Northern Gas Networks

Northern Gas Networks

Long term development statement

2023

we are the network

Foreword

Welcome to our 2023 Long Term Development Statement which contains essential information on the process for planning the development of the gas distribution system, including demand and supply forecasts, system reinforcement projects and associated investment. We publish the report at the end of our 2023 planning process for our two Local Distribution Zones, North East and Northern. The main body of the document provides an overview of the key topics, with further details contained in the report appendices.

At the time of publishing this report we are halfway through our third year of our RIIO-GD2 2021-26 price control period and working hard to meet our license requirements and outperform our targets. The past year has seen many challenges for our industry and the communities that we serve. 2022 saw the UK experience record breaking temperatures in some areas, putting increased pressure on the electricity grid as fans and cooling units were utilised by many.

Furthermore, wholesale gas prices reached record levels in 2022, but have levelled out through 2023. At the time of forecasting our future gas demand, the full extent of the price impact was not in our base dataset and it is unlikely we'll see the true impact until this forthcoming winter closes out and we have more data to work with.

The drive to meet net zero has accelerated globally and the part we must play in transitioning to green energy is ever more apparent and crucial.

Paul Bolton

Head of Programme Management

Version & Circulation

Version Number: Draft 2023 v1

This document, and any updates to this document will be circulated electronically and uploaded to our website.

Disclaimer

The Long-Term Development Statement provides a ten-year forecast of transportation system usage and likely system developments that can be used by companies contemplating connecting to our system or entering into transport arrangements, to identify and evaluate opportunities.

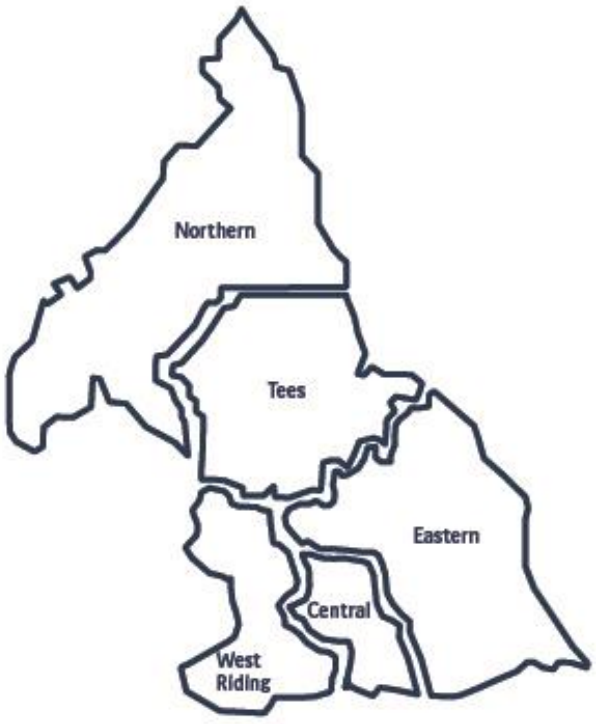
This document is not intended to have any legal force or to imply any legal obligations regarding capacity planning, future investment and resulting capacity.

Background & Context

The Long-Term Development Statement is the product of an annual cycle of planning and analysis. The statement sets out our assessment of future supply and demand for natural gas on our network. It also outlines proposals for investment in our local transmission and distribution systems. Interested parties may use this information to gain an understanding of how we expect gas demand to evolve on our networks over the next 10 years. This will help them plan accordingly when considering connection opportunities.

We are required to publish this annual statement in accordance with Standard Special Condition D3 of our Gas Transporters Licence and Section 4.1 of the Uniform Network Code Transportation Principal Document.

Northern Gas Networks (NGN) manages the development, operation and maintenance of the High Pressure and below 7bar Distribution Networks. These extend from the inlet valves of the pressure regulating installations at the National Transmission System interface, to the outlet of the consumer's emergency control valve in the North East of England, Northern Cumbria and West, North and East Yorkshire. The below map summarises the extent of NGN's two Local Distribution Zones (LDZs):



LDZ	No.	Location
Northern (NO)	1	Northern
	2	Tees
North East (NE)	3	Eastern
	4	Central
	5	West Riding

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Chapter 1

ENA - Gas in our Future Energy

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Chapter 1 - ENA Gas in our Future Energy Systems

In November 2020, The Prime Minister's Ten Point Plan for a Green Industrial Revolution set out a new direction for Britain's gas networks in a Net Zero future, building on much of the work already undertaken through Energy Networks Association's Gas Goes Green programme, setting out the role Britain's gas networks can play in delivering hydrogen and biomethane to homes, businesses and communities across the country.

Tackling climate change means we need to decarbonise the gas that plays a critical role in our everyday lives. That's why Britain's gas network companies are now playing a leading role, to ensure that we, as a country, can get the job done, by undertaking the work needed to replace that natural gas with hydrogen and biomethane through Gas Goes Green, which completed its third full year this year in April 2023.

The programme brings together the engineering expertise of Britain's five gas network companies with the wider energy industry, policymakers, and academics, to tackle the technical challenges associated with a shifting our energy system away from natural gas so that it can allow us all to reap the benefits of a world-leading zero carbon gas grid delivering hydrogen and biomethane. That work has, so far, focussed on the planning and research steps necessary to build the world's first zero carbon gas grid, culminating in major research publications such as Britain's Hydrogen Network Plan (published January 2021) and 'A Hydrogen Vision for the UK' report (published April 2023). The latter sets out a plausible vision for hydrogen rollout across the UK in five year increments from 2030 to 2050.

With the swift progress of the gas networks; flagship H21, HyDeploy and H100 hydrogen innovation projects, the focus of industry, policymakers and, increasingly, the public, has now turned to demonstrating the real-world outcomes of hydrogen trials in a scalable format. The Government's Hydrogen Strategy confirmed that a decision on heat decarbonisation will be made 2026, with hydrogen neighbourhood, village and town trials announced in the Prime Minister's Ten Point Plan providing the evidence required for that.

Gas networks have also been focusing on providing the Department for Energy Security and Net Zero (DESNZ) with the evidence required to inform their 2023 hydrogen blending decision, as outlined in the Prime Minister's Ten Point Plan. In January 2022 Britain's Hydrogen Blending Delivery Plan was published, setting out the key actions required to make hydrogen blending a success. In November 2022 ENA also published hydrogen blending capacity maps, mapping out the 60 TWhrs per year of blending capacity available across the gas transmission and distribution networks.

Gas distribution networks are utilising their world-leading expertise of running one of the world's most extensive national gas grids to develop the hydrogen evidence and skills base that's required for them to provide the solutions the country needs to tackle climate change.

GDN innovation

At the start of the new regulatory period RIIO-2 in April 2021 Britain's network companies introduced the Energy Network Innovation Process providing full governance details of the end-to-end industry led process for reporting, collaboration, and dissemination of Ofgem funded NIA projects in GB.

This new process will include reporting against an Innovation Measurement Framework (IMF) Energy Networks will report on a range of innovation outcomes, including collaboration and partnerships, the speed at which successful innovation is transitioned into BAU and the benefits innovation has delivered for network customers.

RIIO-2 has also introduced a Strategic Innovation Fund (SIF) to support the transition to net zero. This fund supports large-scale transformational research and development projects and will be available to Gas Distribution (GD), Gas Transmission (GT), Electricity Transmission (ET) and the Electricity System Operator (ESO) in the first instance.

In October 2023, ENA jointly held its second Energy Innovation Summit in Liverpool with DESNZ, Ofgem, UKRI and Innovate UK. Sector colleagues used this event to share updates on key innovation projects and discuss new projects that need to be taken forward to help Britain decarbonise.

You can find out more information about individual projects at the Smarter Networks Portal, https://www.smarternetworks.org/

James Earl

Director, Gas

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Chapter 2

Demand

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Chapter 2 - Demand

2.1 Demand Forecasts Overview

This chapter outlines the ten-year gas demand forecast for each Local Distribution Zone (LDZ) within NGN, including both the annual and 1 in 20 Peak day gas demands. It also includes discussion on how current forecasts relate to previously published forecasts. Further information is provided in Appendix 2.

Demand forecasts are prepared as part of an exchange of information that is intended to inform respective capacity planning processes between the Gas Distribution Networks and National Gas. These forecasts are compliant with the demand forecasting requirements of Section H of the Uniform Network Code (UNC) Offtake Arrangements Document.

2.2 Demand Forecasts

2.2.1 Annual Demand

This section provides an outline of our latest annual gas demand forecasts up to and including gas year 2032/33 along with the key underlying assumptions. A more detailed view can be found in Appendix 2.

Annual demand forecasts are produced without the knowledge of future weather conditions. Consequently, we use past data (historical averages) to estimate what future temperature would be under seasonal normal conditions. To compare demand data between years, we adjust our estimates to account for the variance of actual weather and seasonal normal temperature. This adjustment is called 'weather corrected demand'.

The annual demand forecasts are based on analysis of how historic weather corrected demand is influenced by non-weather factors such as the economy, environmental and efficiency initiatives and how the most influential factors are likely to change in the future. Evidence suggests that the most influential factor that determines gas demand annually, after weather, is its price. The largest single components of customer bills are gas and electricity wholesale prices. The wholesale gas prices rose steeply through 2021 and has continued through 2022. The prices are expected to stay high for at least another year. The day ahead gas price has seen a peak of 450p/th in December 2021, and over 500p/th in Q1 2022. The price remained high through 2022, and early 2023, but has stabilised due to the large volume of LNG imports.

It is expected that storage levels are to remain similar to levels to last year, but above the 5 year average as outlined in National Gas's Winter Outlook 2023-24.

Our demand forecasting process takes place in the first quarter of each year, therefore at the time of producing our annual and peak outlook for the next ten years. The data which provides the basis of our analysis was typical of a 'normal' year. We assumed that gas prices would continue to steadily increase therefore, on a Network basis, annual gas demand was forecast to increase by 1.07% over the next 10 years with an average calendar year increase of 0.12%. 2023 NGN has forecast an increase in overall annual gas demand. However, the forecast rate of increase is due to small growth in the North East LDZ, but is primarily a flat profile due to an uncertain economic outlook and relatively high increases in UK gas prices. The economic outlook is even more uncertain since we produced our forecasts at the beginning of the year.

Contributary factors to the decline in gas demand are thermal efficiency improvements across businesses and residential housing, combined with the switch to renewable heat. It is difficult to separate the impact of efficiency improvements from the impact of gas price changes and the effect that a changing number of network supply points has on annual demand. Historic demand, economic data and economic forecasts suggest an average annual increase over the whole forecast period of 0.12% for our North East LDZ and 0.11% for our Northern LDZ.

Load Band	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032
0-73 MWh	38.5	38.6	38.5	38.4	38.3	38.4	38.3	38.3	38.1	38.2
73-732 MWh	5.2	5.2	5.2	5.2	5.2	5.3	5.3	5.3	5.3	5.3
732-5860 MWh	4.1	4.1	4.1	4.1	4.1	4.1	4.1	4.1	4.1	4.1
Small User	47.7	47.9	47.8	47.7	47.7	47.7	47.6	47.7	47.5	47.6
Firm> 5860 MWh	20.2	20.3	20.4	20.5	20.6	20.7	20.8	20.8	20.9	21.0
NGN Consumption	67.9	68.2	68.2	68.2	68.2	68.4	68.4	68.5	68.5	68.7
NGN Shrinkage	0.3	0.3	0.3	0.3	0.3	0.3	0.2	0.2	0.2	0.3
NGN Demand	68.2	68.5	68.4	68.5	68.5	68.6	68.7	68.7	68.7	68.9

Table 2.2.1 NGN's forecast annual demand by load category & calendar year (in TWh)
Note: Figures may not sum exactly due to rounding.

The chart below illustrates the actual annual throughput and our most recent forecasts through to the end of our RIIO GD2 price control[1] period.

