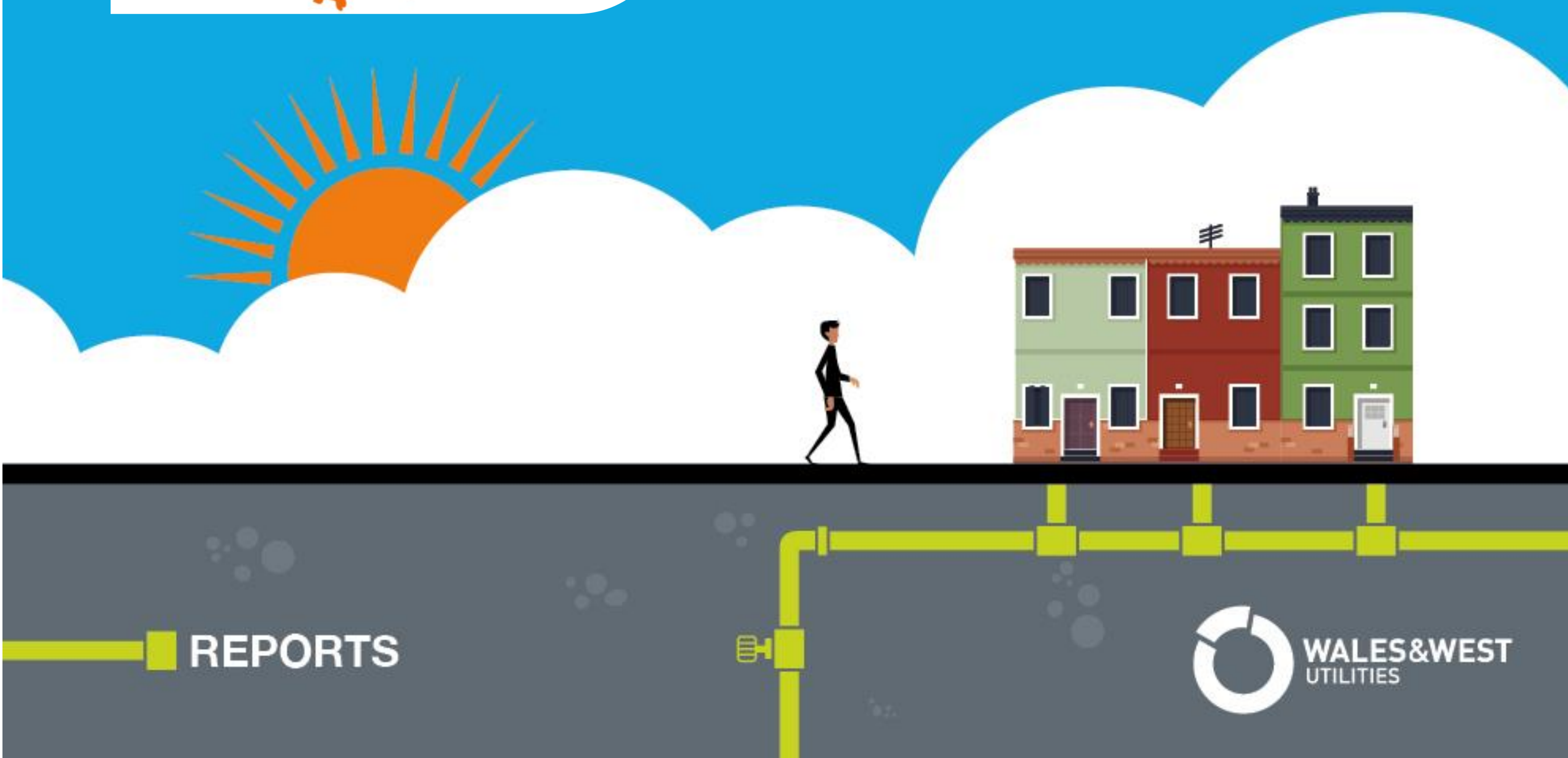
2022 Long Term Development Statement

Wales & West Utilities Ltd



Foreword

Sarah Williams
Director of Regulation, Asset Strategy & HS&E

Welcome to our Long Term Development Statement for 2022. This document provides an indication of the usage for our pipeline system and likely developments. It is intended to help companies that are contemplating connecting to our system or entering into transportation arrangements to identify and evaluate opportunities. The recent step change in our ramp up towards Net Zero readiness has presented its own challenges as well as opening exciting opportunities for the gas network.

The statement reflects our 2022 planning process and incorporates a reappraisal of our analysis of the market and of the demands on our network. As such it contains the latest information on volumes, the processes we use to plan the development of the system (including demand and supply forecasts), the impact of greater integration of electricity and gas networks, and system reinforcement projects with associated investment.

The previous twelve months have been challenging. The start of a new tough RIIO-GD2 price control and continued disruption from the global pandemic, and other geopolitical issues, including Brexit and the Russian invasion of Ukraine, have resulted in a backdrop of volatility in the commodity and supply markets around the world.

With this in mind it has never been more crucial to continue designing and developing of our long-term plans, as well as listening and responding to the needs of our customers. With the energy sector remaining in the spotlight, we are dedicated to delivering "Net Zero" by 2050, which means that our network will be able to transport green gases like hydrogen and biomethane and to play our part in decarbonising heat, power, and transport.

Our current focus builds on the changes we are already seeing in the energy sector, with gas and electricity, transmission and distribution fast becoming a series of complex and dynamic interactions. All work undertaken is based on a broadly defined whole systems approach to decarbonisation.

Turning now to look back at our performance this year, some highlights include:

- WWU continues to develop the Pathfinder 2050 model that enables low carbon alternatives to be evaluated at individual property level. This year we have launched an Energy System's Toolkit which incorporates a 'lite' version of Pathfinder along with a decarbonisation knowledge base document. This was developed through the Tools of Engagement project and is being made available to support stakeholders such as Local Authorities and community groups with their Local Area Planning work.
- The development of our Regional Decarbonisation Pathways project, delivered by Energy Systems Catapult and Costain, has developed Net Zero scenarios for our regions and assessed the implications for WWU's network. It provides a baseline for network and local area energy planning.

Our focus on putting customers and colleagues first has brought significant success again in 2022, this year our efforts have been recognised across the board with:

- We were the first gas network to be awarded ISO45001, the new International standard for Occupational Health and Safety Management Systems and were re-certified in October 2022. Certification against this onerous standard demonstrates our commitment to the health and safety of colleagues and customers alike.
- We have published our first Annual Environmental Report. The report demonstrates our commitment here at WWU to, doing everything we can to respond to the climate emergency and supporting customers to transition to green energy, and create a more positive impact on the environment.
- We received our ninth “Gold Award” from RoSPA in 2022, once again recognised for our industry-leading health and safety performance and commitment.
- We are working towards being one of the first companies to be accredited against the new ISO22458 Inclusive Service Standard.
- We continue to hold the ISO 14001 accreditation from the International Organisation for Standardization (“ISO”) following a recertification audit of the Environmental Management System which was undertaken in October 2022.
- We received accreditation for Achilles Health & Safety achieving 100% for the eighth successive year.

