
Demand in bcm	**Actual demand**	**Weather corrected demand**	**2017/18 forecast**	**Actual demand**	**Weather corrected demand**
NDM	29.3	29.7	30.0	32.0	30.7
DM + industrial	5.0	5.0	4.6	4.9	4.9
Ireland	1.6	1.6	1.6	1.8	1.8
Total for electricity generation	13.8	13.8	12.4	12.7	12.7
Total demand	**49.9**	**50.3**	**48.6**	**51.5**	**50.1**
IUK export	0.8	0.8	0.4	0.7	0.7
Storage injection	1.8	1.8	2.1	2.3	2.3
GB total[3]	**52.5**	**52.9**	**51.4**	**54.8**	**53.4**

Table 3.2
Gas supply by type and percentage of total supply

	2015/16		2016/17		2017/18	
	bcm	%	bcm	%	bcm	%
UKCS	17.8	36%	19.9	38%	19.7	36%
Norway	18.0	36%	21.6	42%	21.0	39%
BBL	3.0	6%	2.7	5%	3.1	6%
IUK	<0.1	0%	2.5	5%	4.7	9%
LNG	6.4	13%	1.9	4%	1.8	3%
Storage	4.1	8%[4]	3.3	6%	3.8	7%
Total	**49.4**		**52.0**		**54.1**	

[3] Please note that total figures include shrinkage.
[4] The percentage figures in this column do not sum to 100% due to a number rounding issue.

Gas operational view

Gas demand and supply events

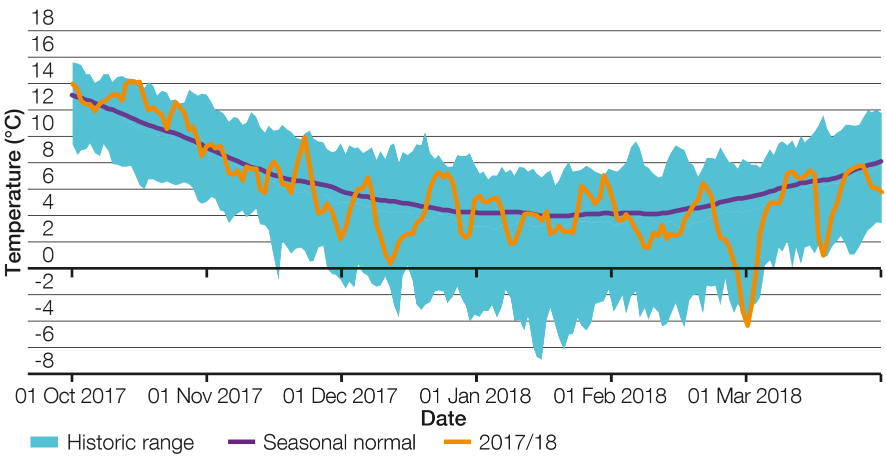
There were two significant events in winter 2017/18 that affected all aspects of the gas demand and supply story. The first was the closure of the Forties pipeline on 12 December for emergency maintenance. This coincided with low temperatures and high demand. The second was the cold weather at the end of February and early March. Both gave rise to high interconnector flows and increases in LNG supply.

Gas demand items

Non-daily metered

Gas demand in the non-daily metered (NDM) sector, where the main use is for heating, was higher than we forecast. The difference was due to the weather. For analysis of the effect of weather on gas demand we combine temperature, wind speed and other factors in a single value called the composite weather variable (CWV). The average CWV for winter 2017/18 was lower than the seasonal normal value, shown in figure 3.1. It was significantly lower than the seasonal normal value on a number of occasions, notably in mid-December, 1 March, and mid-March. As a result, 1 March was the seventh coldest day in our 58-year weather record history. It gave rise to the highest gas demand in seven years, 417.6 mcm. Demand in the distribution networks reached nearly 360 mcm. This was higher than the 1-in-20 peak forecast that we published in our *Gas Ten Year Statement*[5].

Figure 3.1
National composite weather variable for winter 2017/18 and the historic range



[5] https://www.nationalgrid.com/uk/publications/gas-ten-year-statement-gtys

Electricity generation

We were expecting a reduction in gas demand for electricity generation since demand in winter 2016/17 was unexpectedly high. In our *Winter Outlook Report* we said that we expected gas-fired generation to be cheaper and therefore would run above coal in the generation merit order. On two occasions this winter, in response to the Forties pipeline closure and again during the cold weather in March, the gas price rose to a level that made gas-fired generation more expensive than coal-fired generation. Gas-fired generation was reduced on both occasions.

Gas supply items

BBL

At the beginning of winter, shippers held capacity bookings in BBL for approximately[6] 20 mcm/day. In our 2017 *Winter Review and Consultation* report, stakeholders told us that higher flows than this could be expected if the difference in price, or price spread, between the Title Transfer Facility (TTF) in the Netherlands and the National Balancing Point (NBP) in GB, supported it.