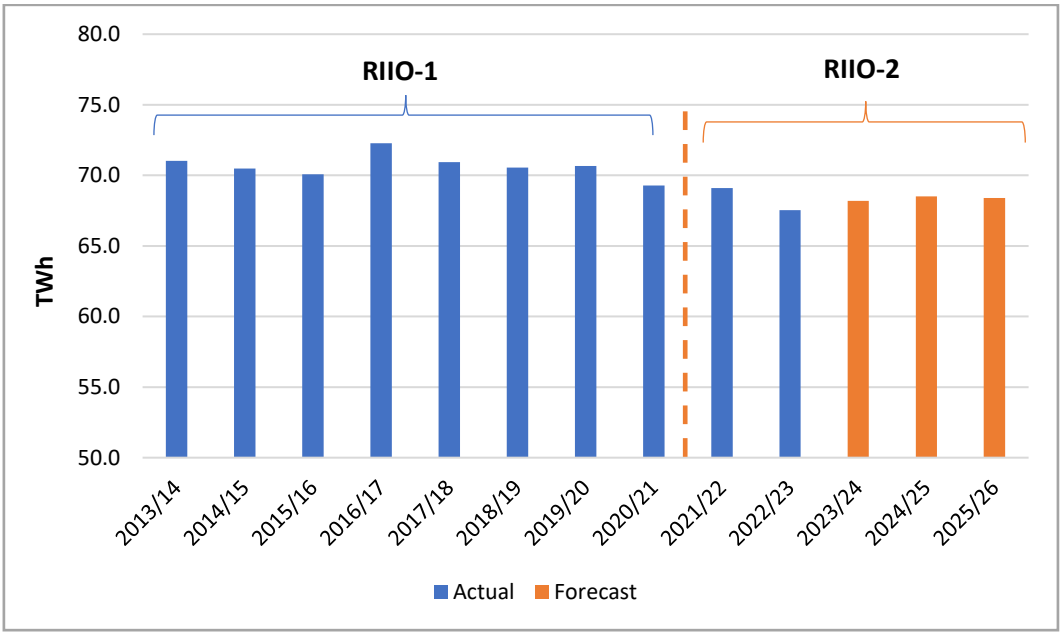

Figure 2.2.2 RIIO GD1 historic annual demand and forecast RIIO GD2 annual demand

[1] RIIO GD2 Price Control https://www.ofgem.gov.uk/publications/riio-2-final-determinations-transmission-and-gas-distribution-network-companies-and-electricity-system-operator

2.2.2 Forecast Accuracy

Table 2.2.3 below provides a comparison of actual and weather corrected throughput during the 2022 calendar year with the forecast demands presented in our 2022 plan. Annual forecast demands are presented in the format of consumption load bands/categories, consistent with the basis of system design and operation.

Load Band	Actual 2022	Weather Corrected 2022	Forecast for 2022	Weather Corrected v Forecast (%)
0-73 MWh	35.32	38.10	40.86	-6.8
73 – 732 MWh	5.02	5.34	5.39	-0.8
>732 MWh	23.42	23.80	25.53	-6.8
Network Shrinkage	0.30	0.30	0.29	1.7
NGN Network Total	64.05	67.54	71.66	-5.7

Table 2.2.3 Comparison of actual and weather corrected throughput in 2022 calendar year (TWh)
Note: Figures may not sum exactly due to rounding.

On a Network basis, the weather corrected annual throughput in 2022 was 67.54 TWh. This shows a decrease of -2.7% from 2021.

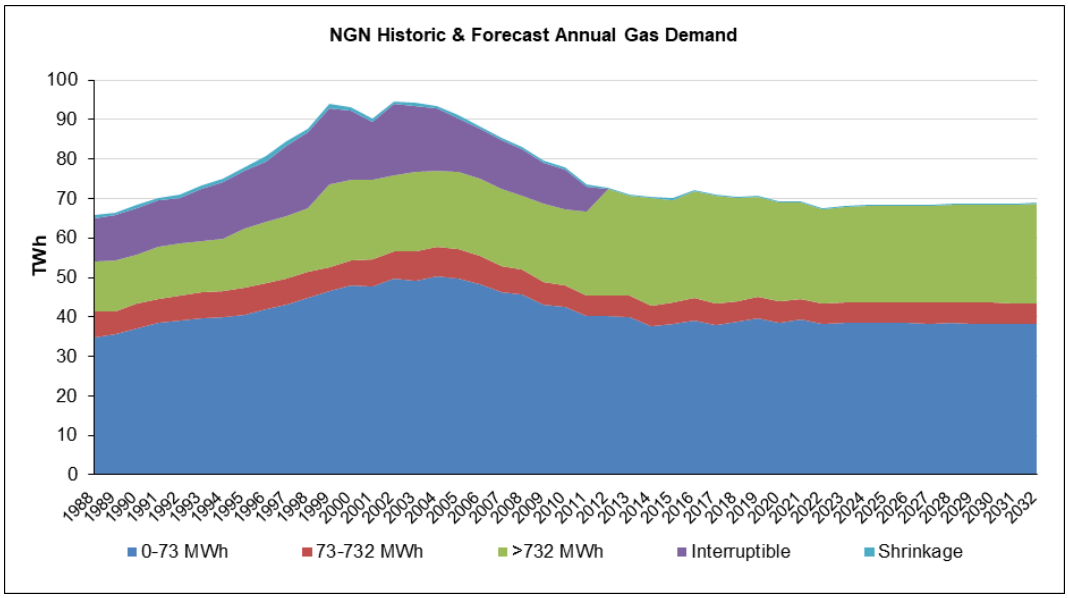

Figure 2.2.4 Historical Weather Corrected Throughput & Forecast Annual Gas Demand by Load Band

The chart above shows weather corrected and forecast gas demand by load band through to 2032. The most significant change in this chart is the change in the Interruptible load in 2011. Following a modification in UNC Interruption Arrangements (Mod 90), which came into effect 01 October 2011, interruptible contracts were only made available at specific supply points where NGN had identified an area in which interruption was necessary. This change to the Interruption process resulted in a significant reduction in Interruptible Load.

2.2.3 Peak Forecast Demand

NGN is required to forecast 1 in 20 Peak day demand on an annual basis. We maintain and operate our network to be able to satisfy this level of demand, as defined in Uniform Network Code section W2.6.4(c):

1 in 20 Peak day demand - 1 in 20 peak day demand is the level of daily demand that, in a long series of winters, with connected load held at the levels appropriate to the winter in question, would be exceeded in one out of 20 winters, with each winter counted only once.

Peak demand is calculated using an established industry methodology[2] and is based on determining the weather-demand relationship for each loadband in each LDZ. Smaller loadbands, which tend to represent households and smaller businesses, are much more weather sensitive than larger loadbands. This is because they tend to use most of their gas for space heating rather than industrial processes which aren't linked to weather.

Evidence continues to suggest that overall demand in NGN's network has become less sensitive to weather. However, during extreme cold weather there is an observable 'cold weather upturn' in demand. One possible explanation for this upturn is, the increased number of people that decide to stay at home when it snows due to school closures.

The forecast 1 in 20 peak day demand in the 2023/24 gas year is 1% lower than the forecast made in 2022. Overall, peak demand is forecast to increase by 0.09% over the 10-year period within our Northern LDZ and 0.23% in our North East LDZ.

This compares with an increase of 0.41% and 0.49% respectively, for these LDZs in the 2022 forecast. As we move into the winter of 2023/24, we are yet to fully understand the full impact of the large increase in the gas prices, which reached record levels in 2022, but have levelled and stabilised throughout the second and third quarters of 2023.

Hybrid working practices still mean that a proportion of the population will be working from home and in the office. As temperatures decrease, we may still see a flatter 'within day' profile, and smaller than the usual morning and evening peaks, than we see when large numbers of people are working in offices during the day.

Higher gas prices will also impact on demand, but the full extent of which will be understood more as we progress through the winter months, even though they have stabilised in the second and third quarters of 2023.

[2] Further information can be found here: https://www.nationalgas.com/connections/national-transmission-system-connections

The following table summarises our 1 in 20 peak day forecasts for the period 2023/24 to 2032/33. These are the forecasts for each gas year covering the period 1st October to 30th September.

1 in 20 Peak day Demand (GWh)										
LDZ	**2023/24**	**2024/25**	**2025/26**	**2026/27**	**2027/28**	**2028/29**	**2029/30**	**2030/31**	**2031/32**	**2032/33**
North	219	220	220	220	220	220	220	220	220	220
North East	262	264	263	263	263	263	263	263	263	263
Total	482	484	482	483	483	483	483	483	483	483

Table 2.2.5 Forecast 1 in 20 Peak day Firm Demands by LDZ from the 2023 Demand Statements (GWh)

Note: *Figures may not sum exactly due to rounding*

The chart below illustrates the historic peak day demands from RIIO GD1, and the RIIO GD2 forecasts. Prior to GD1 the highest demand in recent years was seen in the winter of 2010/11.

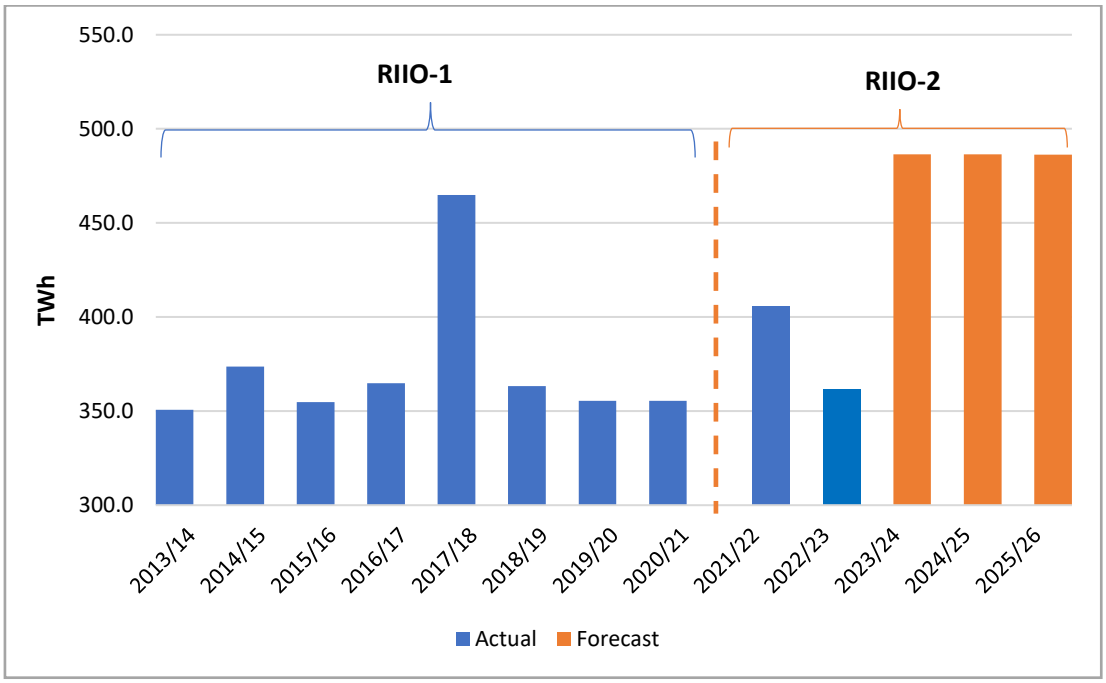

Figure 2.2.6 Historic Peak day Demand Actuals and RIIO GD2 forecasts (GWh)

National Grid ESO carry out Future Energy Scenarios (FES) for both transmission and distribution networks, which are supplied to distribution networks in May each year. The FES outline four different pathways for the future of energy over the next 30 years. A five-year central forecast is also supplied. Each scenario considers how much energy we might need and where it could come from.

Comparisons are undertaken with the data received in previous years to understand how National Grid ESO drivers are changing. There is a great deal of variance across the scenarios and the drivers are dependent on factors such as policy surrounding the decarbonisation of heat, the state of the economy, societies willingness to change and advancements in technology. National Grid ESO may apply diversity so that the national generation figure reflects national requirements whereas the distribution network will book sufficient capacity for our large loads to operate on a 1:20 in line with their bookings without making assumptions about which

loads National Grid ESO would call into operation. More information can be found https://www.nationalgrideso.com/future-energy/future-energy-scenarios/

Impact assessment will be undertaken and form part of the NGN 2023 forecasts and FES 2023.

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Chapter 3

Supply and storage

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Chapter 3 - Supply & Storage

3.1 Supply

Gas is predominantly brought into our network through offtakes connected to the National Transmission System (NTS). Offtakes are above ground installations (AGIs) that connect the NTS to NGN's Local Transmission System (LTS). NGN's offtakes can operate to an inlet pressure of up to 85bar. From the offtake, gas then passes through the Local Transmission System, into the Distribution System and then onward to consumers.

We develop the network to meet our customers' requirements. National Gas will also develop the NTS in line with supply and demand forecasts, provided by us and used in conjunction with their own demand forecasts of network demand. The National Gas Ten Year Statement can be found on their website[3]

The amount of gas NGN requires to satisfy its 1 in 20 peak day demand commitment is secured from National Gas on an annual basis via an offtake capacity booking process. This process involves our network modelling team using the 1 in 20 forecasts at the Local Distribution Zone (LDZ) level to derive a booking quantity at each of our offtakes to satisfy demand at the local level. NGN then request a daily energy quantity and a volume of storage for each of the offtakes. We also indicate the peak hourly flow and associated minimum inlet pressure required. Following discussion between the two parties, National Gas will allocate the capacity and our Control Room will operate the system accordingly.

Over the course of RIIO GD1 we reduced our capacity bookings to 1 in 20 peak day forecast levels. Historically, capacity was held at levels that were in excess of current demand levels, mainly due to demand levels being higher in the past. In order to reduce our customer bills and free-up capacity on the National Transmission System for other users, we have made significant changes to reduce our bookings at each of our offtakes. The offtake capacity incentive in place in RIIO GD1 has been replaced with a new licence obligation for the gas transporter licence holders to comply with an enhanced obligations framework in relation to the exit capacity booking process. We now comply with the Exit Capacity Planning Guidance which is available here: Exit Capacity Planning Guidance. The Exit Capacity regime as we know it was under review and we are supporting and encouraging positive regime changes which will allow us to run an even more efficient network for our customers. More information on the final workgroup report can be found on the Joint Office website[4].