We are proud of all these achievements as we continually seek to further improve the service we provide to today’s customers and plan to deliver a net zero future for tomorrow’s consumers.

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Sarah Williams
Director of Regulation, Asset Strategy & HS&E

1. Executive Summary

1.1 Context

This document contains our annual and peak demand and supply forecasts. These forecasts have been developed in conjunction with National Grid – Electricity System Operator (NG-ESO) and through our own modelling and analysis.

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 (UNC) Transportation Principal Document.

In recent years we have improved our forecasting techniques include new approaches for forecasting flexible gas generation and compressed natural gas (CNG) connections using the latest market information. Our forecasts are now presented in a range of no-growth to growth scenarios owing to some uncertainty in housing and exit connection growth.

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1.2 Demand and supply outlook

As a result of our modelling our peak demand is now forecast to increase in the range of 7 to 9% in the next 10 years.

We have continued to work with our biomethane customers who have sites that they wish to connect to our network. We have 20 biomethane sites delivering green gas into our network and have a further 6 accepted enquiries. In total the 26 sites would provide heat to over 190,000 homes if fed into a traditional heating system, or around a million hybrids. Research suggests that significant feedstock is available to support further growth in this area, and the potential for our region is substantial.

We are already experiencing entry capacity issues in parts of our network and have had issues with a small number of sites being backed out at periods of low demand, usually overnight in the summer. We proactively reconfigure local pressure settings to allow the biomethane site to take priority over our adjacent natural gas sites. However, as the number of connections to our network continues to grow, we are looking at smarter, longer term solutions such as automated pressure control, compression and storage.

Our **OptiNet** project, a collaboration with Cadent, is looking to investigate how using compression and other new technologies in parallel might alleviate such constraints and increase entry capacity. Our smart pressure control solution has been trialled successfully through this project and we are now looking at extending this automated control more widely on the same network. This will allow the connection of 4 more bio sites.

Through our work with the Energy Networks Association (ENA) on the Gas Goes Green (GGG) initiative, we have collaborated with Northern Gas Networks (NGN) to explore the potential for bringing existing biomethane to grid. Following the completion of this review on the available techniques and methods to facilitate this injection like central hubs and reverse compression, we have identified a number of potential projects in the South Wales area to pursue.

1.3 Net Zero Readiness

The UK is committed to legally binding obligations to eradicate the UK's net contribution to climate change by 2050. We are fully committed to achieving these targets and believe that the gas network can contribute to this. We have a clear vision of the role our network will play to decarbonise heat, power, and transport in our regions, what needs to happen to facilitate this, and how much investment is required in RIIO-GD2. Our network will be able to support the required quantities of green gas, eliminating the need to use fossil fuels, as we develop a **Net Zero-ready gas network**. We will have the flexibility to support flexible generation and transport, which in turn, supports the decarbonisation of the electricity and transport sectors.

It is widely acknowledged that whole system solutions that optimise energy flows across gas and electricity transmission and distribution networks will play a major part in facilitating the delivery of a sustainable energy solution for the UK. Increased integration of gas and electricity networks will result in changes on one network having the potential to impact another.
These impacts have again been accounted for in the forecasting models and research that we have undertaken. A couple of examples are given below and these and other projects are discussed further in Appendix 4.

1.4 Investment implications

Our stakeholders have told us that maintaining a safe, reliable gas supply is a key priority. We adopt innovative techniques to ensure efficient investment in network health through use of monetised risk models and have fed this analysis into our business planning processes.

Going forward we anticipate new requirements for compression, storage, and smart control to accommodate increasing demands for flexible gas usage and injection from our customers.

We anticipate that hydrogen uptake will be accelerated in response to the Government's net zero announcement. The mains replacement programme means that our networks are largely hydrogen ready in our low pressure distribution networks. As a result, minimal additional investment would be required to make them properly hydrogen ready in order to support the transformation across to hydrogen. That said, the volumes of hydrogen required to maintain energy demand will be greater when compared to natural gas and this and the transition approach itself will drive some level of investment in the network.

Data from our Regional FES suggested that blended hydrogen will be injected by 2027 in Wales and by 2030 in the Southwest of England. We also anticipate significant use of pure hydrogen to support industry in South Wales from 2030 which would then offer opportunities for use in other cities along the M4 during RIIO-GD4

1.5 Innovation

Innovation is part of our DNA. It has helped us deliver benefits that go far beyond financial benefits to encompass safety, customer experience, value, and reliability.

From our engagement we know that investing in innovation and working collaboratively with the wider industry to support national strategic energy challenges is an important priority to our stakeholders.

Our innovation focus areas for the 2020s build on the ENA's Gas Network Innovation Strategy. They are centred on the steps needed to deliver a net zero ready network to support decarbonisation, providing more from our current network to the homes and businesses that rely on us in their daily lives. Our network facilitates secure and resilient energy for heat, power and transport and enabling cleaner, greener energy is central to our ambition.

We are pleased that Ofgem have allowed the Network Innovation Allowance (NIA) expenditure in their final determinations and are keen to continue to work with them to develop the rules of the NIA and Strategic Innovation Fund (SIF) including the use of the benefits measurement framework.

The continuation of the NIA funding mechanism will allow us to collaborate widely to create solutions to meet the challenging targets of Net Zero and address consumer vulnerability. Additionally, in supporting innovation, Ofgem has also developed the Net Zero & Heat Policy re-openers and the new SIF mechanism.

2. The UK Gas Network

James Earl
Director of Gas at ENA

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 second full year this year in April 2022.

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 (January 2021), which set out a national, detailed green print for the roll out of hydrogen in the UK.

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 information required for that.

Gas networks have also been focusing on providing BEIS 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.

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

2.1 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 September 2022, ENA jointly held its first Energy Innovation Summit in Glasgow with BEIS, Ofgem, UKRI and Innovate UK. Sector colleagues used the first major in person event following Covid to reconnect in person and 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 of Gas at ENA

3. Net Zero Readiness

3.1 Key messages

- We recognise the clear steer from our consumers, communities, local authorities, and public opinion in general, that society must act now to mitigate the threat of climate change.
- Government is developing clearer policy to drive the transition to a green economy.
- The Government's approach will help shape the future of our energy system, and key strategy documents recognise a role for low carbon hydrogen in replacing natural gas.
- Our underground gas network is safe, secure, and resilient – whatever the weather, and as part of an integrated energy network, it can continue to power homes, businesses, and industry long into the future.
- We are working collaboratively with the other gas networks through the Gas Goes Green project to define the role of the gas network in a Net Zero energy system and provide the evidence required for future policy decisions.