In November a small amount of new capacity was booked for the first quarter of 2018. From 1 January 2018, BBL was integrated into the TTF market area. This meant entry and exit charges were no longer applicable at the Dutch end of the pipe. This reduced the price spread needed to make flows profitable. More substantial capacity bookings were made at auctions during the first quarter of 2018. Gas flows reflected the increased capacity bookings for many days in January, as shown in figure 3.2.

Gas flows exceeded 40 mcm/day twice during winter 2017/18. The first was in response to the Forties Pipeline shutdown, reaching close to the maximum physical limit of 46 mcm/day on 13 December. The second time was on 2 March, when flows also exceeded 40 mcm/day just after the cold spell. On both these occasions, the price spread between NBP and TTF was high enough to make it worth buying pipeline capacity on the day.

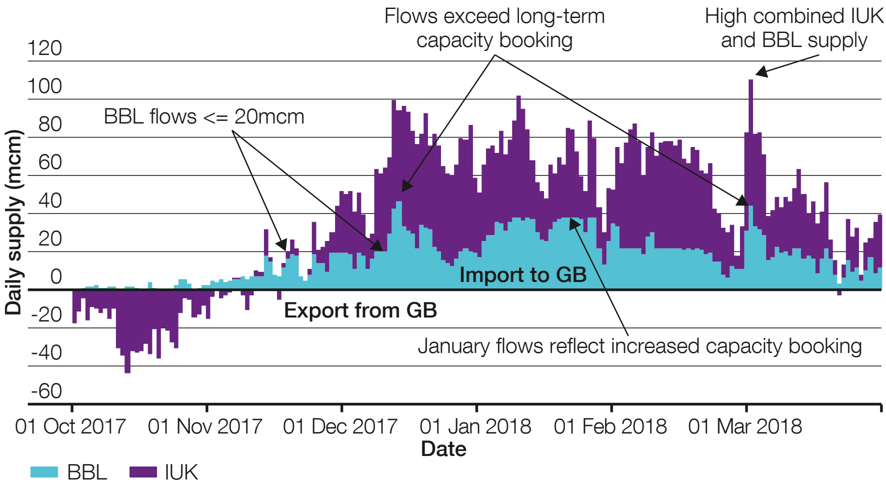
IUK

Gas flows through IUK respond well to the price spread between the Zeebrugge hub in Belgium and the NBP hub in GB. Forward prices in autumn 2017 suggested that gas would be flowing from Belgium to GB for most of the winter, and this proved to be the case. Flows were significantly higher than last winter, exceeding 60 mcm/day on a number of occasions, although the maximum flow rate of 74 mcm/day was not reached.

[6] Bookings are made in energy, GWh/day. We have converted this to volume, mcm, for consistency with our operational reporting.

Gas operational view

Figure 3.2
Daily supplies through BBL and IUK



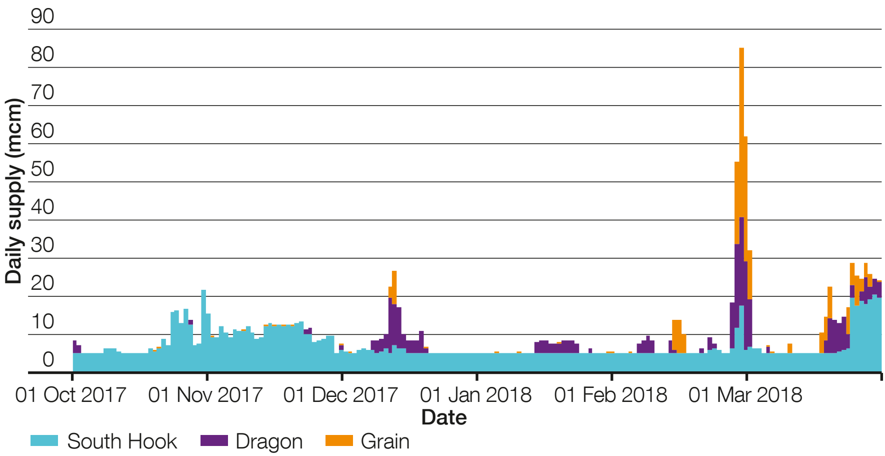
	Consultation questions for consideration
3.1	Is there anything that could have an impact on European supply and demand which could affect gas flows to and from GB over winter 2018/19?
3.2	BBL flowed at between 0 and 45 mcm/day last winter. Do you anticipate that the reduced production from Groningen will have an effect on this winter's flows, especially on days of high GB demand?
3.3	IUK flowed at between 0 and 67 mcm during winter 2017/18. Do you anticipate any change to IUK deliverability this winter, especially on days of high demand?

LNG

Supplies of LNG this winter were the lowest for many years. LNG flowed to markets in Asia instead, where it attracted a higher price. Figure 3.3 shows that for much of the winter aggregate flows were below 10 mcm/day. We saw higher flows to support demand on the day of the Forties pipeline shutdown in December, and particularly during the cold spell at the beginning of March.