3.2 Distributed Network Entry

We have 19 biomethane connections to our network, 2 of which are new sites which we commissioned in 2022. These developments have the potential to contribute to the transition to a low carbon economy. We are actively involved the Entry Customer Forum and the Entry Technical Workgroup to address the technical, regulatory, legislative and commercial challenges and opportunities that these developments present over this time. Through our commitment to support increased injection to our network, NGN will play a direct role in the UK achieving its legally binding commitments to reduce greenhouse gas emissions to net zero of the level in 1990 by 2050 as set out under the terms of the Climate Change (Net Zero UK Carbon Account) Act.

The demand for biomethane connections during our busiest connection periods in regulatory years 2015/16 and 2019/20 was heavily influenced by the Government's environmental programme, known as the Non-Domestic

[3]https://www.nationalgas.com/insight-and-innovation/gas-ten-year-statement-gtys
[4] https://www.gasgovernance.co.uk/0705

Renewable Heat Incentive (RHI). This has now been replaced by the Green Gas Support Scheme (GGSS), which launched in autumn 2021. The scheme will be open to applications until march 2028.

NGN are still receiving healthy numbers of initial biomethane enquiries. During the 2023 calendar year NGN received the highest number of initial enquiries to date. We are also still receiving a good number of requests for detailed analysis relating to available injection capacity in areas of our network, with a handful of enquires reaching the connection reservation stage. We hope to see some of these projects move forward to build and commission in the coming years.

3.3 Storage in the Network

3.3.1 Linepack

The compressibility of natural gas allows the use of linepack to compensate for fluctuations of gas demand. Linepack refers to the volume of gas that can be 'stored' in the gas pipeline during periods of low demand when the pressure in the system is lower. When demand increases this stored gas can be released to ensure supply to consumers. Linepack is of strategic importance to NGN in the absence of physical storage vessels such as gas holders.

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Chapter 4

Investment in the Distribution Networks

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Chapter 4 - Investment in the Distribution Networks

The Local Transmission System is designed to transport gas across our network and store it for the purposes of satisfying the 1 in 20 peak day forecast demands. The system is developed, based on demand and supply forecasts, to ensure that this capability is maintained. This routinely involves significant investment projects to improve efficiency, system design and replace ageing equipment.

The following are major projects currently in the 2023 plan:

Northern LDZ

- Bishop Auckland - Offtake condition upgrade / WBH Heater Control Upgrade– 2023/24
- Blaydon – Pressure Reduction Installation preheating upgrade - 2023
- Coldstream – Metering Upgrade – 2024/25
- Corbridge – Pressure Reduction Installation preheating upgrade - 2023/24
- Cowpen Bewley – Offtake condition upgrade & Metering Upgrade – 2023/24
- Elton – Offtake Condition Upgrade – 2023/24
- Guyzance – Metering & Boiler upgrade – 2023/24
- Keld – Boiler upgrade – 2023
- Tow Law – Metering upgrade WBH Heater control cabinet upgrades – 2023/24

North East LDZ

- Meadow Lane - Physical Security Upgrade - 2023/24
- Pickering - Offtake condition upgrade - 2023/24
- Mulcture Hall – PRI condition upgrade – 2024/25
- Chapel Haddlesey – PRI condition upgrade – 2024/25
- Burley Bank – Metering upgrade – 2023/24
- Ganstead – Boiler Replacement / Heat Exchanger – 2023/24
- Hartshead Moor – Boiler upgrade – 2023
- Keighley – Boiler upgrade – 2023/24
- Transpennine electrification Phase 2 – Diversion (Heaton Junction) – 2023/25
- Transpennine electrification Phase 3 – Diversion (Ridge Road) – 2023/26
- Transpennine electrification Phase 4 – Diversion (Austhorpe) – 2022/25

4.1 Below 7barg Distribution System

The NGN below 7barg system is designed to operate between levels of pressure defined by statute, regulation and safe working practices.

We also continue to invest in the replacement of our transportation network assets, primarily for the renewal of mains and services within Distribution systems. This includes expenditure associated with decommissioning of mains and services to a programme agreed with the Health and Safety Executive. This covers the decommissioning of all smaller-diameter iron gas pipes (Tier 1: 8 inches and below) within 30 metres of occupied buildings before April 2032, and the progressive decommissioning of larger iron pipes based on their risk and condition.

Mains Workload (km)	21/22	22/23	23/24	24/25	25/26	TOTAL	ALLOWED
Tier 1	437.4	430.4	457.3	457.3	404.5	2,186.8	2,144.3
Tier 2a	3.2	1.6	1.8	1.8	1.8	10.1	10.1
Tier 2b	19.1	17.7	21.7	21.7	21.7	102.0	102.0
Tier 3	5.3	5.4	5.8	5.8	5.8	28.1	22.7
Iron Mains (ex. >30m)	464.9	455.0	486.6	486.6	433.8	2,327.0	2,279.2
Steel <2"	45.4	33.0	46.8	46.8	46.8	218.9	218.9
Other	35.8	31.0	41.9	41.9	41.9	192.4	189.8
Diversions	11.1	9.4	11.6	11.6	11.6	55.5	56.6
Total	557.3	528.4	579.1	579.1	526.3	2,793.7	2,744.4

This year we have delivered a total of 528.4km of mains abandonment.

The **Tier 1 Mains** target is 2,144.3km over RIIO-2, or 428.9km per annum. Over RIIO-2 we plan on delivering 2,186.8km, or 437.4km per annum. This is an increase of 8.5km each year, 42.5km over the 5 years. This will allow us to recover the Covid-19 related shortfall of workload seen in the final year of RIIO-1 by the end of the Repex programme in 2032. This increased workload will be funded under the Tier 1 Mains volume driver.

Tier 2a Mains are also subject to a volume driver as the workload is very difficult to predict. We expect to deliver 10.1km over RIIO-2.

We are slightly behind the planned run rate for **Tier 2b Mains**, and **Tier 3 Mains**, as well as **>2" Steel**. We fully expect to deliver the allowed workload for all these activities by the end of RIIO-2.

We expect to deliver broadly in line with the allowed <2" Steel mains workload over the price control. Volumes are likely to vary year on year as the majority of this mains type is replaced when we find it whilst replacing Tier 1 iron mains. As Tier 1 mains volumes increase as described above, there is a possibility for this workload to increase as well. Other Mains and Diversions work is difficult to predict, as the former includes poor performing PE and Asbestos, which we replace when it's found, and the latter is third party driven. We expect to deliver the allowed workload over RIIO-2.

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Chapter 5
Innovation

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Chapter 5 - Innovation

5.1 Gas in Our Future Energy Systems

In March 2022, the gas networks, in collaboration with the Energy Networks Association (ENA) published their latest strategy for network innovation projects and priorities. This latest strategy expanded on the previous success' associated with the original inaugural strategy first set out in 2018, to reflect the latest net zero policy and technology developments.

Network innovation projects are essential to provide critical evidence and understanding to support the energy systems transition and ensure that impact on customers in vulnerable situations is clearly understood help deliver increased efficiency and value for money, and develop the new technologies and approaches needed for decarbonisation. The gas networks colaborate to share learning and ensure that projects are delivering industry and government goals. You can find out more information about individual projects at the Smarter Networks Portal, https://smarter.energynetworks.org/.

In addition to the strategy documents, we have worked in partnership with the ENA and electricity DNO's to produce the Energy Networks Innovation Process (ENIP[5]). As part of the Ofgem requirement for RIIO-2 price control, this industry-led reporting and collaboration process was put in place. This process is followed by all Energy Networks, formally in place and operational for RIIO-2 on 1 April 2021. ENIP is scheduled to be reviewed at least every two years, with the latest version published in March 2023. This document contains the full details of the end-to-end industry led process for reporting, collaboration, and dissemination of Ofgem funded NIA projects in GB. This process has been presented to Ofgem and external stakeholders, and feedback from these groups have been incorporated.

The latest versions of the Energy Networks Innovation Strategy and Energy Networks Innovation Process can be found in the following link: https://smarter.energynetworks.org/enip/

The RIIO-T2 and RIIO-GD2 price controls, which apply from April 2021, include a new mechanism called the **Strategic Innovation Fund (SIF)** detailed in section 5.4.

[5] https://smarter.energynetworks.org/enip/

5.2 Gas Network Innovation Competition (NIC)

The Gas Network Innovation Competition (NIC) was an annual opportunity for gas transmission and distribution network companies to compete for funding for the development of new technologies, operating and commercial arrangements.

The Gas NIC allowed for up to £20 million of funding per year for innovative projects which help all network operators understand how to provide environmental benefits, reduce costs, and maintain security of supply as Great Britain (GB) moves to a low carbon economy.

Funding was awarded to the following companies:

- Cadent
- National Grid Gas (Transmission)
- Northern Gas Networks
- SGN

The Gas NIC was closed to new proposals with the ending of the RIIO-T1 and RIIO-GD1 price controls in March 2021. The RIIO-T2 and RIIO-GD2 price controls, which apply from April 2021, include a new mechanism called the **Strategic Innovation Fund (SIF)** detailed in section 5.4.

You can see all publications relating to the Gas NIC and its qualifying projects in the link below.

Gas Network Innovation Competition (RIIO-1)

H21 (2017-2021)

The final presentation and launch of the work undertaken in H21 Phase 1 was launched at the “Gas Goes Green” virtual mini summit hosted by the Energy Networks Association on the 20 May 2021. The results were also delivered virtually to Gas Industry experts, our regulators at Ofgem and the HSE in February 2021. The launch also provided other industry leaders the opportunity to present on the work they are doing to ensure hydrogen can deliver a safe and reliable energy supply to Britain's homes in a net zero future. All of the reports from H21 Phase 1 are available through request, with the H21 Phase 1 Technical Summary Report available on the H21 website. The final close out report was submitted to Ofgem in October 2021 and the project has now been formally closed.

https://h21.green/projects/h21-nic-phase-1/

H21 Phase 2 (2019-2023)

H21 Phase 2 reviewed the existing natural gas distribution operational procedures and assessing their suitability with the network converted to 100% hydrogen. The was further broken down into 4 key areas that were reported against below.

Phase 2a - Appraisal of Network Operations

By the end of 2020 our project partners at HSE Science and Research Centre had conducted an in-depth appraisal of NGN’s 300+ distribution procedures that related to operations on the 0-7barg network. This research allowed a test plan to be developed focusing on the key areas requiring further evidence and determined the changes likely to be required when undertaking operations on a converted hydrogen gas distribution system.

Detailed engineering designs were undertaken early in 2020 and construction of a 0-7barg hydrogen test network known as the ‘microgrid’ started in October 2020 and was completed commissioned in June 2021 at DNV’s Spadeadam research centre in Cumbria despite all the difficulties winter and the covid pandemic presented. Operational testing at the microgrid started immediately following completion of the build and is

was complete in October 2022. The test programme has included demonstrations under live hydrogen conditions at all network pressures including those associated with finding and accessing leaks, live under pressure connections and isolations, purging pipelines and routine maintenance of pressure regulation equipment along with validation of current pressure and flow modelling software used by several gas distribution networks currently.

The completion and publication of all technical reports was completed in 2023 and will enable industry to take the journey towards hydrogen conversion trials, pilots and wider national roll out further forward. The findings and recommendations are critical to allowing the gas distribution networks to develop safe operating and emergency response technical procedures that in turn will roll out into future training ready for live public hydrogen trials and beyond.

Phase 2b – Unoccupied Network Trials

Construction of the unoccupied test site at Southbank in Middlesbrough commenced in July 2021 following a detailed design and development of a stringent safety management system undertaken in partnership with NGN and DNV. The site comprises public streets of a former now demolished area of housing where the existing iron low pressure network were left in place. This presented an opportunity to convert the network to 100% hydrogen in a typical public setting as would be the case when networks start to be converted to customers homes and businesses. The build phase was successfully completed in Nov 2021 and testing kicked off in Jan 2022 following a period of pre-testing and commissioning of the new infrastructure over the Christmas period. The testing programme focused on procedures relative to older metallic networks while similar in nature to the Phase 2a testing, those tests were focused in the main on procedures adopted on a PE network. The test programme continued until August 22 and the team have now completed the final technical reports which were published in Autumn 2023.

This site was the 1st time an actual live network had been repurposed from natural gas to 100% hydrogen in the UK and furthermore hydrogen that was odourised locally on site. The trial network not only served the purposes for testing but also supplied hydrogen to heat and provide hot water to the welfare facilities and offices on site. Furthermore, it allowed 3rd party suppliers of network tooling and equipment to utilise their equipment such as flow stop for the 1st time on a live hydrogen network under the recommendations made in Phase 1a of the project.

Phase 2c – Combined Quantitative Risk Assessment (QRA)

The combined network and downstream Quantitative Risk Assessment work concluded in September 2022, and we the results have been socialised with the other GB distribution networks and key stakeholders throughout 2023. This critical piece of work determined that with safety mitigation controls adopted a hydrogen system can be operated at least as safe as today's exemplary natural gas system. The work allowed advancements to be made to the CONIFER risk assessment model adapted for hydrogen in H21 Phase 1 to be further improved in Phase 2 and also include for risks downstream of the emergency control valve to be assessed in a consistent manner to the distribution network. The work has shown that with relatively minor disruption and cost-effective controls the safety of hydrogen utilisation can be assured in line with the timescales for net zero. The H21 QRA is being further advanced in 2023 under a project led by Cadent and SGN to include for a more diverse range of building architype and end users including larger commercial and multi occupancy buildings.