3.2 Policy and industry-wide developments

The overarching national policy framework has developed through recent years, with key strategic documents including:

- **10 Point Plan for a Green Industrial Revolution**, which includes ambitions around hydrogen production, blending, trials and town conversion in the 2020s.
- **Industrial Decarbonisation Strategy**, setting out the potential for Carbon Capture, Usage and Storage and Hydrogen for heavy industry, which is expected to be sited around clusters.
- **Hydrogen Strategy**, providing more detail on ambitions for hydrogen across the energy system. BEIS and Ofgem have asked the Gas Distribution Networks to develop outline feasibility studies for potential hydrogen 'village' trial locations. WWU is developing a hydrogen trial proposal and collaborating with other networks to share learning.
- **A Heat and Buildings Strategy**, which sets out the government's plan to significantly cut carbon emissions from the UK's 30 million homes and workplaces in a simple, low-cost and green way whilst ensuring this remains affordable and fair for households across the country.

In the past year, this has developed further through consultations and calls for evidence on key policy measures to deliver the following strategies:

- Hydrogen Business Models,
- Enabling or requiring hydrogen-ready industrial boiler equipment, and
- Proposals for hydrogen transport and storage business models.

Gas Goes Green (GGG), we're collaborating with other gas networks on GGG project designed to identify ways to meet the challenges in delivering a low-cost, low-carbon gas network across the UK. This includes collaborative research on the technical and economic feasibility of converting gas network assets to carry decarbonised hydrogen. This evidence will support the delivery of Hydrogen trials and conversion projects.

The gas networks are working collaboratively to deliver evidence on the transition to a **Hydrogen Grid**. We are leading and contributing to a range of collaborative projects as part of this effort, developing evidence on areas such as network safety, system transformation, and supporting vulnerable customers. We are also partners with Northern Gas Networks on the **Redcar Hydrogen Community**, which proposes to convert 2,000 customers in North Yorkshire from natural gas to Hydrogen.

3.3 Regional developments and WWU led activity

In addition to working with industry partners across the UK, WWU is leading or involved in a number of projects helping to understand the role our network can play in delivering a Net Zero energy system.

Regional Decarbonisation Pathways has built a strategic plan and roadmap for our entire network, to provide a vision for the role of hydrogen, biomethane and smart technologies across our region with clearer analysis on the implications for our Gas Distribution Network infrastructure.

This project analysed pathways to decarbonise our gas network at a regional and sub-regional level with regards to transport, storage, conversion, and usage of energy using three energy system pathway analysis scenarios:

1. high hydrogen,
2. high electrification and
3. midway balanced

Each scenario showed that hydrogen and the gas networks have a significant role to play towards 2050 decarbonisation, with unabated natural gas largely removed, and industrial and heating demand being met by hydrogen.

The output of this project provides information to national, regional, and local policymakers, becoming a strategic cornerstone in the net zero project roadmap. It will also provide evidence for the future focus of WWU activities to deliver Net Zero for our customers and communities. Follow on projects are already being planned and learnings will contribute to the development of core clusters such as SWIC and Southwest Hydrogen.

Pathfinder - to support energy planners understand the impact of different decarbonisation options, we developed Pathfinder, which analyses current energy data and future options, assessing the viability of any decarbonisation approach. It defines the implications of energy investment plans, showing their impact on energy reliability, and the resultant carbon emissions, in a way that is easy for people outside of our industry to understand. The full **Pathfinder Plus** tool is currently being used in support of a range of projects.

In the past year, we have also developed a **Pathfinder Lite** model which is more accessible to a wider range of stakeholders and users. This is part of our **Energy Systems Toolkit** which provides a suite of information to support Local Area Energy Planning.

We continue to contribute to the **South Wales Industrial Cluster (SWIC)** and Deployment projects, which seek to identify the best options for cost-effective decarbonisation of industry in South Wales. These projects continue to look at the infrastructure required for the development of the hydrogen economy for large scale CO2 capture, usage, and storage (CCUS) and transport, as well as onsite strategic opportunities specific to each industry. The first phase of projects was completed in September 2022, with a second phase due to start in November 2022. This work will focus on developing the first hydrogen distribution pipelines in Wales, and linkage with geological storage.

SWIC comprises a diverse set of industries including oil refining, paper, nickel, insulation, chemicals, LNG import, coin production, general manufacturing, steel, and cement. The wider benefits to decarbonise home heating and power generation are also included within the cluster activities.

The **Milford Haven Energy Kingdom** project aims to accelerate the transition to an integrated hydrogen and renewable energy system, making use of its deep water port for Hydrogen transportation. The project has built and demonstrated a hydrogen electrolyser, a hydrogen refuelling station and a hybrid hydrogen heating system. This project is developing evidence for the early hydrogen market architecture with smart energy systems to link up supply with demand and to utilise local renewable electricity via virtual private wire. The partners and main contractors included Pembrokeshire County Council, the Offshore Renewable Energy Catapult, Riversimple, Port of Milford Haven, ARUP, and the Energy Systems Catapult.

We are founder members of **Hydrogen Southwest** (HSW), a consortium launched in 2022 to explore the development of an ecosystem for hydrogen around Bristol and for the Southwest of England. Other organisations include Bristol Airport, Easyjet, Airbus, GKN, Wessex Water and Bristol Port. We are working with HSW members to explore the role of hydrogen in the Southwest within transportation markets such as aviation and shipping and for communities across the region.

HyCompact, building on WWU's pioneering innovation in hybrid heating systems, we are working with Scotia Gas Networks (SGN) to carry out laboratory testing on compact hybrid heating systems for our decarbonisation pathway. We are continuing to assess the role of smart technology and appliances to support decarbonisation more broadly.

Our network planning proposal for 2021-26 has taken account of these important projects, and we will be continuing to work with regional stakeholders to develop opportunities around decarbonised gasses as these pursuits evolve.

3.4 Gas as an essential component of future energy policy

As with the energy system as a whole, the gas distribution sector is going through significant change, and clear trends are emerging that have informed our investment proposals for RIIO-GD2 and beyond.

- Energy networks are becoming much more closely integrated and are interacting in more complex and dynamic ways. Our demand data, for example, clearly shows the increase in the use of flexible generation at times when renewable generation decreases because of weather conditions.