While much of the LNG exported from Qatar went to Asia, GB did receive some deliveries from new LNG sources. Dragon received the first cargo from the newly commissioned Cove Point terminal in the US. Grain and Dragon received four cargoes from the new Yamal terminal on the Russian Arctic coast, though at least one of these was subsequently re-exported.

Figure 3.3
Daily supplies of LNG



Medium-range storage

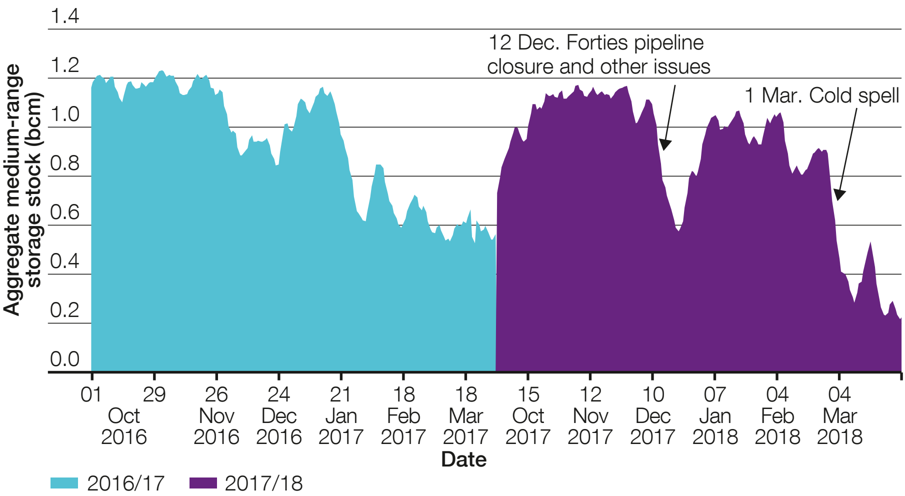
The use of gas in medium-range storage (MRS) has changed in the last few years. In our 2018 *Summer Outlook Report* we showed that both injection into, and withdrawal from, MRS in the summer months had increased since 2015. We have seen similar trends through the winter months.

Total injection and withdrawal in winter 2017/18 was greater than winter 2016/17. In figure 3.4, you can see the very sharp reduction in stock in December 2017 and again at the end of February 2018. The December withdrawal was in response to the outage on the Forties pipeline system. The withdrawal in February and March was in response to high demand as a result of cold weather.

	Consultation questions for consideration
3.4	Forecasting LNG volumes is challenging. Flows over the last two winters have been low. Do you expect anything to change this winter?
3.5	Over the last few winters, shippers have increasingly made use of injection into, and withdrawal from, medium-range storage. Do you think this will change this winter?

Gas operational view

Figure 3.4
Aggregate stock levels in medium-range storage



System operability

This section examines the challenges associated with the planning and operation of the gas system.

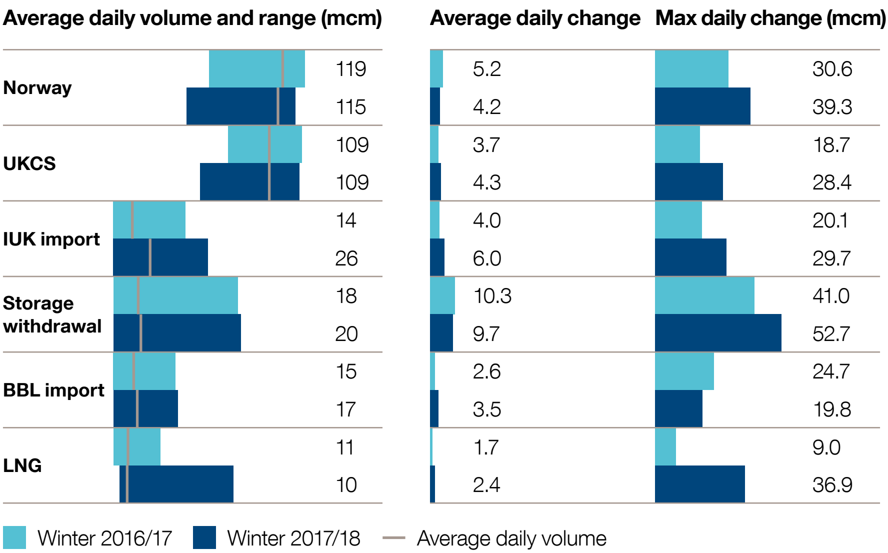
We look at the day-to-day supply and demand variability and how we're responding to meet our customers' needs.

Headlines

- The unpredictability of supply and demand patterns continues to contribute to the upward trend of increased compressor usage.
- The way in which our customers use the gas network on a day-to-day basis continues to change, with no clear pattern emerging year on year.
- During winter 2017/18 we experienced the highest ever daily linepack swing of 39 mcm.

During winter 2017/18, gas supplies into GB continued to be variable. On average, these variations were similar to winter 2016/17. However, as shown in figure 3.5, in some cases the maximum change on a daily basis was much greater in comparison.