Phase 2d – Social Sciences Research

This phase of the project was delivered in 2020/21. The study followed on from the Phase 1 Qualitative Research via a UK wide survey that explored customer perceptions of hydrogen. Participants were then presented with a hydrogen animation and interactive display content that was produced throughout Phase 2 following feedback received from surveys to see if the content is successful in enhancing people's understanding and perceptions of hydrogen. The final report of the research was released at the end of 2022. Further to this and in line with the phases 2a,b and c of the H21 Phase 2 project, all final technical reports were submitted to the HSE's Evidence Review Group for their assessment which is still in progress

Hydrogen Home

The Hydrogen Homes were formally opened by the UK Energy Minister in July 2021 and first opened to visitors in August 2021. During its first year the Homes welcomed 1757 guests, as well as hosting 254 visits, 24 media visits and 32 educational visits with visitors from around the UK and internationally with guests from Australia, Canada and Japan. Additionally, several dedicated events were held such as Manufacturer Days, where visitors have the chance to speak to representatives from the appliance manufacturers, IGEM events and general public open days.
The Homes have and continue to generate a lot of interest with appointments to visit the Homes being regularly booked up 3 months in advance of actual visits.

Hydrogen Village Trial (HVT)

After successful award of funding for stage 2 of the HVT, our business has undertaken a detailed design for the conversion of circa 2000 Natural Gas consumers to hydrogen from 2026 and submitted this to Ofgem and DESNZ in October 2023. The proposal is centred around Redcar and Cleveland and includes the nearby conurbation of Warrenby and Coatham and we are hopeful the submission will be successful to allow us to progress through to the build and delivery stages of the project between 2024 and 2028.

The Prime Minister's Ten Point Plan set out key milestones for a pioneering programme of net zero trials. Government is supporting industry to undertake the detailed design of converting 2000 consumers to hydrogen, known as the Hydrogen Village Trial (HVT). The trial will provide crucial evidence to inform decisions on the role of hydrogen in heat decarbonisation in 2026. DESNZ are now bringing forward the necessary legislative changes to facilitate the village trial (a grid conversion trial). Currently in Phase 2 (detailed design) of a planned 5 phases through to 2028, NGN are creating proposals for a community surrounding Redcar and Cleveland to be the favoured trial location.

This year the team have been further designing and developing trial project proposals following successful progression through the initial stages 1 and 2 and forming successful partnerships with local authorities, energy companies, organisations and communities which will be essential to enable the project to go ahead to stages 3-5. In our Detailed Designs, the project team included clear evidence of our ongoing engagement with customers and stakeholders in the Redcar area, and have demonstrate dhow we have responded to feedback and will continue to do so, along with our plans for delivering the project at as minimal disruption to our customers as possible.

Town Pilot

As part of the UK Government's 10 point plan the Networks have started engaging with DESNZ to map out the process for delivering one or more hydrogen Town Pilots.

The process will include several initial stages including preparing proposals for suitable town size locations of between 10,000- and 20,000-meter points, and outline design and detail design for the chosen locations by 2025.

East Coast Hydrogen

East Coast Hydrogen, phase 1 is a collaboration between Northern Gas Networks, Cadent and National Grid Gas Transmission. It is a 15-year programme that will be carried out in multiple discrete phases.

The East Coast Hydrogen Feasibility Report is the first step in the decarbonisation of industrial, commercial and domestic demand across the East Coast Hydrogen region and beyond. The project would see up to 39,000 businesses and over 4 million homes converted to hydrogen. The programme will benefit from the natural assets of the North of England, including existing and potential hydrogen storage facilities, and build on the hydrogen production in two of the UK's largest industrial clusters in the North East and North West, in turn ensuring significant private sector investment in the UK's industrial heartlands.

It will be the first major step in the conversion of our national gas networks to hydrogen and will act as a blueprint for subsequent conversions across the UK. The project also demonstrates the innovation, engineering capabilities and economic opportunity in the North, and creates tens of thousands of highly skilled Green jobs in the future hydrogen economy.

NGN plans to invest more of its UIOLI in 2022/23 to progress phase 2 of the East Coast Hydrogen project to generate evidence to support an application for additional funding to commence the project build through the Net Zero Pre-construction and Small Net Zero Projects Re-opener later in RIIO-2.

HyDeploy Phase 3 – Enabling Government Policy

The HyDeploy project is an Ofgem funded project, established 2017, to develop the evidence base for the safe introduction of up to 20% by volume blend of Hydrogen into the GB natural gas distribution network. Phase 1 of the project focused on usage in domestic and small commercial appliances and settings, concluding with the completion of the first demonstration in Keele University's private gas network. Phase 2 progressed to a demonstration on a public network at Winlaton in 2021 and will conclude with a final evidence submission to support the Government policy objectives on Hydrogen Blending as per the 10 Point Plan for a Green Industrial Revolution.

The UK Government has committed to sanctioning the use of hydrogen blending across the gas distribution network, if a positive economic and safety case can be made by the end of 2023. HyDeploy is working to complete the safety evidence needed to allow the UK Government to make this decision.

The Government has consulted to help inform their assessment of hydrogen blending's potential strategic and economic value and lead options for its implementation, if enabled. This will help to inform a strategic policy decision on whether to support blending of up to 20% hydrogen by volume into Great Britain's gas distribution networks.

The HyDeploy project will submit the required safety evidence for review by the Health & Safety Executive (HSE) to inform DESNZ's decision on weather to enable blending into existing GB gas distribution networks through regulatory amendments.

https://hydeploy.co.uk

Smart Hydrogen-Gas Network (SHyGaN) Concept

This project is aimed at decarbonising an energy intensive process of the network - gas preheating. SHyGaN will be installed on NGN's existing infrastructure at the Low Thornley NERV Centre and PRS. A consortium of H2GO Power, Baxi, NGN, HSSMI and The MTC make up the project.

The SHyGaN heat-in-a-box combines electrolysis, novel low-pressure hydrogen storage and Baxi's hydrogen boiler, the first-ever pure hydrogen boiler for commercial applications. The end-to-end system will be powered by solar PV and supported by an AI-enabled optimisation software platform developed by H2GO Power (HyAI), the world's first optimisation end-to-end Software as a service platform specifically designed for hydrogen systems.

The project will demonstrate that heat-in-a-box is highly beneficial for industrial facilities with preheating or other heating processes to reduce their emissions. The industrial applicability of heat-in-a-box is flexible as it can decarbonise heating processes from multiple industries such as the cement, glass, ceramics, chemical, food & drinks, paper & pulp and more. Furthermore, the demand for heat is three times higher than the demand for power and is responsible for 40% of all global emissions. Decarbonisation of heat systems have been proven difficult and costly to achieve so far, but with the introduction of the SHyGaN system we offer a real potential for a wider decarbonisation of heating applications.

https://www.h2gopower.com

5.3 Network Innovation Allowance (NIA)

Ofgem continued the provision of the Network Innovation Allowance (NIA) in the RIIO-2 price controls. NIA is received by each network licensee for the purpose of delivering a portfolio of innovation projects, focussing on facilitating energy system transition and/or benefitting consumers in vulnerable situations.

For a RIIO-2 NIA project to be eligible it must satisfy several areas of governance, demonstrating the fulfilment of the requirements set out below:

- Facilitate energy system transition and/or benefit consumers in vulnerable situations
- Potential to deliver a net benefit to consumers
- Involve research, development or demonstration
- Develop new learning
- Be innovative
- Not lead to unnecessary duplication

The following are recent projects from NGN's RIIO-2 NIA innovation portfolio:

IoT Pressure Sensor Pilot

Gas Distribution Networks (GDN's) are under increasing pressure to lay the foundations for the Energy Systems Transition to low/zero carbon, whilst maintaining customer services and to optimise efficiency. In support of this, NGN aimed to apply new digital technologies such as industrial IoT technology incorporating Machine Learning and AI systems that facilitate new insights into the overall management and decision-making processes, substantially reducing operational costs and continually improving performance of the network, for the shareholders and for the customer's ultimate benefit.

At present, NGN has real-time visibility of network performance via its primary SCADA system. The deployment of such technology remains mostly in the high-pressure systems to manage the intake of gas and management through the NGN networks through to the lower pressure tiers. In the lower pressure systems information from the network becomes less dense and moves from real time to near real time via traditional, data logger technology. This means, therefore, that detail surrounding the performance and behavioural characteristics of the high-pressure system is more acute than at below 7 bar, and more so as the pressures drop to 75mbar and below. This reduced level of information can mean a less effective and efficient response to prevailing conditions than would be desirable, with potential for increased costs, impact on customers and improvement opportunities missed.

The IoT Pressure Sensor Pilot focus' on the application of low cost, simple pressure sensing technologies which promise to offer detailed views of system performance which will underpin the required operations to manage low carbon gas networks effectively, enabling improved situational awareness, and increasing opportunities to enable system flexibility, which will be particularly important for the Energy System Transition.

Further updates on the IoT Pressure Sensor Pilot can be found at the following link: https://smarter.energynetworks.org/projects/nia_ngn_303/

Futures Close

In order to meet the challenge of achieving net-zero by 2050, there is a need for complementary material change across all energy networks and all households. The UK needs to decarbonise an average of 20,000 properties each week for the next 20 to 25 years to meet its goal. This includes work to improve the energy and water efficiency of households, which will look at the technologies and appliances, as well as the building fabric itself. Such a large-scale implementation requires influencing household behaviours. Even small changes at the household level when it comes to technology adoption and consumer behaviour can result in a significant impact on energy suppliers and network operators when aggregated.

This project constructed a new research infrastructure, Futures Close, formerly named the "Customer Energy Village", located at Northern Gas Networks' Low Thornley research station, in Gateshead. The project (majority funded by the UK Government's Getting Building fund) aims to reflect the challenges of heat decarbonisation faced by millions of consumers.

NGN will then utilise that infrastructure to undertake research, with partners National Energy Action [NEA] and Newcastle University, into new energy efficiency measures from across the supply chain, [digital, physical and commercial]. We will continue working with the NEA customer base explore the barriers to adoption of those measures, to support development of future policy and training materials, which would enable these to make a significant impact in reducing existing heat demand, thus enabling decarbonisation to take place ahead of any significant technology switch to either electrical heat or decarbonisation gas.

Further updates on Future's Close can be found at the following link: https://smarter.energynetworks.org/projects/nia_ngn_345/

Visualising the opportunity for pipeline hydrogen for mobility applications

Hydrogen is a vector in the UK's plan for meeting its decarbonisation targets and is widely expected to play a critical role in future decarbonised heating, industry, and transport sectors. As a gaseous fuel, it is anticipated that pipeline distribution will be the most cost-effective solution for bulk distribution of hydrogen in the developed market, with gas network operators faced with the challenge of delivering a hydrogen ready grid to support the net-zero transition.

Whilst hydrogen for heating and industry has been the subject of significant strategic planning by gas network operators, with projects such as HyNet and the Hydrogen Village Trials, little attention has been afforded to investigating the role of the gas grid in supplying hydrogen transport demands. Consequently, collaboration in hydrogen station siting between gas network operators, transport planners, and station installers has been very limited.

The heavy-duty transport sector is facing a serious decarbonisation challenge, the UK having failed to deliver any material reductions in heavy duty vehicle (HDV) emissions since 1990. Hydrogen is regarded as a strong contender to cost-effectively decarbonise heavy duty vehicles (HDVs) and meet UK climate targets and fossil fuel HDV sales bans in 2035 & 2040.

This project will model the hydrogen mobility and hydrogen gas grid networks with the key output being a dynamic visualisation tool which will support the co-development of the hydrogen gas grid and hydrogen heavy transport sectors. The model will compare the locations of existing and planned hydrogen gas network infrastructure and projected future hydrogen transport demand. The tool will allow users to visualise the likely hydrogen transport demands and hydrogen gas grid locations to identify high potential future sites for gas grid connected hydrogen refuelling stations.

Further updates on the Visualising the opportunity for pipeline hydrogen for mobility applications project can be found at the following link: https://smarter.energynetworks.org/projects/nia_ngn_420-1/

More information on NGN's RIIO2 NIA innovation portfolio can be found in the latest version of our Annual Innovation Summary Report: https://www.northerngasnetworks.co.uk/wp-content/uploads/2023/08/Annual-Innovation-Summary-2022-23.pdf

5.4 Strategic Innovation Fund (SIF)

The Strategic Innovation Fund (SIF) is a funding mechanism which aims to find and fund ambitious, innovative projects with the potential to accelerate the transition to net zero. These projects should help shape the future of energy networks and succeed commercially where possible. OFGEM have allocated £450 million to this fund over the period 2021 to 2026, with the option to extend and increase as necessary. The SIF is delivered in partnership with Innovate UK, part of UK Research and Innovation (UKRI). The Strategic Innovation Fund (SIF) is a major opportunity for innovative businesses and academics to work with energy networks on innovative projects that will deliver benefits to consumers.