- New types of customers, with different requirements and behaviours, are having a significant impact on the use of our network. For example, we are having to increase the frequency with which we reconfigure our medium and intermediate pressure systems to enable green gas producers to continue to inject during periods of hot weather (when demand is low). We also anticipate having to implement smarter systems to manage changes in network flows to support gas and electric vehicle charging.

- Peak demand is increasing and is set to increase by 7 to 9% over the next ten years due to the new requirements detailed above. In some areas investment in our network will be required so that we can continue to provide a reliable and safe supply of gas. This will be necessary despite a reduction in annual gas demand because our customers will be using gas in different ways.

- Gas generators are making use of the cheap form of storage provided by our network, enabling them to offer flexibility and a quick response at a lower cost than many other forms of electricity storage. By making use of our network, flexible gas generators are able to compete in the services they provide for national grid electricity balancing. This benefits electricity customers.

- There is increased recognition that while many technological solutions have great potential to support decarbonisation, at present there is no single technology that will work at scale for consumers and to minimise whole system costs. There is now a growing consensus that, instead, we must consider all technologies, and on a regional basis.

The forecasts detailed in this document represent a range from low to high growth forecasts, and they consider current policy and customer trends.

3.5 Distribution network entry and storage

We recognise and support the increasing focus on Distribution Network (DN) entry and storage, including for gas from many sources such as anaerobic digesters and synthesis gas. We are also anticipating an increasing use of hydrogen in our network. Gas from non-fossil sources contributes to achieving the UK Government's climate change targets. In 2013 networks

introduced a change to their transportation charging methodology to better reflect the use of the system by Shippers injecting gas at DN entry points.
Connections for entry and storage to our network will be provided in accordance with our licence obligations.

Key issues for gas entry include gas quality, odorisation, flow weighted average calorific value (CV) and the capacity available on the system. We are working to resolve these issues through working groups and innovation projects across the industry most often in collaboration with the other GDNs and our customers.

Further details on current gas quality specifications can be found in Appendix A6.3.1 and further information on our connections process for DN entry is available at the following location: Distributed Gas Connections Guide.

We currently have 20 biomethane sites that have connected to our network since 2013. Recently we have seen renewed interest in this area and have accepted a further 6 connection enquiries. This activity has been primarily driven by the creation of the government's Green Gas Support Scheme (GGSS).

We occasionally have entry capacity issues in parts of our network and have had issues with green gas sites being backed out at periods of low demand, usually on summer evenings. We proactively reconfigure local pressure settings to allow the biomethane sites to take priority over our adjacent natural gas sites when this happens. However, as the number of connections to our network continues to grow, we will need to look at longer term, more sizeable solutions such as compression and storage. The OptiNet project is looking to increase entry capacity in a specific part of a gas network by using compression and other new technologies. Developing solutions to these issues will become increasingly important to support the UK in its ambition to become net zero.

3.6 Our net zero ready vision

Our business plan has laid out our ongoing plans to support the UK's decarbonisation targets and become a net zero ready network. This vision was based on our extensive research and stakeholder engagement to consider the future of energy. It was founded on a broadly defined whole systems approach, working together to keep bills low, and to maintain reliability and minimise householder disruption.

As policy, technology and regulation develop, we are reviewing our strategy and approach to ensure that it reflects the latest progress.

4. Demand

4.1 Key messages

- Peak demands are forecast to increase over the next ten years in our forecast scenarios by 7 to 9%.
- We have connected another 2 flexible generation sites since we last published our long term development statement.
- Due to continued uncertainty around the use of gas in new homes from 2025 and non domestic connections, we are now forecasting a range of growth forecasts depending upon the level of housing and industrial growth.
- Our Growth Scenario is based on sustained growth in flexible generation and Compressed Natural Gas (CNG) connections but at a lower level than experienced in recent years. We have included a reduced growth rate for domestics from 2025 when compared to last year's forecast scenarios.
- Our No Growth Scenario assumes growth in domestic, flexible generation and CNG to 2025 with no notable growth in the following years. Any new connections would be offset by efficiencies or reductions in other load bands.
- Additional investment in capacity, storage and smart network control may be required in the longer term to support ramp-up rates and the intermittency of flexible generation, as well as predicted increases in the number of customers using gas vehicles.

4.2 Forecasting approach

In previous versions of our long term development statement, we talked about how our customers' requirements and use of our network are changing as we see the growth of renewable energy supplies in the UK. We also set out how we were developing our long term forecasting and modelling capability to ensure that we can continue to develop reliable and efficient networks. Data on emerging exit connections that could impact our future demand forecast are logged and tracked for inclusion in future forecasts e.g., Data centres could have a significant impact if connected in large numbers.

4.2.1 Stakeholder engagement

This year we have engaged with a wide range of stakeholders from within and outside the industry to support both our ongoing business as usual processes and as part of our engagement to inform this ten-year development plan. We also continue to act as a leading partner in debates around the future of energy – influencing, informing, and listening at national, regional, and local levels. The following section details the key stakeholders we engage with each year:

4.2.1.1 Large Load Customers

If a customer is significant enough to have a substantial impact on the network, then we will talk to them with regards to their demand and usage patterns across the day / year and future strategies e.g., in relation to decarbonisation and the potential to offer interruption services.

This engagement can take the form of questionnaires to the user and ‘face to face’, virtual discussions as required.

4.2.1.2 Connections Enquiry Data

Relevant monthly data on Industrial and Commercial (I&C) enquiries is made available throughout the year to inform our demand forecasting process. An annual report for the previous calendar year is compiled using this data from the following sources:

- I&C enquiries of > 4166 scm/h (45132 kWh) or 0.1 mcmd,
- those identified by separate load type tags e.g., Power Generation and CNG fuelling sites,
- details of the Advanced Reservation of Capacity Agreement (ARCA) sites which require financial commitment from the customer due to reinforcement.

This information is included in the pre forecast information sent to National Grid Gas Transmission (NGGT).

4.2.1.3 Flexible Generation & Other Non-Typical

As a group of DNs, we have reacted to the changing demands asked of our customer and commercial services in relation to flexible generation and unregulated supplies. We have adapted/added to processes to provide a better and consistent approach across the industry. We utilise public information sources like the Capacity Market Register to gain up to date views on the potential power generation in our network. Power Generation sites often secure electricity contracts prior to engaging with the relevant Gas DN and we refresh our view in line with the Capacity Market Auction timetable. To gain a view on daily demand, we have built up an average usage of 10 hrs per day from our connected sites logger data.

4.2.1.4 Local Authorities

In the last few years our involvement in Local Area Energy Planning has increased considerably at town, Local Authority, regional and national levels. In 2022 we have supported several advisory groups across our region to support the development of local, regional, and national decarbonisation strategies. We have also led / supported a number of innovation projects including EPIC, Tools of Engagement and Blaenau Gwent’s project to develop a Smart Industrial and Commercial Energy Platform Model Solution to achieve Net Zero Outcomes.