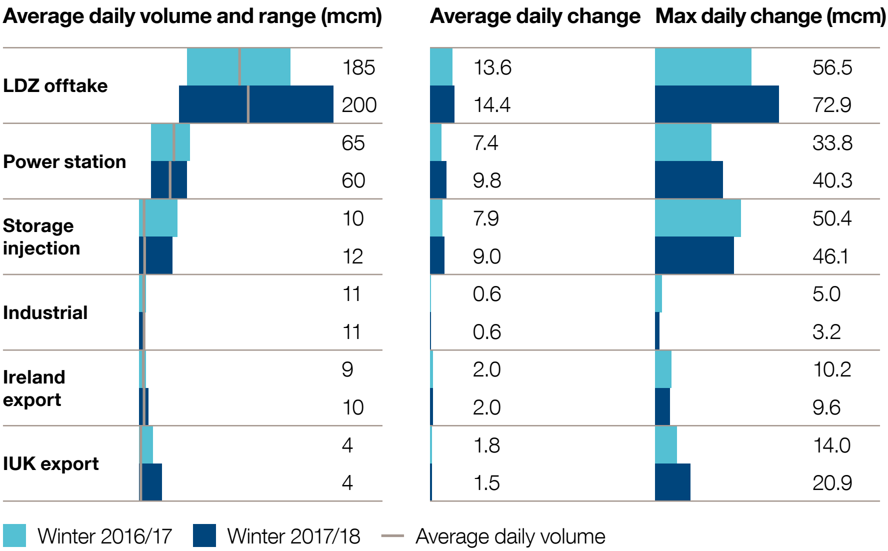
Figure 3.5
Day-to-day variations in supply throughout winter 2017/18



We experienced a similar trend in demand, although, not as consistent, with both increases and reductions to the maximum daily change as seen in figure 3.6.

System operability

Figure 3.6
Day-to-day variations in demand throughout winter 2017/18



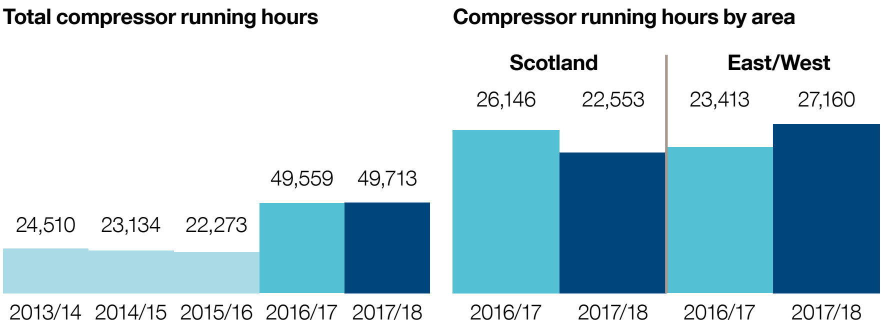
Comparing the maximum daily change for winter 2016/17 and 2017/18, illustrates the unpredictability of supply and demand. This presents challenges when planning and operating the gas transmission network. To manage the variations in the short term means the continued trend of high compressor usage and ultimately increased running hours and maintenance (figure 3.7).

The impact of increasing variations day-to-day leads to the need to better predict the scale and location of the changes to allow us to configure the network accordingly and optimise the use of the compressor fleet.

In the short to medium term, we are developing tools that will help us predict these changing patterns, and the rate they will occur, to ensure we continue to deliver the expectations of our customers.

	Consultation questions for consideration
3.6	Do you expect this upward trend in daily variations to supply and demand to continue/increase? If so, why?
3.7	What do you believe is driving these within-day changes?

Figure 3.7
Compressor use throughout winter 2017/18 compared to previous winters



NTS linepack

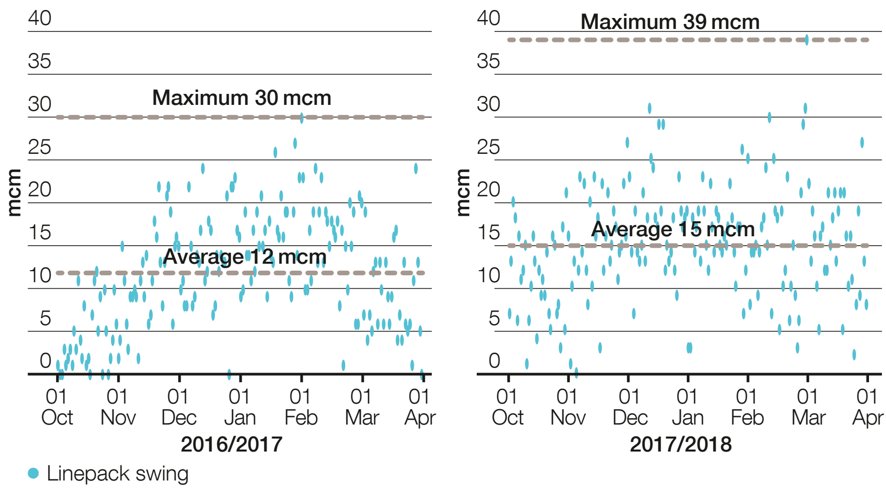
A further consequence of supply and demand variations is the effect they have on the volume of gas, or linepack, within the National Transmission System (NTS) pipelines. Locational changes in supply and demand patterns and shippers' balancing their portfolios closer to real time causes fluctuations in linepack levels. Managing these fluctuations places a greater focus on our operational and commercial strategies. Linepack is essential for the safe management of system pressures. As the System Operator, it is crucial that we ensure gas pressures stay within safe and acceptable limits.