The Innovation Challenges for Round 1 of the SIF, which opened August 2021, were: whole system integration, data and digitalisation, heat, and zero emission transport. These broad areas remain the focus of the SIF. For Round 2, a refined set of Innovation Challenges was developed. These were: supporting a just energy transition,

preparing for a net zero power system, improving energy system resilience and robustness, and accelerating decarbonisation of major energy demands. For Round 3, in 2023, SIF will further focus on specified areas that are key to achieving key sectoral targets over the next decade, such as delivering a net zero power system by 2035.

Round 3 SIF Innovation Challenges are as follows:

1. Whole system network planning and utilisation to facilitate faster and cheaper network transformation and asset rollout
2. Novel technical, process and market approaches to deliver an equitable and secure net zero power system
3. Unlocking energy system flexibility to accelerate electrification of heat.
4. Enabling power-to-gas (P2G) to provide system flexibility and energy network optimisation.

SIF is structured to deliver positive outcomes over three Project Phases (Discovery Phase, Alpha Phase and Beta Phase), with successful application and assessment against Eligibility Criteria as a condition of receiving SIF Funding for the relevant Project Phase.

The following are recent projects from NGN's RIIO-2 SIF innovation portfolio:

Thermal Imagery Analysis (Round 1 Discovery & Alpha)

The aim of this project was to develop approaches to support a safe, environmentally conscious, and cost-effective transition in as many existing assets as possible, expanding on previous robotic leak detection technology development carried out at the start of RIIO2 within the NIA funded project LeakVISION. This SIF project aimed to inform where legacy assets potentially need to be replaced and/or maintained, providing an operational tool for both natural gas and Hydrogen leakage management supported by a digitised inspection process.

To support gas networks reductions in emissions, whether hydrogen conversion is or isn't progressed, NGN collaborated with partners to develop the capability to detect leakage from within live gas filled pipelines using a prototype sensing system. This resulted in a technology that can inspect pipelines for leakage under a number of scenarios, which are crucial to help achieve Net Zero targets. These scenarios could include: pre conversion leakage pinpointing, natural gas leakage detection and repair, and hydrogen leakage identification.

The solution uses robotics with thermographic sensing technology to analyse the internal characteristics of live pipelines transporting natural gas, and simulate changes, typically in the form of deterioration or leakage that may occur through changing factors such as gas type or pressure.

The Alpha Project Phase tested different solutions for digitisation, gathering user requirements across GDNs. With support from key technology partners, the project then introduced, demonstrated, and gathered feedback on Proof of Concepts for the "Push Rod" LeakVISION system (which aimed to enable analyse of Tier 1 (<8") systems to further de-risk hydrogen operation.

UKRI and OFGEM took the decision not to fund a future Beta Phase of the Thermal Imagery Analysis programme in 2023. Following this decision, NGN has continued discussions with key partners to evaluate the most practical and efficient routes to continue development and deployment of robotic leakage detection technology to further support a sustainable route to decarbonising gas network operations.

Further information on the Thermal Imagery Analysis project can be found at the following link: https://smarter.energynetworks.org/projects/10037368/

HyCoRe (Hydrogen Cost Reduction) (Round 2 Discovery & Alpha)

Renewable hydrogen and energy storage options are widely regarded as critical to achieving the UK's 2050 net-zero target. For project developers planning offshore-wind/hydrogen production facilities, an abundance of design choices and configurations exist, each of which has advantages and disadvantages, and questions remain about how to integrate electrolysers/energy storage devices into the existing energy system.

These include:

1. Where best to locate these systems;
2. What enabling technologies are required to deploy them efficiently;
3. How to validate/demonstrate novel enabling technologies;
4. How to efficiently incorporate the resultant hydrogen into the existing gas network while minimising the costs of a secure, resilient, multi-vector energy system.

The Discovery Project Phase aimed to answer these questions through delivery of the following three primary work streams:

1. Defining the optimal methods of exporting energy from an offshore-wind farm in the context of value for money for customers
2. Defining the energy carrying characteristics of electricity vs hydrogen to establish the cost drivers and identify opportunities for cost reduction.
3. Understanding the impact on the gas/electricity networks of the imminent increase in renewable generation into the network and how strategic deployment of electrolysers, energy storage devices, and novel enabling technologies can reduce energy network investment requirements.

In October 2023, UKRI and OFGEM confirmed their intention to fund an Alpha Phase of the HyCoRe programme, with NGN as the lead GDN via the Strategic Innovation Fund. NGN and key partners will collaborate for 6 months until mid-2024 to identify UK regions with strong potential for green hydrogen, produced from offshore-wind and injected into the onshore gas network, to offer a more economic and deliverable solution than offshore wind farms producing electricity directly.

To achieve this, HyCoRE will focus on three key research areas:

- National Modelling: identifying high-potential areas based on offshore/onshore constraints and opportunities.
- Modelling of a selected regional specific solution: understanding infrastructure solutions that will provide connectivity between offshore wind production areas and energy consumers/gas network.
- Technical challenge assessment: identifying technical challenges that may impede deployment and design/optimisation of test/validation solutions to de-risk technology pathways.

Further information on the HyCoRe project can be found at the following link: https://smarter.energynetworks.org/projects/ngn_9021_sif_r2_discovery-ukri_10058442/

You can read more about the fund on the UKRI website and Ofgem's Strategic Innovation Fund (SIF) website.

Appendix 1

Process methodology

Appendix 1 - Process Methodology

A1.1.2 Daily Demand / Weather Modelling

Temperature explains most of the variation in daily LDZ demand, but a better fit can be obtained by including other variables. Within each model the Composite Weather Variable (CWV) which is the gas industry's data item that provides a measure of daily weather in each Local Distribution Zone (LDZ). It is calculated in UK Link using various data items, including weather variables such as temperature, wind speed and a set of parameters designed to provide a strong linear relationship to LDZ gas demand.

In order to compare gas demand between different years, we need to take out the variability of weather and see the underlying pattern. We do this by correcting records of actual weather to seasonal normal weather basis which is the same for all years. This allows comparison of demand under the same weather conditions to see underlying trends. The Seasonal Normal value of the Composite Weather Variable (SNCWV) is therefore a key parameter used in various calculations. CWV and SNCWV are key building blocks in the production of demand models, profiles, peak load factors and the Non-Daily Metered allocation formulae.

For stability across the many industry processes impacted, the Demand Estimation Sub Committee[6] (DESC) review the CWV and SNCWV, as a minimum, every 5 years. New CWV and SNCWV figures came into effect on the 1st October 2020. The calculation now includes a 'solar effect' variable which provides substantial improvement in demand estimation, particularly for the colder months.

A1.1.3 Peak day Demand Modelling

Once the annual demand forecasts and daily demand/weather models have been developed, a simulation methodology is employed using historical weather data for each LDZ dating back to 1st October 1960. This determines the peak day and severe winter demand estimates. The model estimates what demand would be if historical weather from 1960 were to repeat today and generates a statistical distribution of the results which can be used to determine 1 in 20-year peak day demand. That is the level of demand you would statistically expect to occur once in every 20 years.

A1.1.4 High Pressure Tier Planning

Although the development of the GDN's Local Transmission System (LTS) is largely demand led, LTS capacity planning processes are not dissimilar to those utilised for the development of the National Transmission System (NTS). GDNs use forecast demand to model system flow patterns and produce capacity plans that take account of anticipated changes in system load and within-day demand profiles.

The options available to relieve LTS capacity constraints include:

- Uprating pipeline operating pressures
- Uprating offtakes from the NTS, regulators and control systems
- Constructing new pipelines or storage
- Constructing new supplies (offtakes from the NTS), regulators and control systems

[8] http://www.gasgovernance.co.uk/desc

As well as planning to ensure that LTS pipelines are designed to the correct size to meet peak flows, there is a requirement to plan to meet the variation in demand over a 24-hour period. Diurnal storage is used to satisfy these variations and for NGN this is in the form of linepack.

A1.1.5 Below 7 barg planning

The lower pressure tier system (distribution system) is designed to meet expected gas flows in any peak six-minute period assuming reasonable diversity of demand. Lower tier reinforcement planning is based on LDZ peak demand forecasts adjusted to take account of the characteristics of specific networks.

Network analysis is carried out using a suite of planning tools with the results being validated against a comprehensive set of actual pressure recordings. The planned networks are then used to assess future system performance to predict reinforcement requirements and the effects of additional loads. Reinforcement options are then identified, costed and programmed for completion before the constraint causes difficulties within the network. Reinforcement is usually carried out by installing a new main or by taking a new offtake point from a higher-pressure tier. In general, the reinforcement project is of such a size that the work can be completed and operational before the following winter.

A1.1.6 Investment Procedures and Project Management

All investment projects must comply with The Investment Planning Policy, which set out the broad principles that should be followed when evaluating high value investment or divestment projects.

The Investment Planning Policy defines the methodology to be followed for undertaking individual investments in a consistent and easy to understand manner. This policy is used to ensure maximum value is obtained. For non-mandatory projects, the key investment focus in most cases is to undertake only those projects that carry an economic benefit.

For projects that are associated with Network Assets a key factor is the successful delivery of the Network Asset Risk Measure (NARM) risk reduction. This is a metric agreed with Ofgem at the beginning of the regulatory period and will help show that investment has delivered the required outputs.

For mandatory projects such as safety-related work, the focus is on minimising the net cost whilst not undermining the project objectives or the safety and reliability of the network. The successful management of major investment projects is central to our business objectives.

Our project management strategy involves:

- Allocating the appropriate project management expertise to manage the project
- Determining the level of financial commitment and appropriate method of funding for the project
- Monitoring and controlling the progress of the project to ensure that financial and technical performance targets are achieved post project and post investment review to ensure compliance and capture lessons learned

NGN have four frameworks in place to help deliver our Capital Investment Programme which were all competitively tendered through the OJEU process. These framework agreements ensure we build lasting relationships with our partners to deliver quality at the most efficient cost for our customers. Our design framework is due to expire at the end of this year and we are in the process of re-tendering. Our three delivery

frameworks were re-tendered during 2021 and went live in May 2022, the Major Framework consists of six framework partners and work is awarded via mini competition, the two Minor Frameworks consist of four framework partners each, two assigned in the North and two in the South, and work is shared between them and prices negotiated. The frameworks have been designed to suit the work type, complexity, and volume to deliver the most economical value. All four frameworks are based on the NEC forms of contract which are renowned and approved worldwide as a project management contract, focussing particularly on cost and programme.

All projects are completed in line with the Capital Projects Integrated Management System (IMS) which covers the project lifecycle. The IMS is critical to ensuring NGN delivers projects consistently and in line with all relevant legislative requirements fulfilling NGN's obligations as the employer.

Our project management of major investment projects is designed to ensure that they are delivered on time, to the appropriate quality standards at minimum cost. The project management process makes use of professional consultants and specialist contractors, all of whom are appointed subject to competitive tender.

Performance of the Contractors is monitored using Key Performance Indicators (KPI's) to ensure that the standards of Health & Safety, Environmental Performance, Quality, Commercial Performance and Programme management are all of the required level. Within the new framework, these figures will be used to incentivise high levels of performance, whilst still providing a tool to ensure consistent levels of performance.

Where Third Party funded schemes are raised, these are sanctioned, awarded, and managed in exactly the same way with a focus on value, programme and quality, however the Project Manager role may be sourced from the Professional Services Framework (as opposed to an NGN employee) on an ad-hoc basis to ensure that the Capex workload is delivered without compromise.

Appendix 2

Gas Demand Forecasts

A2

Appendix 2 - Gas Demand Forecasts

A2.1 Annual Demand

Annual demand forecasts are developed without knowledge of future weather conditions. Consequently, we calculate a Seasonal Normal Temperature (SNT) based on past averages. To compare throughput between years, actual demand data is adjusted to account for the variance of actual weather and SNT. This is known as weather corrected demand.

The network code states that the calculated methodology used to derive seasonal normal values must be reviewed periodically. The 'seasonal normal composite weather variables' (SNCWV) have been reviewed and the new figures went live on the 1st October 2020. These figures now include solar effect. Seasonal normal values reflect the general upturn, in warm weather, that has been experienced over the past decade.

Derivation of the seasonal normal values is designed to reflect the most accurate statistical relationship between demand and weather. It does not attempt to estimate any potential impact of global warming and as such the peak 1 in 20 weather assumptions have not altered. Prior to the 2005 revision, seasonal normal values were carried out using 35 years of weather data, this was revised and implemented in 2005 using 17 years of data.

Over the next ten years annual gas demand is forecast to increase by 1.04% in the Northern LDZ and an increase of 1.10% in the North East LDZ. As discussed in section 2.2, the forecast rate of change has an overall flat profile, and with an uncertain economic outlook and high forecast increases in UK gas prices; amongst other factors which are outlined overleaf. The following tables show the LDZ specific forecasts:

Northern LDZ

Load Band	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032
0-73 MWh	17.8	17.8	17.7	17.7	17.6	17.6	17.6	17.5	17.5	17.5
73-732 MWh	2.3	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4
732-5860 MWh	1.9	1.9	1.9	1.9	1.9	1.9	1.9	1.9	1.9	1.9
> 5860 MWh	9.5	9.6	9.7	9.7	9.8	9.8	9.9	10.0	10.0	10.1
LDZ Shrinkage	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
LDZ Demand	31.6	31.8	31.7	31.8	31.8	31.8	31.8	31.9	31.9	32.0

Table A2.1A Forecast Annual Demand by Load Category & Calendar Year for North LDZ from 2023 Demand Statements
Note: Figures may not sum exactly due to rounding.