In addition to our Local Area Energy Planning projects, our below 7 bar planning team liaise with local authorities to gain the latest views on growth and probability of growth on the distribution network from domestic and small I&C projects.

4.2.1.5 Other DNs

We lead a regular GDN planning forum to collaborate on planning activities and changes introduced like Exit Capacity Planning Guidance (ECPG), inviting National Grid (NG) to participate when it is relevant to do so. We have more recently been working on a consistent approach to analyse the introduction of Hydrogen blends and 100% into the networks.

4.2.1.6 NG Gas Transmission (NGGT), NG – Electricity System Operator (NG-ESO)

Each year in the middle of March we have bilateral meetings with NG-ESO to discuss the pre forecast data we provide them with and to receive an overview of their draft forecast. This is always subject to change and the final version of the demand forecast is received in May.

Meetings are held with NG at several stages of the forecasting and planning process and 3rd parties are invited to attend to observe these discussions as per the new ECPG requirements. The meetings cover the expectations of the Demand Forecast, the expectations of our booking requests, the likely response to the Assured Pressure Requests, the response to the bookings requests and changes to accommodate rejections of the requests where needed.

Engagement with NG ESO also happens outside the ECPG process in relation to the development and outputs of the FES process. Network only discussions happen via the Network FES Forum.

4.3 Demand summary

This section describes the key forecast assumptions and drivers that are used in our current processes to generate the ten-year forecast demand for each of the three Local Distribution Zones (LDZ) within our DN.

This includes the headline outcomes, as well as information about how current forecasts relate to those we have published previously. Further information, including the detailed numerical tables, is provided in Appendix 2.

Our gas demand forecast levels are underpinned by our stakeholder engagement and analysis which shows that natural gas will continue to play a significant role in the UK energy market beyond 2030. This is consistent with current statements made by the Department for Business, Energy & Industrial Strategy and supported by detailed analysis commissioned by WWU and other GDNs.

To summarise:

- Peak (daily) network demand is expected to increase in the range of 7 to 9% in the next 10 years as per our No Growth from 2025 and Growth Forecasts respectively.
- Annual demand is not expected to change notably over the 10-year horizon.

During the next ten years, our view is that peak day demand in our network will increase from 2022/23 out to 2031/32 for all LDZs. This is primarily due to new connections of domestic customers and smaller loads, along with flexible generation and CNG fuelling which will off-set reductions we anticipate as a result of efficiency improvements, including improvements to insulation.

The relationship between peak and annual demand continues to change and customers continue to use gas in different ways today than historically seen. One example of this is gas used for electricity generation; these loads were previously base load and varied very little day by day. More recently gas generation is being used for flexibility and demand significantly varies day to day depending on the availability of renewable generation such as wind and solar.

4.4 Forecast Scenario Development

4.4.1 Annual Demand

We use the NG forecasts for our expected annual volumes. These are produced in line with TD76, which can be found here; Gas Demand Forecasting Methodology (nationalgrid.com)

Over the past decade we have recognised that the relationship between peak and annual demand was changing and made the decision to develop our own forecasting for peak. Our new model forecasts peak demand independently of annual demand and is explained further below.

Demand scenario projections are provided by NG ESO to GDNs in May each year. These are produced by NG ESO in line with the FES process for each of the 4 Future Energy Scenarios. A five-year central forecast is also supplied. The NG projections and forecast are subject to review to ensure differences can be explained.

Comparisons are also undertaken with data received in previous years to understand how NG drivers are changing. In addition, significant attention is paid to the large load projections. These are often different to assumptions within the GDN e.g., for peak generation, figures NG may apply diversity so that the national generation figure reflects national requirements whereas GDN 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 ESO would call on-line.

4.4.2 WWU Process Background to Peak Forecasting

In 2010, a review of forecasting capability was carried out in WWU because of significant divergence in the scenario data received from NG ESO from year to year. As part of this project a peak-day model was produced by Delta-EE to forecast future demands for non-daily metered loads. The model considers factors including load growth, weather sensitivity, projected improvements to boiler efficiencies and the latest Composite Weather Variables (CWV) from the Xoserve process.

Peak-day forecasts for larger sites are derived based on available data as detailed in the engagement section.

WWU develop a range of sensitivities to consider the following key factors:

- Growth of key sites such as flexible generation and CNG Fuelling sites
- Impacts of any future homes' standard on growth of domestic connections

A summary of our resulting forecast scenarios from this year's process and considerations is as follows:

Figure 1: Forecast Scenarios

	Process Step	Growth	Non-Domestic Growth	No Growth - post 2025
1	Historical Actual Demand	√	√	√
2	WWU Forecast Unidentified Gas (UIG) Data – Shrinkage plus other, accounted for in the Non Daily Metered load band	√	√	√
3	Updated Composite Weather Variable (CWV) per LDZ	√	√	√
4	A Review on Industrial Load and changes in their usage	√	√	√
5	Average Historical Domestic Growth applied up to 2025	√	√	√
6	Capacity Market Info. for forecast Power Generation & Compressed Natural Gas (CNG) data for vehicle fuelling connections to 2025	√	√	√
7	Continued low level Domestic Growth applied from 2025	√		
8	Power Generation & CNG Fuel projected forecast growth from 2025	√	√	

The forecasts within this document take account of national data and assumptions from many sources including NG's FES scenarios and our own forecasting models.

4.4.3 Composite weather variables

Due to the temperature sensitivity of the domestic load band, LDZ forecasts of annual demand are based on an assumed average weather condition. The demand models use factors known as composite weather variables (CWVs). The CWVs are derived from temperature and wind speed data to optimise the correlation between demand and weather.

To comply with the UNC, we are obliged to review the definition and seasonal normal basis of all CWVs, at least once every five years. The last review took place during 2019 in readiness for the new values being effective from 1st October 2020.

This latest review of the CWV formula resulted in a change, with the addition of a Solar Radiation term. The same review also saw a more up to date view of climate change adjustments being used in the derivation of the Seasonal Normal Composite Weather Variable (SNCWV).

4.4.4 Capacity management

We annually assess the level of capacity that is required to operate the network in a safe and secure manner and to comply with the obligation to meet 1 in 20 demand conditions. There are a variety of ways in which capacity requirements can be managed. If a capacity constraint occurs on our network our main options would be to:

- proceed with the network investment that is described in Chapter 0; or
- interrupt key sites through bilateral interruption contracts with customers where available.

If interruption is not available there may also be a requirement to increase our bookings of capacity from the NTS.