The difference between the amount of gas in the system at the start of the day and at the lowest point in the day is referred to as 'linepack swing'. We are seeing an upward trend in the amount of linepack swing on the system, both in terms of the average and the maximum swing. The impact of this for customers can be a variation in network pressures. The location and extent of the impact depends on network configuration and the supply and demand pattern at the time. In winter 2017/18 we experienced the highest ever daily swing of 39 mcm, as shown in figure 3.8. Our ability to maintain delivery and offtake pressures remained strong throughout the winter period.

We continue to work with our customers to understand how we can provide better insight into these conditions on a closer to real time basis.

System operability

Figure 3.8
Average and maximum within-day linepack swing for 2017/18 compared to previous winter



Winter case study – February 26 through to 2 March

What had been an average winter in terms of temperature turned very cold at the end of February. Weather forecasts had forewarned the UK and Continental Europe of the forthcoming 'Beast from the East' and storm Emma. The cold weather front brought unseasonably low temperatures and heavy snowfall and, combined with storm Emma, transported cold air from Siberia. Temperatures dropped to 9°C lower than the seasonal norm. Harsh conditions and red weather warnings affected GB's energy networks and assets and prompted consumers to turn up their heating.

On 1 March, the gas network had to manage the highest demand for seven years. This was coupled with upstream supply losses caused by gas supply assets being impacted by the sub-zero temperatures. This resulted in the gas system being 47 mcm below the end of day demand level and an unprecedented 100 mcm less than instantaneous demand by 7am. As a consequence, a Gas Deficit Warning (GDW)[7] was issued. The purpose of this notice is to inform the market of a significant supply deficit. It encourages shippers to balance their portfolios and informs them to be prepared to respond to any balancing requests issued by National Grid Gas. Market prices increased in response to tight system conditions. Trading occurred throughout the day to improve the supply/demand balance. Prices in GB rose ahead of prices in Continental Europe, attracting gas imports into GB. UKCS and Norwegian flows increased throughout the day as asset issues were resolved.

The impact of the cold weather on the electricity system was less extreme than it was for gas. On 28 February, the IFA interconnector was exporting. This was due to extremely tight conditions in France driven by the cold weather and plant losses. While there was still sufficient generation to meet GB demand and exports, the challenge was in transferring the energy from where it was produced to where it was needed. This led to constraints in the South East. In order to secure the system, National Grid worked collaboratively with the French System Operator to reduce the level of export across peak periods. Low temperatures affected plant and some power stations encountered problems ramping up. Because gas prices had increased to 250 pence/per therm, coal-fired generation became the most economical plant to run, and by 1 March coal-fired plant was providing some of the baseload.

Temperature
-2 to -4°C

Gas demand
417.6 mcm

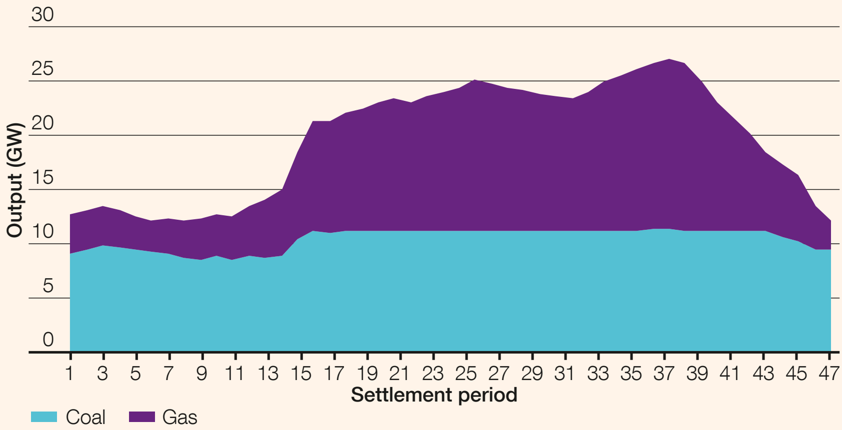
Gas price
250 p/pth

Electricity demand
50.7 GW

[7] https://www.nationalgrid.com/sites/default/files/documents/Ops%20Forum%20pack%20March%202018.pdf