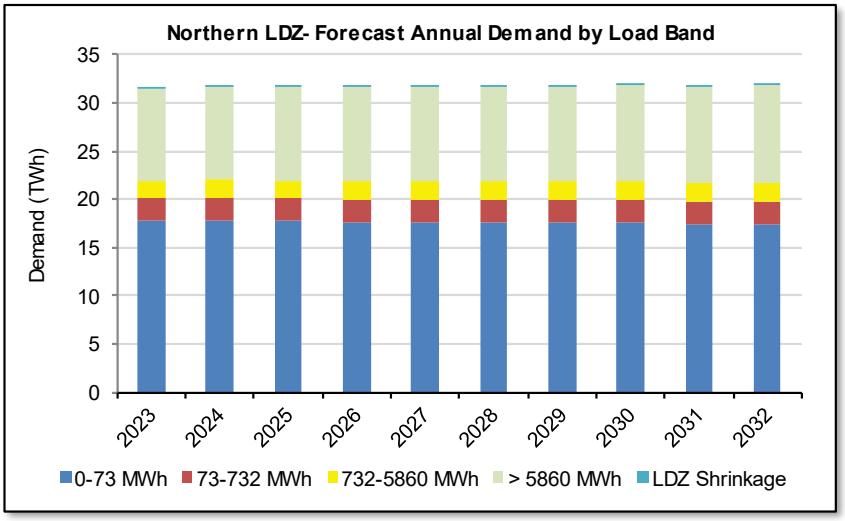


Figure A2.1A Northern LDZ - Forecast Annual Demand by Load Band

North East LDZ

Load Band	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032
0-73 MWh	20.7	20.8	20.8	20.7	20.7	20.8	20.7	20.7	20.7	20.7
73-732 MWh	2.8	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9
732-5860 MWh	2.2	2.2	2.2	2.2	2.2	2.2	2.2	2.2	2.2	2.2
> 5860 MWh	10.7	10.7	10.7	10.8	10.8	10.8	10.8	10.9	10.9	10.9
LDZ Shrinkage	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
LDZ Demand	36.6	36.7	36.7	36.7	36.7	36.8	36.8	36.9	36.8	37.0

Table A2.1B Forecast Annual Demand by Load Category & Calendar Year for North East LDZ from 2023 Demand Statements (TWh)

Note: Figures may not sum exactly due to rounding.

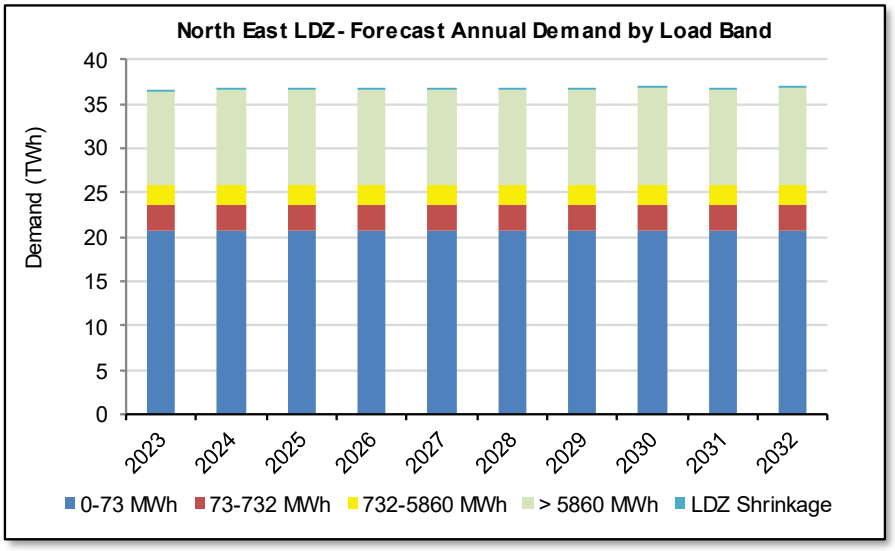


Figure A2.1B North East LDZ - Forecast Annual Demand by Load Band

A2.2 Key Assumptions in developing the 2023 NGN Demand Forecasts

This section provides an overview of the key econometric assumptions used to inform our 2023 demand forecasts. The commentary underpins the forecasts made back in the first quarter of this year, in which the continued impact of the cost of living crisis and high energy prices on the economy are still being felt. The base date for our 2023 forecast models captures the recent spike in gas prices, the long term effects are still unknown as gas prices have remained high, and although the prices have started to stabilise, there is uncertainty how the market and prices will react in the coming cold months

Gross Domestic Product (GDP) and Gross Value Added (GVA)

GVA measures the contribution to the economy of each individual producer, industry or sector in the United Kingdom. GVA is used in the estimation of GDP, which is a key indicator of the state of the whole economy. Therefore, it is an important driver for gas demand. A significant decline in GDP occurred during 2008/9 set against a long period of growth from 1992. However, there has been steady and sustained recovery in GDP since that time. The economic figures produced by the Office of National Statistics (ONS) show the impact to the economy during 2022 (see graph below). The preliminary figures from the ONS show that annual GDP growth for 2022 is around 4%. This is a decrease from the outturn figure for 2021 of -7.6%.

The level of growth is expected to recede slightly with a rate of -0.2% in 2023, and the level of growth to recover by 1.8% in 2024 and 2.5% in 2025. The forecasts for 2026 and 2027 are 2.1% and 1.9% respectively. The Office for Budget Responsibility (OBR) published the range of forecasts of potential GDP paths in March 2023 which is shown in figure A2.2.1A.

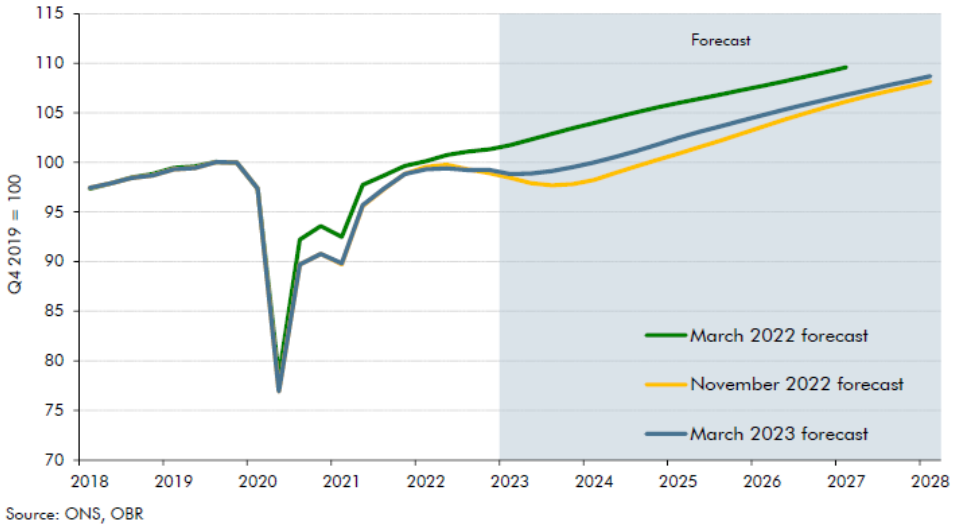


Figure A2.2.1A – UK Real GDP Growth Chart

GVA growth in both LDZs has generally been below the growth for the whole of the UK with the impact of the recession and the pandemic being present at the same time in both LDZs as the UK but of slightly less impact in both instances.

Gas & Energy Prices

Analysis shows that gas prices and demand are inversely related; an increase in price leads to a demand reduction. All prices in all markets have shown significant rises – with a combination of well publicised factors, which created unstable wholesale gas prices reaching a year end peak of around 500 p/Therm. Gas prices have steadily stabilised through 2023, due to an increase in LNG supplies, and support from renewable generation.

Any assertions made by commentators regarding the delinking of gas prices from oil, may currently appear to have been a reasonable assumption given the surge in wholesale gas prices at levels way beyond those seen in the oil market. According to the International Energy Agency (IEA)

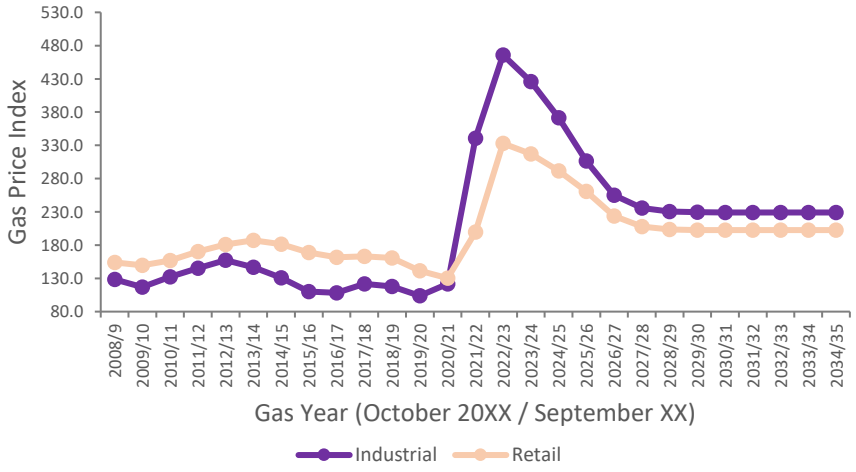


Figure A2. 2.1B– Retail & Industrial gas price index (1987 = 100; base figure)

Wholesale Price

Our 2023 forecasting process will capture data related to the recent price spikes and seek to understand any associated effects on gas supply and demand. At the time of producing our 2023forecasts There has been some significant fluctuation in the wholesale gas price (as represented by the UK NBP price at 2019 prices) over time but the general trend has until recently been upwards. Following the steep decline in oil prices between 2014 and 2015 the wholesale price fell in 2016, but then increased again in 2017 and 2018. The price then fell sharply and only partially recovered during 2019 followed by another dip and rise during 2020, then a steep rise through 2021, and 2022. The price is currently higher than previous years, but has stabilised through the second and third quarters of 2023. The forecast provided is based on an assessment of the forecasts of wholesale price used by National Gas and DESNZ for their energy demand forecasts, but adjusted to account for the current high levels, but assuming that the price will level by 2024/5.

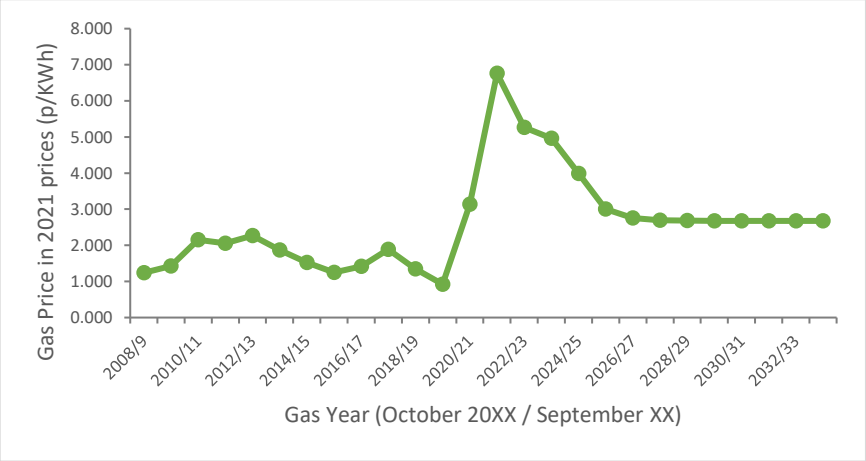


Figure A2.2.1C – Wholesale gas price in 2021 prices (p/KWH)

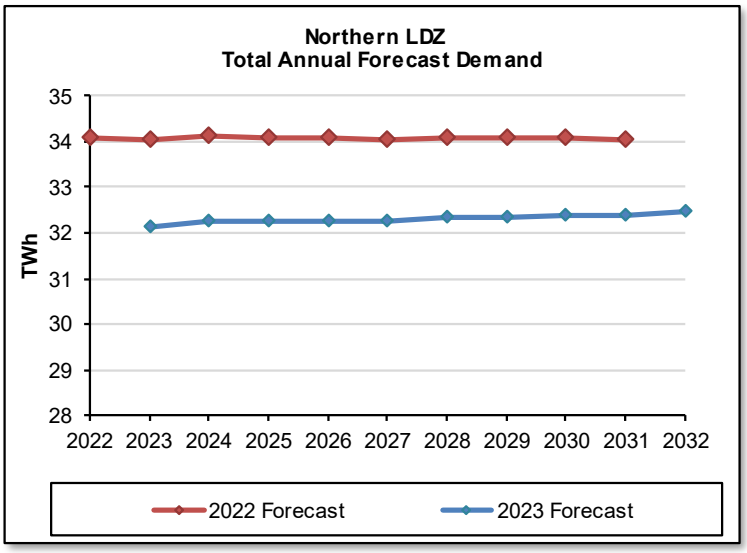
Efficiency

Gas demand, when corrected to seasonal normal weather conditions, has been declining in recent years, although there are some instances of growth in some sectors in some parts of the country, possibly driven by historical falling gas prices and the improving economy. There is also evidence that average consumption per customer is falling steadily. It is difficult to separate the impact of efficiency improvements from the impact of variations in gas prices and the effects of variations in the number of supply points. This is further complicated by the impact of the penetration of renewables into households that were using gas as their primary source of heating and now have renewable alternatives when they are available and then use gas heating as a top-up. Therefore there remains the possibility that gas demand at peak could be the same as previously seen at those properties before the installation of renewable heat sources.