We no longer have any interruptible customers on our network despite having regularly participated in the annual auction for interruption processed by Xoserve on behalf of the gas networks.

This year we have made a small number of both reductions and increases in our bookings for capacity from the NTS as required going forward.

4.4.5 LDZ peak forecasts results

This section provides the latest gas demand forecasts through to 2031/32. More detailed information is provided in Appendix 2, which includes forecasts by load band for both peak and annual demand on a year-by-year basis. Our peak forecasts are now given as a range of anticipated gas demand in a low growth and a high growth scenario.

In this year's forecasts, our growth scenario continues to project increases in our peak demands over the next ten years. This is primarily influenced by electricity generation and CNG fuelling requirements having an impact at peak.

The 2022 peak demand forecast for the network is 494 GWh/d. We project that this will increase to 538 GWh/d by 2031/32 under our growth scenario, which represents a 9% increase. The increase is attributed to the continued low-level growth of domestics, power generation and CNG fuelling sites. We have included:

- loads that have accepted connection offers from us in 2022/23.
- power generation sites that have capacity via the electricity capacity register in 2025/26 (T-4).

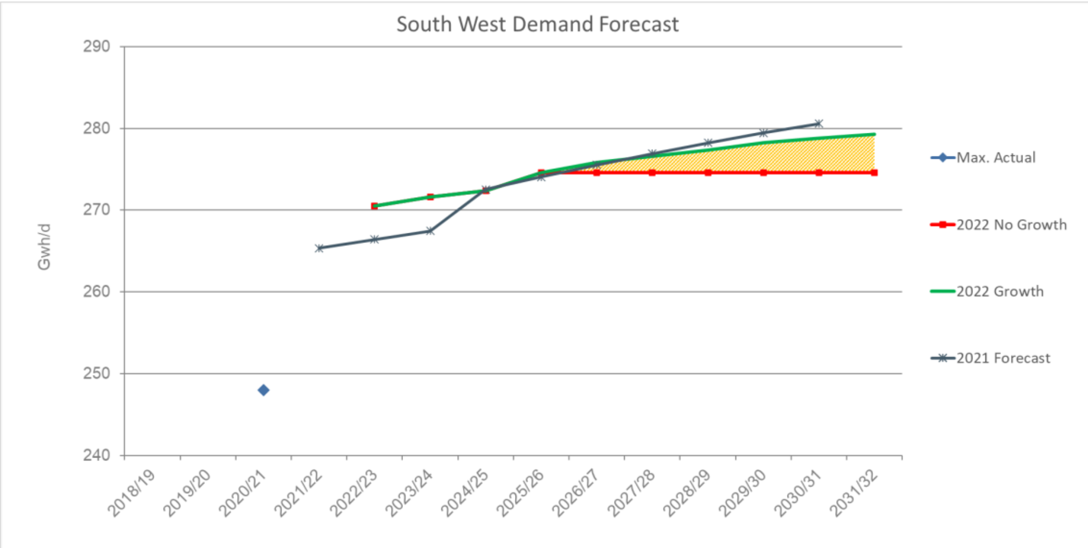
For the years after 2025/26 and in our growth forecast, we have assumed low levels of flexible generation growth in all network areas based on the indications from the capacity market information. We are also including a projection in growth of CNG fuelling sites which has been indicated by site developers. Both of these areas of growth on our network are at lower levels when compared to last year's view.

South West:

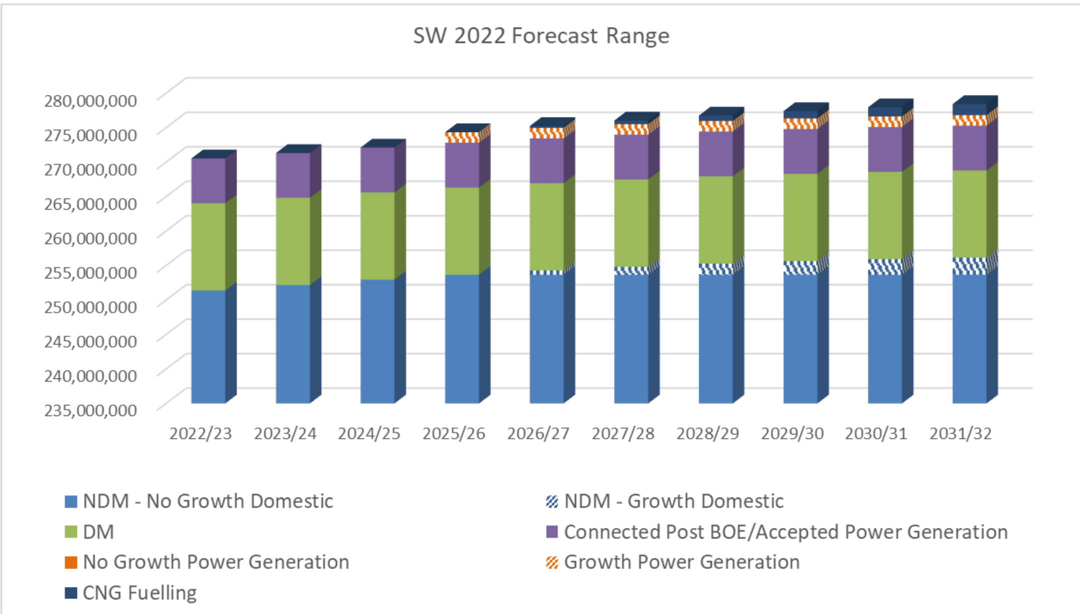
The 2022 peak demand forecast for the Southwest is 271 GWh/d. This is projected to increase by 4 to 9 GWh/d by 2031/32, which represents a range between 2 and 3% for this LDZ.

The maximum demand for 2021/22 was 177 Gwh/d, experienced on 20th January 2022.