System operability

Figure 3.9
Gas and coal output 1 March 2018



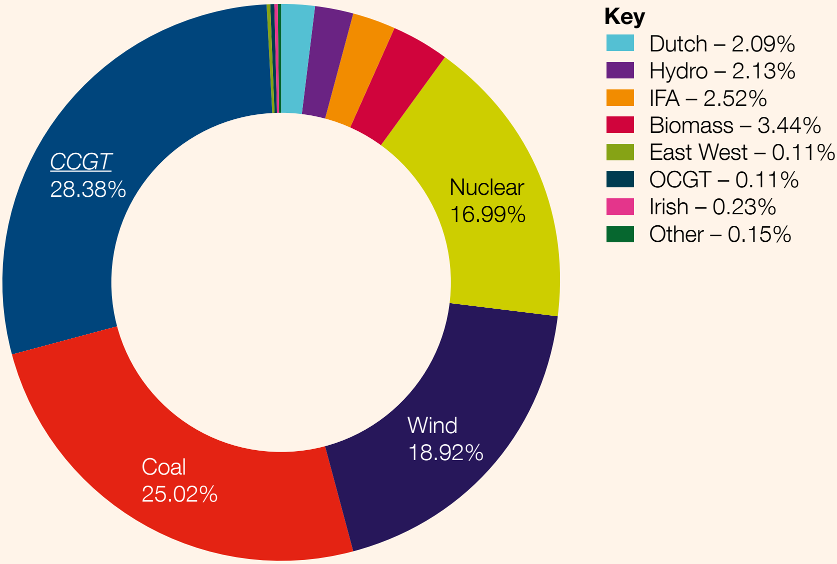
On 1 March, coal-fired units were generating for 89 per cent of the day compared with only 44 per cent for gas. Coal produced 27 per cent of the energy needed for the day. Demand peaked at 50.7 GW. This was driven by the cold weather and the absence of any customer demand management because it was outside of Triad season. This was the first time that this had happened since demand records began.

The week was operationally challenging to ensure that GB's security of supply was maintained. Both the electricity and gas networks called upon the tools at their disposal to manage the within-day challenges. The gas system was affected more than their electricity counterparts, although we observed interdependencies between the two systems in respect of CCGT capacity holdings. Electricity margins remained adequate throughout the period, helped by the higher wind levels. The GDW was withdrawn on 2 March.

National Grid Gas has undertaken a review of the events leading up to and during the cold snap and is currently working with industry on follow-up activities. More specifically, we are looking at:

- The review of our gas warning notices (covered in more detail in the next chapter).
- A review of the suite of gas balancing tools and industry communication.
- Gaining a better understanding of the drivers for LNG and interconnector response to UK price triggers.
- 1-in-20 cold spell calculation.
- Re-evaluating our local distribution demand (LDZ) forecast model, given the infrequency of unseasonably cold weather. Based on the results, we will feed back to the Demand Estimation Sub-committee (DESC) to ensure wider industry circulation.

Figure 3.10
Energy make up for week commencing 26 February 2018



Chapter four

Industry notifications

Update to the GB percentage margin formula

Headlines

- To reflect the growth in interconnection capacity, an update to the GB margin formula is required this year.
- The formula change leads to a minor impact on the margin in percentage terms. This is because the capacity of interconnection is still relatively low compared to future forecasts.
- Changing it now ensures that the percentage margin continues to be a robust representation of GB security of supply risk. It will also allow greater comparability across future years.
- The margin in GW terms remains unchanged as a result of this margin update, as does the *loss of load expectation* (LOLE) estimate. Only the percentage margin number is affected.

Key terms used in the formula below

- Supply GB: refers to the total de-rated capacity on the GB system. This includes all transmission and embedded conventional capacity, wind power, demand response, storage, etc.
- Interconnection: refers to the total contribution of interconnectors from Continental Europe and Ireland to GB security of supply at the time of winter peak demand.
- Demand: in this formula demand refers to the winter average cold spell (ACS) peak demand plus the basic reserve for response requirement on the GB system.

The GB margin formula at present

As part of last year's *Winter Review and Consultation*, we moved away from a transmission demand-based margin, to a margin based on total underlying demand. The change was necessary to reflect the growing levels of embedded generation on the system and the introduction of the Capacity Market. The margin in gigawatt (GW) terms remained approximately the same; however, as a result, the margin in percentage terms was slightly lower. LOLE was not affected.

The GB de-rated capacity margin can be expressed as either a GW number or as a percentage of demand. In figure 4.1, the existing formula, which was agreed by Ofgem in 2012, is shown with the margin in GW and percentage terms. Note that the value below the line in the percentage formula subtracts interconnection from demand.

Figure 4.1
The present formula

De-rated capacity margin:

(in GW terms) = Supply (GB) + Interconnection - Demand

$$\text{(in \% terms)} = \frac{\text{Supply (GB)} + \text{Interconnection} - \text{Demand}}{\text{Demand} - \text{Interconnection}}$$

The updated formula introduced this year

This year, based on recent market observations, a further update is needed to reflect the growing levels of interconnection in the near future. There could potentially be 18 GW of total connection capacity to neighbouring countries by the late 2020s[8]. This increase has important implications for the existing GB margin formula. The effect of higher interconnection would greatly reduce the net demand below the line in the percentage formula, as seen in figure 4.2. Therefore, by dividing by a smaller number below the line, the current percentage margin would appear 'inflated' even for the same GW margin. The effect of higher interconnection therefore undermines the current margin formula in percentage terms as a representation of security of supply. It would also make historical benchmark comparisons more difficult.