There has been a steady and substantial programme of gas fired domestic boiler replacement for a very long period now and the high levels of efficiency achieved with these new boilers is a significant contributory factor in the decline in gas demand. However the increases in efficiency may in some circumstances have been used to provide higher comfort levels, especially in winter. There has also been a sustained effort by gas suppliers and other parties to encourage the use of loft and cavity wall insulation. This has been extensively used to reduce household consumption. The major suppliers are however in many instances refusing to offer top-up loft insulation as the benefits are not sufficient to cover the cost.

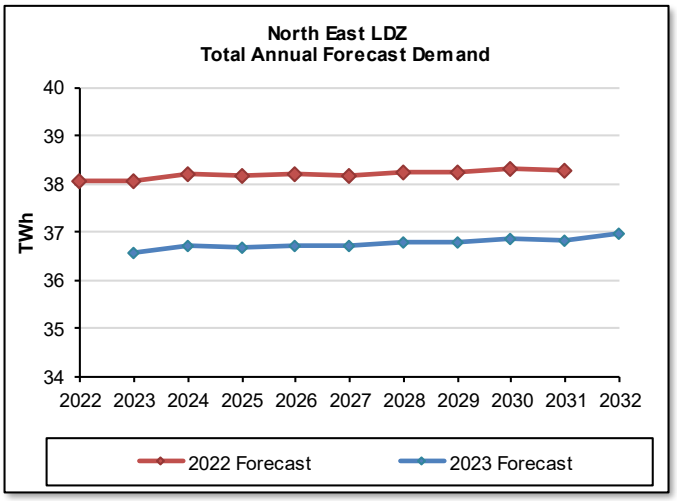
A2.3 Forecast Comparisons

The following charts provide a comparison of the current forecasts with those published in the 2022 Demand Statements (DS).



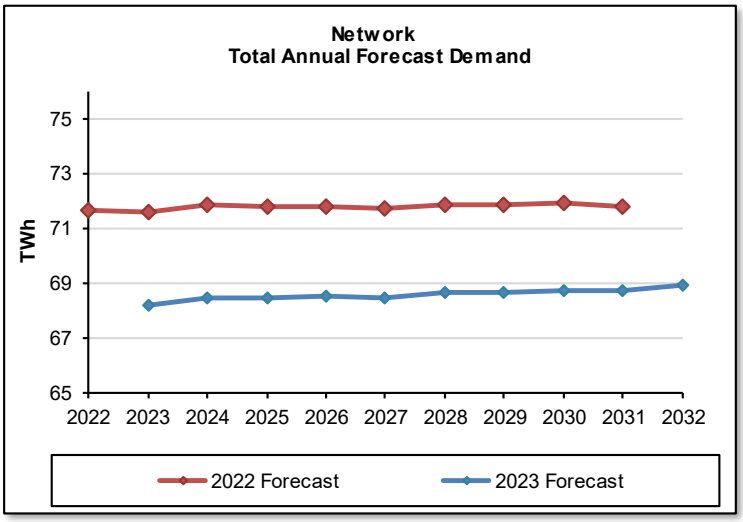
Forecast (TWh)			
Year	2022 DS	2023 DS	% Difference
2023	33.53	31.64	-5.65
2024	33.63	31.76	-5.56
2025	33.58	31.74	-5.47
2026	33.57	31.76	-5.39
2027	33.53	31.75	-5.30
2028	33.59	31.83	-5.21
2029	33.56	31.84	-5.12
2030	33.57	31.88	-5.03
2031	33.52	31.87	-4.93
2032		31.96	

Figure 2.3A – Northern LDZ Total Annual Forecast Demand



Forecast (TWh)			
Year	2022 DS	2023 DS	% Difference
2023	38.07	36.56	-3.95
2024	38.22	36.72	-3.93
2025	38.18	36.69	-3.90
2026	38.20	36.72	-3.88
2027	38.18	36.71	-3.85
2028	38.26	36.79	-3.84
2029	38.27	36.81	-3.82
2030	38.32	36.86	-3.80
2031	38.28	36.83	-3.77
2032		36.97	

Figure 2.3B – North East LDZ Total Annual Forecast Demand



Forecast (TWh)			
Year	2022 DS	2023 DS	% Difference
2023	71.60	68.20	-4.74
2024	71.85	68.48	-4.70
2025	71.76	68.43	-4.64
2026	71.78	68.49	-4.59
2027	71.71	68.47	-4.53
2028	71.85	68.63	-4.48
2029	71.83	68.65	-4.43
2030	71.89	68.74	-4.38
2031	71.80	68.70	-4.31
2032		68.93	

Figure 2.3C – Network Total Annual Forecast Demand

Appendix 3

Actual Flows 2022

A3

Appendix 3 – Actual Flows 2022

A3.1 Annual Flows

Annual forecasts are based on average weather conditions. Therefore, when comparing actual throughput with forecasts, throughput has been adjusted to take account of the difference between the actual weather and the seasonal normal weather. The result of this calculation is the weather corrected throughput.

The basis for any calculation of forecast demand is the accuracy of the previous forecast.

Table A3.1.A and chart A3.1.B provide a comparison of actual and weather corrected throughputs during the 2022 calendar year, with the forecast demands presented in the 2022 Demand Statements. Annual demands are presented in the format of LDZ and NTS load bands/categories, consistent with the basis of system design and operation.

The 2022/23 winter severity, based on the 62 winters starting from October 1960, was deemed to be average cold for the 6 month period from October to March and average cold for the 3 month period from December to February. This was the 23rd warmest October to March in the last 62 years.

Northern LDZ 2022	Actual Demand	Weather Corrected Demand	Forecast Demand	Corrected v Forecast (%)
0 to 73.2 MWh	16.09	17.60	18.67	-5.7
73.2 to 732 MWh	2.26	2.43	2.44	-0.6
>732 MWh	11.00	11.21	12.32	-9.0
Shrinkage	0.14	0.14	0.14	1.4
Total LDZ	29.48	31.38	33.57	-6.5

Table A3.1A Northern LDZ Throughput 2022 **Note:** Figures may not sum exactly due to rounding.

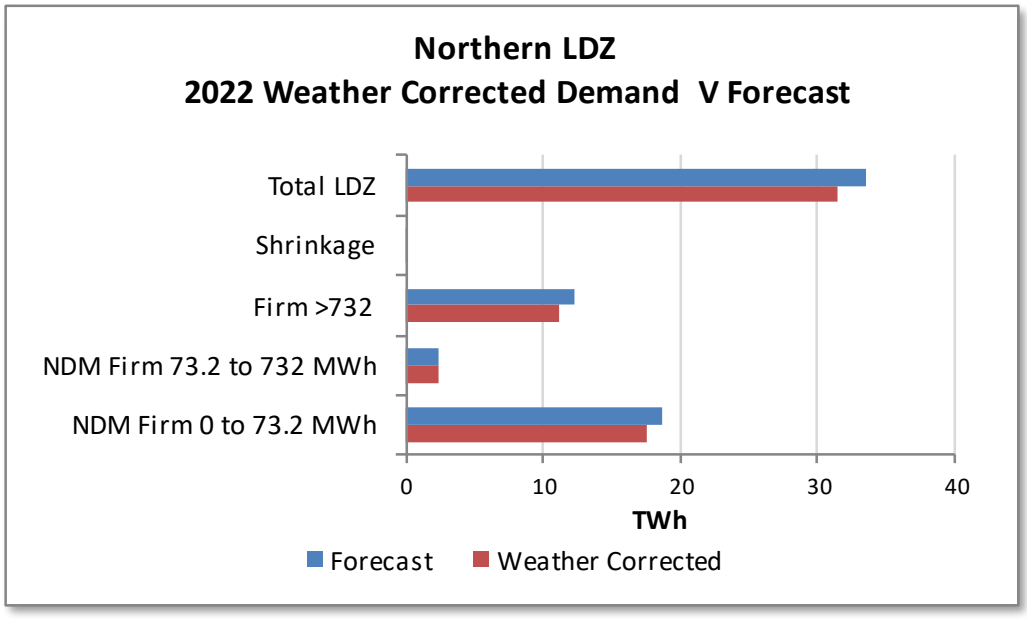


Chart A3.1B 2022 Northern LDZ Weather Corrected Demand V Forecast

In the Northern LDZ, the forecasts for each of the loadbands, were higher than the actual throughput. Overall the total LDZ weather corrected throughput was 6.5% lower than forecast.

North East LDZ 2022	Actual Demand	Weather Corrected Demand	Forecast Demand	Corrected v Forecast (%)
0 to 73.2 MWh	19.23	20.49	22.19	-7.6
73.2 to 732 MWh	2.76	2.91	2.94	-1.0
>732 MWh	12.42	12.59	13.21	-4.7
Shrinkage	0.16	0.16	0.15	1.9
Total LDZ	34.57	36.15	38.09	-5.1

Table A3.1C North East LDZ Throughput 2022 **Note:** Figures may not sum exactly due to rounding.

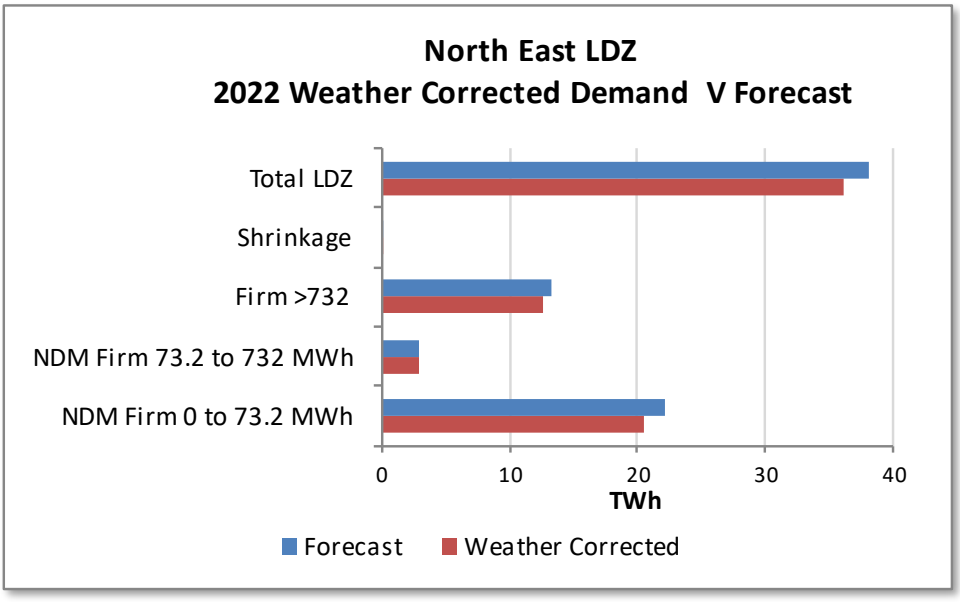


Chart A3.1D 2022 North East LDZ Weather Corrected Demand V Forecast

Similarly, the North East LDZ forecasts were overstated for all load bands. At LDZ level, the weather corrected throughput was 5.1% lower than forecast.

A3.2 Peak Flows

The maximum demand day for Northern LDZ during winter 2022/23 was 15th December 2022, when the network demand was 14. 49 mcm, equating to **73.9%** of the expected 1 in 20 peak day for winter 2022/23. This was 1.8% lower than the highest demand day in 2021/22 of 14.75 mcm.

The maximum demand day for North East LDZ during winter 2022/23 was 15th December 2022, when the network demand was 16.72 mcm, equating to **70.9%** of the expected 1 in 20 peak day for winter 2022/23. This was 4.8% lower than the highest demand day in 2021/22 of 17.56 mcm.

Our 2023 forecasts suggest that over the next ten years, the 1 in 20 Peak day forecast demand will increase by 0.09% in the Northern LDZ and 0.23% in the North East LDZ in line with annual forecasts, as shown by the charts below.