Figure 4.2
The proposed formula[9]

Proposed modification to formula
De-rated capacity margin:

(in GW terms) = Supply (GB) + Interconnection - Demand

$$\text{(in \% terms)} = \frac{\text{Supply (GB)} + \text{Interconnection} - \text{Demand}}{\text{Demand}}$$

We propose to update the percentage margin formula by excluding interconnection flow from below the line. The security of supply contribution of interconnection imports will still be included via the supply-side calculation above the line. This will maintain consistency of the percentage margin number going forward, regardless of the growth in interconnection.

Impact assessment of the update

Using last year's *Winter Outlook Report 2017* Base Case, we have assessed the significance of this issue, both now and in the future when the interconnection levels could be higher.

The *Winter Outlook 2017* Base Case, which had an assumed 2.4 GW of interconnection flow, was compared with a version of the same case using 12.5 GW of interconnection flows (this is just an example of possible peak flows in future). The margin in GW terms was adjusted to the same 6.2 GW level for consistency; the results can be seen in table 4.1.

[8] National Grid *Future Energy Scenarios* 2017

[9] This year, to reflect recent changes in the Capacity Market regarding duration-limited storage, storage is included in the supply side on the basis of an Equivalent Firm Capacity (EFC). The Equivalent Firm Capacity (EFC) of a supply component is that amount of perfectly reliable, infinite duration firm capacity that can be replaced while maintaining the same security of supply level.

Industry notifications

Table 4.1
Comparison of percentage margin and the impact of the modified formula

	Underlying demand margin (GW)	Underlying demand percentage margin – Existing formula	Underlying demand percentage margin – Updated formula	Loss of load expectation: (LOLE) (hrs/year)
Winter Outlook Report 2017 Base Case with existing interconnection flow (2.4 GW)	6.2 GW	10.3%	9.9%	< 0.01
Winter Outlook Report 2017 Base Case with a future possible interconnection flow (12.5 GW)	6.2 GW	12.5%	10.0%	< 0.01

The impact assessment shows that by applying the updated percentage margin formula, the inflation in the percentage margin number (10.3 per cent to 12.5 per cent) can be avoided as the levels of interconnection grow. As a result, with the new formula, the margin in percentage terms remains constant regardless of the level of interconnection (circa 9.9 per cent to 10 per cent). Also, we avoid a significant step change (12.5 per cent to 10 per cent) in the future by introducing the change now. Importantly, the margin in GW terms remains the same with the new approach, as does the LOLE risk level.

Consultation on the update

We believe the update this year (which builds on the changes introduced last year) is important as it will present the percentage margin in a more consistent manner in the future. We plan to introduce this updated formula for the headline margin reported in the *Winter Outlook Report* in October 2018. We are interested to hear any industry stakeholder views on this proposed change as part of the consultation process.

Gas Margins Notice and Gas Deficit Warning consultation

Currently, we have two main tools to provide notice of a possible imbalance between gas demand and supply; a Margins Notice and a Gas Deficit Warning (GDW). A Margins Notice (MN) is issued if forecast demand for the day ahead exceeds a pre-defined forecast of supply. It is intended to encourage the industry to take action to improve the supply and demand balance. A GDW is issued if there is a more serious supply and demand imbalance leading to a material risk to the end-of-day balance on the NTS. The procedures are described in more detail on our website[10].

We issued a GDW on 1 March 2018 in response to a number of coincident events. Some of these we were able to forecast, such as cold weather and high gas demand, and others we couldn't, notably the failure of some key supply infrastructures upstream of the NTS. The Margins Notice has not been used since its introduction in 2012, though it is likely that one would have been issued on 1 March if we had not moved straight to the GDW.

As the GDW notification has recently been used, we feel that it is appropriate to review the process. Is there, for example, any information that customers could provide that would help us to improve the forecasts that are used in the Margins Notice? We would also like to check that customers feel that this provides the information they need in order to take appropriate timely action.

We would therefore like to open a discussion with the industry, acknowledging at the outset that any proposal for change would need to be appropriately justified and balanced against implementation costs and any wider impacts. Within this discussion, we would also like to consider whether the gas market rules to facilitate demand-side response in such circumstances remain appropriate.

We consider that the Transmission Workgroup would be the most appropriate forum in which to raise these issues and propose to do so in the near future. For more information please use the following link: https://www.gasgovernance.co.uk/tx

[10] https://www.nationalgrid.com/uk/gas/balancing/margins-notices-mn-and-gas-deficit-warnings-gdw

Chapter five

Glossary

Word	Acronym	Section	Description
Average cold spell	ACS	Electricity	ACS methodology takes into consideration the variability in weather due to people's changing behaviour, e.g. more heating demand when it is colder and the variability in weather dependent demand distributed generation e.g. wind generation. These two elements combined have a significant effect on peak electricity demand.
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	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 is designed to ensure security of electricity supply. This is achieved by providing a payment for reliable sources of capacity, alongside their electricity revenues, ensuring they deliver energy when needed.
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.
Customer demand management	CDM	Electricity	Where industrial or commercial users change their pattern of energy consumption. This may be to avoid using energy at peak times.
Darkest peak		Electricity	Peak half-hourly demand between 5pm and 7:30pm during Greenwich Mean Time (GMT).
Daily metered	DM	Gas	A classification of customers where gas meters are read daily. These are typically large scale consumers.
De-rated capacity		Electricity	De-rated capacity is the capacity of generation reduced to best reflect what is expected to be available in real time. The reduction is to account for unexpected outages or breakdowns and other restrictions to the generators which is based on historic performance.
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.
Distribution connected generation		Electricity	Any generation that is connected directly to the local distribution network, as opposed to the transmission network. It includes combined heat and power schemes of any scale. Generation that is connected to the distribution system is not usually directly visible to National Grid and acts to reduce demand on the transmission system.
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/
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.

Glossary

Word	Acronym	Section	Description
Equivalent Firm Capacity	EFC	Electricity	The Equivalent Firm Capacity (EFC) of a supply component is that amount of perfectly reliable, infinite duration firm capacity that can be replaced while maintaining the same security of supply level.
European Union	EU	Various	A political and economic union of 28 member states that are located primarily in Europe.
Export		Various	Interconnectors flowing out of GB.
Future Energy Scenarios	*FES*	Various	The *FES* is an annual publication showing range of credible pathways for the future of energy out to 2050. The scenarios 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/
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.
Import		Various	Interconnectors flowing into GB.
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.
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 http://grainlng.com/
Load		Various	The energy demand experienced on a system.
LDZ demand		Gas	Local Distribution Zone (LDZ) demand refers to the total amount of gas used by gas consumers connected to the Distribution networks.
Loss of load expectation	LOLE	Electricity	Used to describe electricity security of supply. It is an approach based on probability and is measured in hours/year. It measures the risk, across the whole winter, of demand exceeding supply under normal operation. This does not mean there will be loss of supply for three hours per year. It gives an indication of the amount of time, across the whole winter, which the System Operator (SO) will need to call on balancing tools such as voltage reduction, maximum generation or emergency assistance from interconnectors. In most cases, loss of load would be managed without significant impact on end consumers.

Glossary

Word	Acronym	Section	Description
Medium-range storage	MRS	Gas	These commercially operated sites have shorter injection/withdrawal times. This means 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	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
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, multi-junction sites and offtakes. Pipelines transport gas from terminals to offtakes and are designed to operate up to pressures of 94 barg.
Negative reserve active power margin	NRAPM	E	The insufficient NRAPM warning is a request to encourage more flexible parameters from generators, and inform participants of a risk of emergency instructions. A NRAPM may be issued if there is insufficient flexibility available to ensure that generation matches demand during periods of low demand. A localised NRAPM occurs where there is a danger that the combination of demand and inflexible generation within a constraint group can exceed the constraint limit of a portion of the network; in both cases there is a risk that NG may need to issue emergency instructions to inflexible and non-BM participating plant. Localised NRAPM are more common in the north of Scotland due to the large volume of wind and water generation and relatively low demand.
Net import/export			The sum of total generation flowing via interconnectors either into or out of GB.
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.
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.
Off-peak firm capacity		Gas	Off-peak capacity is made available to the market at offtake points where it can be demonstrated that firm capacity is not being utilised.
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.
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.

Word	Acronym	Section	Description
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.
Reserve		Electricity	National Grid currently manages different types of reserve in order to maintain system security under a range of credible scenarios. Reserve can be thought of as the requirement for a total amount of head room (positive reserve) and foot room (negative reserve) provided across all generators synchronised to the system. Reserve is required to: • account for errors in demand, wind and solar forecasting • cover demand and generation losses in the period from day ahead to real time, and • facilitate the holding of high frequency dynamic response. In the future, the requirement to hold reserve is likely to increase. This is because of the continued growth in solar PV capacity and the need to manage the additional variability in demand between four hours ahead and real time.
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.
Seasonal normal demand		Gas	The level of gas demand that would be expected on each day of the year. It is calculated using historically observed values that have been weighted to account for climate change.
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.
Station load		Electricity	The onsite power station requirement, for example for systems or start up.
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 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).
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.
Triad avoidance		Electricity	Triad avoidance occurs when some industrial and commercial users reduce their electricity consumption when demand is expected to peak, in order to avoid transmission charges.
Title transfer facility	TTF	Gas	A virtual trading point for natural gas in the Netherlands.

Glossary

Word	Acronym	Section	Description
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 out turned 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.
Winter Outlook Report	WOR	Various	The *Winter Outlook Report* is published each year in October by National Grid to show the expected security of supply position on both the gas and electricity systems for the coming winter. It is the product of the Winter Consultation process and is based on data supplied by the industry, market insight and analysis.
Within-day		Gas	Defined as any operation that takes place during the 'gas day' (5am to 4:59am)

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