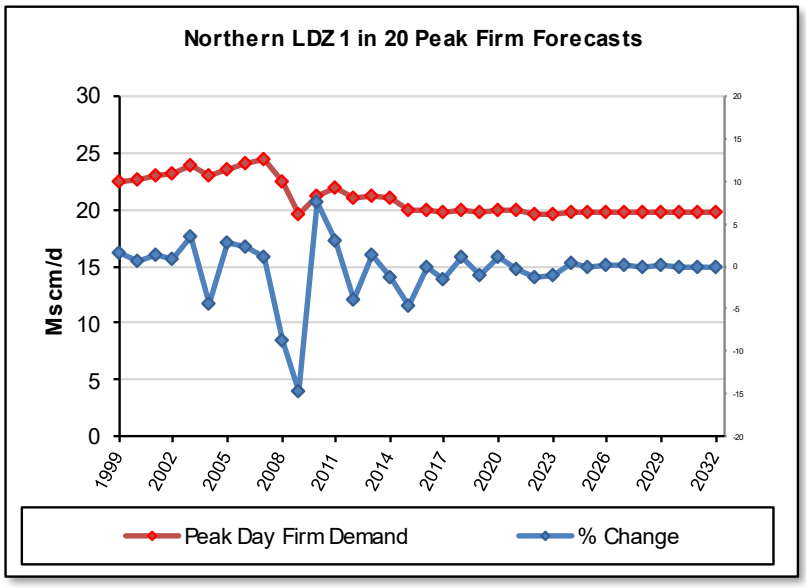


Figure 3.2a Historical Throughput & Forecast Peak day Firm Demand for Northern LDZ

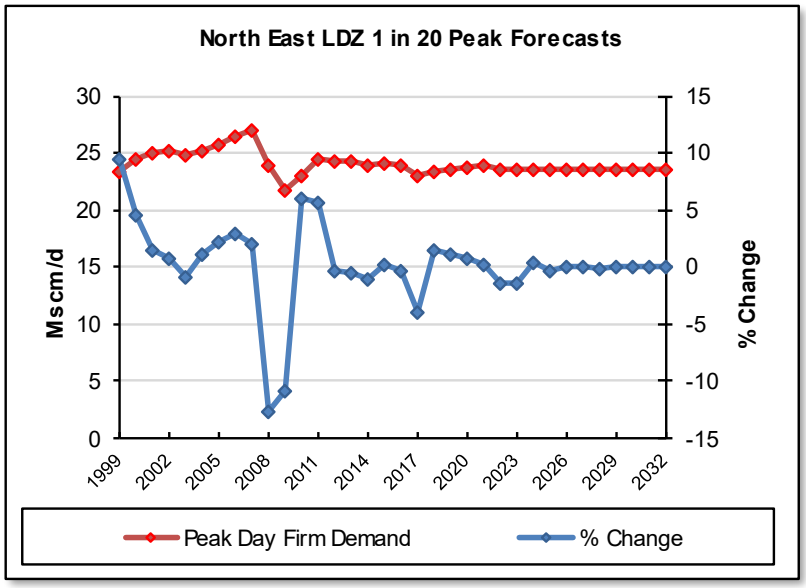


Figure 3.2b Historical Throughput & Forecast Peak day firm Demand for North East LDZ

Appendix 4

Connections to our system

Appendix 4 – Connections to our System

A4.1 Connection Services

Within the space of a few years, the gas industry in the UK has evolved from a situation where one company provided all new connections, to one where many alternative connection services are now available on a competitive basis.

Indeed, whilst Northern Gas Networks continues to offer connection services in line with our Gas Act obligations, customers and developers have the option to choose other parties to build their facilities, have the connection vested in or adopted by the host gas transporter (depending upon circumstances), pass assets to a chosen system operator, transporter, or retain ownership of them.

The following are the generic classes of connection;

Entry Connections: connections to delivery facilities processing gas from gas producing fields or, potentially in the future, LNG vaporisation (i.e. importation) facilities, for the purpose of delivering gas into the NGN system. Biomethane is a fully renewable source of energy and NGN is fully committed to maximising the entry of biomethane into our gas network.

Exit Connections: connections that allow gas to be off taken from our system to premises (a 'Supply Point') or to Connected System Exit Points (CSEPs). There are several types of connected system including:

- A pipeline system operated by another gas transporter
- Any other non-NGN pipeline transporting gas to premises consuming more than 2,196MWh per annum
- Storage Connections: connections to storage facilities for the purpose of temporarily off taking gas from our system and delivering it back at a later date

Please note that storage may both deliver gas to the system and offtake gas from the system, therefore specific arrangements pertaining to both Entry and Exit Connections will apply. In addition to new pipes being termed connections, any requirement to increase the quantity of gas delivered or off taken is also treated as a new connection.

A4.2 Connections to the Local Transmission System

There has been 3 HP Connection enquiries and 0 HP connections for the gas year Oct 22 – Sep 23. There have been no new physical HP connections.

A4.3 Electricity Flexible Generation

For the fourth year running NGN have seen reduced numbers of quotation enquiries for large load connections- 9 year to date (Oct 22 – Sept 23). We expect that flexible generation enquiries will start to reduce in numbers over the coming years and throughout the remainder of GD2 due to the areas of the UK that require flexible generation already being covered and the increasing focus on carbon emissions.

We currently have 16 live issued quotes with customers and expect a number of these to be accepted and progress to a connection.

There are 13 flexible power generation sites currently connected, with another 8 accepted sites anticipated to progress across RIIO-GD2.

We expect the numbers of hydrogen and CNG Fuelling stations to significantly increase across RIIO-GD2. We currently have 2 connected CNG sites, no accepted CNG Fuelling station projects and a number of innovative hydrogen projects.

It should be noted that any 3rd party wishing to connect to our network, or requiring increased flow must contact NGN as early as possible via the correct process to ensure that their requirements can be met.

A4.4 Additional Information Specific to System Entry and Storage Connections

We require a Network Entry Agreement or Storage Connection Agreement as appropriate, with the respective operator of all delivery and storage facilities to establish, among other things, the gas quality specification, the physical location of the delivery point and the standards to be used for both gas quality and the measurement of flow.

A4.4.1 Network Entry Quality Specification

For any new entry connection to our system, the connecting party should notify us as soon as possible as to their likely gas composition. We will then determine whether the gas can be accepted, taking into account our existing statutory and contractual obligations.

The ability of NGN to accept gas supplies into the system is affected by, among other things, the composition of the new gas, the location of the system entry point, volumes entered, pressure ranges and the quality and volumes of gas already being transported within the system.

In assessing the acceptability of any proposed new gas supply, we will take account of the following.

a) Our ability to continue to meet statutory obligations (including, but not limited to, the Gas Safety Management Regulations 1996 (GS(M)R)).
b) The implications of the proposed gas composition on system running costs.
c) Our ability to continue to meet our contractual obligations.

For indicative purposes, the schedule set out below is usually acceptable for most locations and encompasses, but is not limited to, the statutory requirements set out in the GS(M)R. https://www.legislation.gov.uk/uksi/1996/551/schedule/3/made

A4.5 Additional Information Specific to System Exit Connections

Any person can contact NGN to request a connection, whether a shipper, operator, developer or consumer. However, gas can only be taken off the system where the Supply Point created has been confirmed by a shipper, in accordance with the Uniform Network Code.

More information regarding NGN connections can be found here https://www.northerngasnetworks.co.uk/gas-connections/

A4.6 National Transmission System (NTS) Connections

For information regarding NTS Connections visit https://www.nationalgas.com/connections/national-transmission-system-connections

A4.7 Distribution Network Connections

Gas will normally be made available for offtake to consumers at a pressure that is compatible with a regulated metering pressure of 21mbarg.

A4.8 Self Lay Pipes or Systems

In accordance with Section 10(6) of the Gas Act, and subject to the principles set out in the published Licence Condition 4B Statement and the terms and conditions of the contract between us and the customer in respect of the proposed connection, where a party wishes to lay their own service pipe to premises expected to consume 2,196MWh per annum or less, ownership of the pipe will vest in us once the connection to our system has been made.

Where the connection is for a pipe laid to premises expected to consume more than 2,196MWh per annum or the connection is to a pipe in our system which is not a relevant main, self-laid pipe do not automatically vest in us. However, subject to the principles set out in the published Licence Condition 4B Statement and the relevant contractual terms and conditions, we may take ownership of pipes to such premises.

Parties considering laying a pipe that will either vest in us or is intended to come into our ownership should refer to our Connections Methodology Statement and contact our connections team on 0800 040 7766 and (option 2) or email gasconnections@northerngas.co.uk

A4.9 Reasonable Demands for Capacity

Operating under the Gas Act 1986 (as amended 1995), we have an obligation to develop and maintain an efficient and economical pipeline system and, subject to that, to comply with any reasonable request to connect premises, provided that it is economic to do so.

In many instances, specific system reinforcement may be required to maintain system pressures for the winter period after connecting a new supply or demand. Details of how we charge for reinforcement and the basis on which contributions may be required can be found in the published Licence Condition 4B Statement. Please note that dependent on scale, reinforcement projects may have significant planning, resource and construction lead-times and that as much notice as possible should be given. We will typically require three to four years' notice of any project requiring the construction of high-pressure pipelines or plant, although in certain circumstances, project lead-times may exceed this period.

Glossary

Of terms

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Glossary of Terms

Calorific Value (CV)
The ratio of energy to volume measured in mega Joules per cubic meter (MJ/m3), which for a gas is measured and expressed under standard conditions of temperature and pressure.

Composite Weather Variable (CWV)
A single measure of weather for each LDZ, incorporating the effects of both temperature and wind speed. A separate composite weather variable is defined for each LDZ.

Distribution Network (DN)
An administrative unit responsible for the operation and maintenance of the local transmission system (LTS) and <7barg distribution networks within a defined geographical boundary.

Diurnal Storage
Gas stored for the purpose of meeting, among other things, within day variations in demand. Gas can be stored in special installations, such as gasholders, or in the form of linepack within transmission, i.e. >7barg, pipeline systems.

Formula Year
A twelve-month period commencing 1st April, predominantly used for regulatory and financial purposes.

Gas Supply Year
A twelve-month period commencing 1st October, also referred to as a Gas Year.

Gas Transporter (GT)
Formerly Public Gas Transporter (PGT), GTs, such as Northern Gas Networks, are licensed by the Gas and Electricity Markets Authority to transport gas to consumers.

Kilowatt hour (kWh)
A unit of energy used by the gas industry. Approximately equal to 0.0341 therms. One megawatt hour (mWh) equals 103 kWh, one gigawatt hour (GWh) equals 106 kWh, and one terawatt hour (TWh) equals 109 kWh.

Linepack
The volume of compressed gas within the National or Local Transmission System at any time.

Load Duration Curve (1 in 50 Severe)
The 1 in 50, or severe, load duration curve is that curve which, in a long series of years, with connected load held at the levels appropriate to the year in question, would be such that the volume of demand above any given

demand threshold (represented by the area under the curve and above the threshold) would be exceeded in one out of fifty years.

Load Duration Curve (Average)

The average load duration curve is that curve which, in a long series of winters, with connected load held at the levels appropriate to the year in question, the average volume of demand above any given threshold, is represented by the area under the curve and above the threshold.

Local Distribution Zone (LDZ)

A geographic area supplied by one or more offtakes. Consists of LTS and distribution system pipelines.

Local Transmission System (LTS)

A pipeline system operating at >7barg that transports gas from one or more offtakes to distribution systems. Some large users may take their gas direct from the LTS.

National Transmission System (NTS)

A high-pressure system consisting of terminals, compressor stations and pipeline systems. Designed to operate at pressures up to 85 bar. NTS pipelines transport gas from terminals to LTS offtakes.

Non-Daily Metered (NDM)

Gas distribution networks review their total consumption in an LDZ vs the total consumption of the daily metered (DM) sites within a particular LDZ. The remaining consumption is then allocated as non-daily metered (NDM) consumption, which is then divided between the shippers, who supply gas to that LDZ, by applying an agreed formula.

It should also be noted, that following the implementation of project nexus in 2017, all meter points regardless of the supply class or registered demand volumes are reconciled when a valid meter read is submitted by the consumer.

Odorisation

The process by which the distinctive odour is added to gas supplies to make it easier to detect leaks. We provide odorisation at our offtakes.

Offtake Capacity Statement (OCS)

The Offtake Capacity Statements are received by NGN in September of each year from National Grid specifying assured pressures and the amount of capacity available at each offtake.

Own Use Gas (OUG)

Gas used by us to operate the transportation system. Includes gas used for compressor fuel, heating and venting.

Peak day Demand (1 in 20 Peak Demand)

The 1 in 20 peak day demand is the level of demand that, in a long series of winters, with connected load held at the levels appropriate to the winter in question, would be exceeded in one out of 20 winters, with each winter counted only once.

Seasonal Normal Composite Weather Variable (SNCWV)

The seasonal normal value of the CWV for an LDZ on a day is the smoothed average of the values of the applicable CWV for that day in a significant number of previous years.

Shrinkage

Shrinkage refers to the gas which is lost from the transportation network. Shrinkage is a combination of Leakage, Own Use Gas and Theft of Gas.

Therm

An imperial unit of energy. Largely replaced by the metric equivalent: the kilowatt hour (kWh). 1 therm equals 29.3071 kWh.

Unaccounted for Gas (UAG)

Gas lost during transportation. Includes leakage, theft and losses due to the method of calculating the Calorific Value.

Uniform Network Code (UNC)

The document that defines the contractual relationship between System Users. The Uniform Network Code has replaced the Network Code and, as well as existing arrangements, covers the arrangements between all gas transporters.

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we are the network