Graph 1: Comparison of current forecast range and previous forecast vs actual maximum flow



Graph 2: 2022 peak demand forecast range by load type

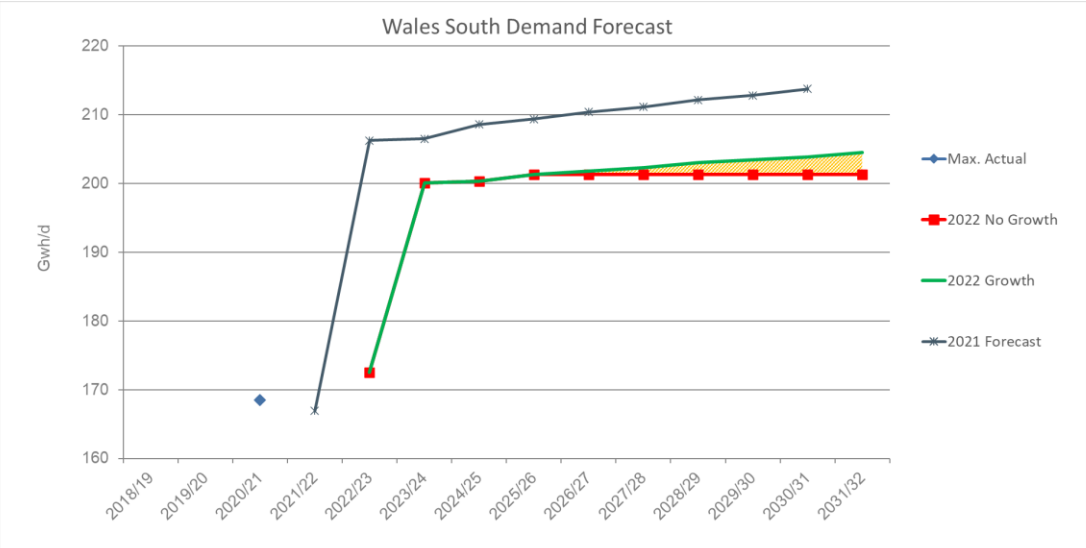


Wales South:

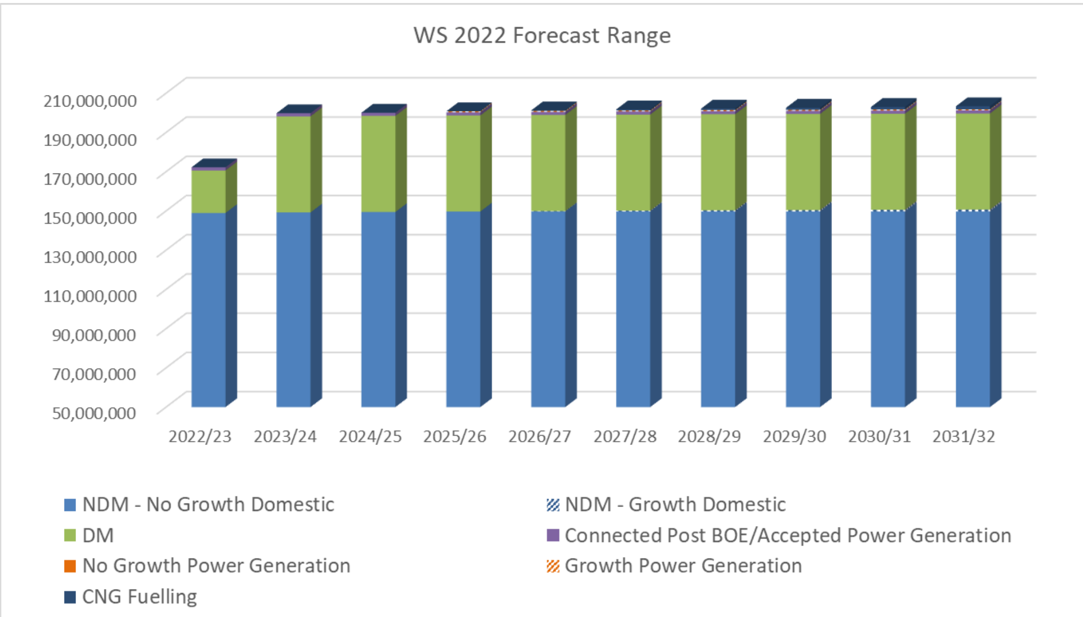
The 2022 peak demand forecast for Wales South is 173 GWh/d. This is projected to increase by 29 to 32 GWh/d by 2031/32, which represents a 17 to 19% increase.
The high projected increase and significant step change going into 2023/24 is due to a large load which has been offline and is expected to recommission in this year.

The maximum demand for 2021/22 was 112 GWh/d, experienced on 24th January 2022.

Graph 3: Comparison of current forecast range and previous forecasts vs actual maximum flow



Graph 4: 2022 peak demand forecast range by load type

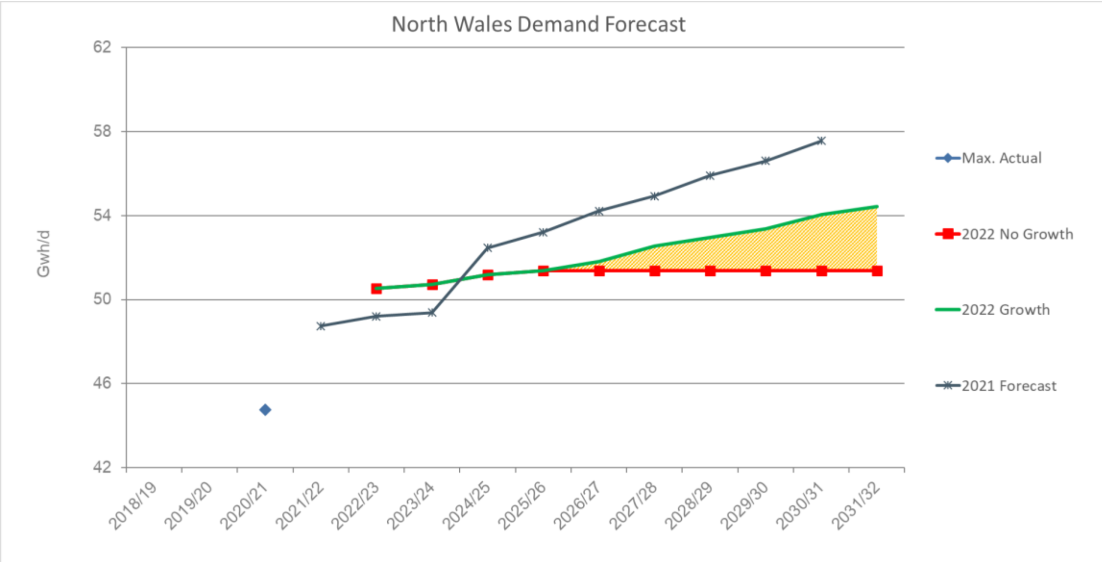


Wales North:

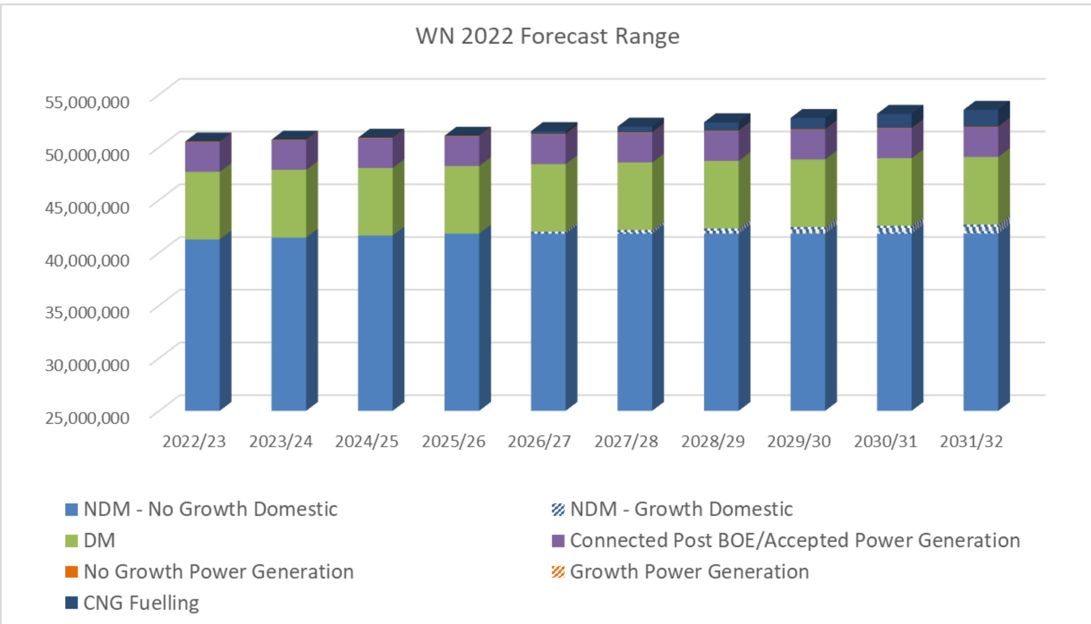
The 2022 peak demand forecast for Wales North is 51 GWh/d. This is projected to increase by 1 to 4 GWh/d by 2030/31, which represents a 2 to 8% change.

The maximum demand for 2021/22 was 33 GWh/d, experienced on 25th January 2022.

Graph 5: Comparison of current forecast range and previous forecast vs actual maximum flow.



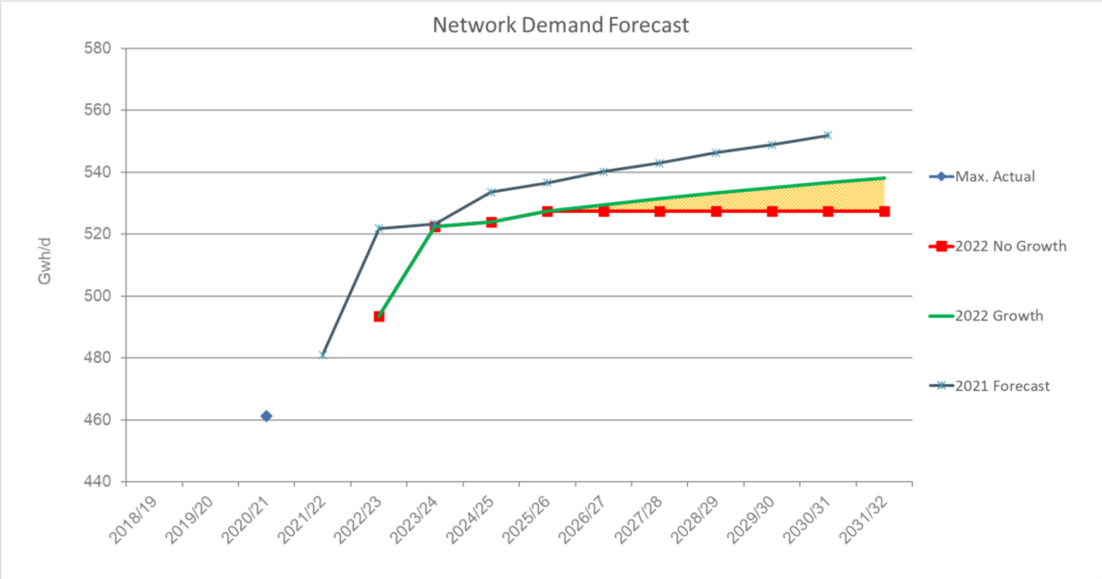
Graph 6: 2022 Demand forecast range by load type



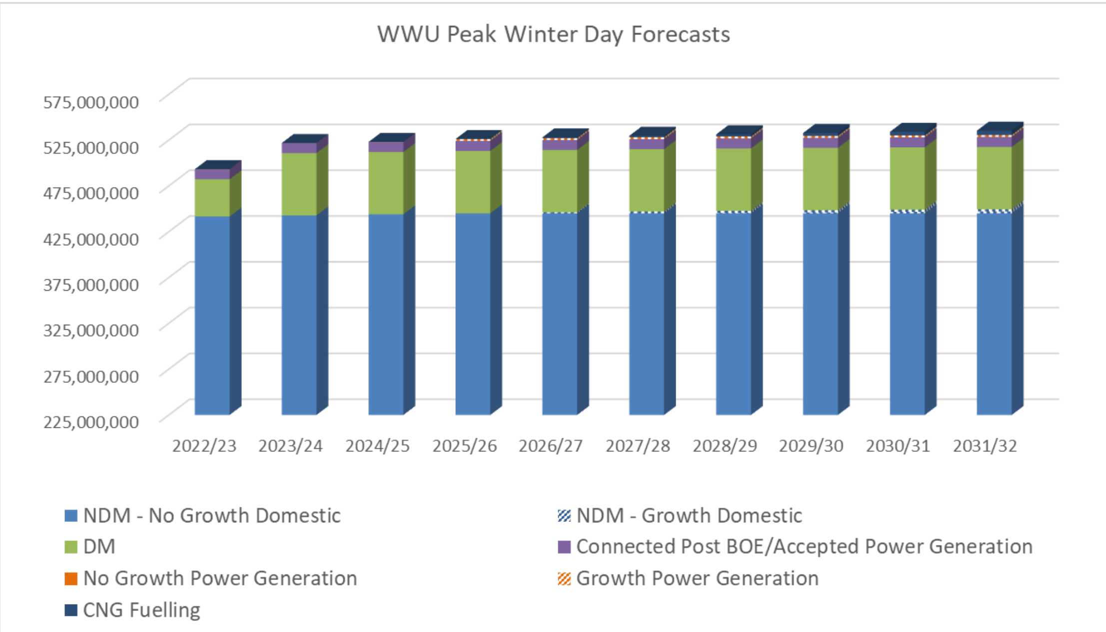
WWU network:

The graphs below show the gas demand forecast summation of all 3 of our LDZ's, which taken as a whole is projected to increase by 34 to 45 GWh/d, which equates to a rise of 7 to 9% over the next 10 years.

Graph 7: Peak demand forecast range for the network



Graph 8: 2022 network demand forecast range



4.4.6 Annual gas demand

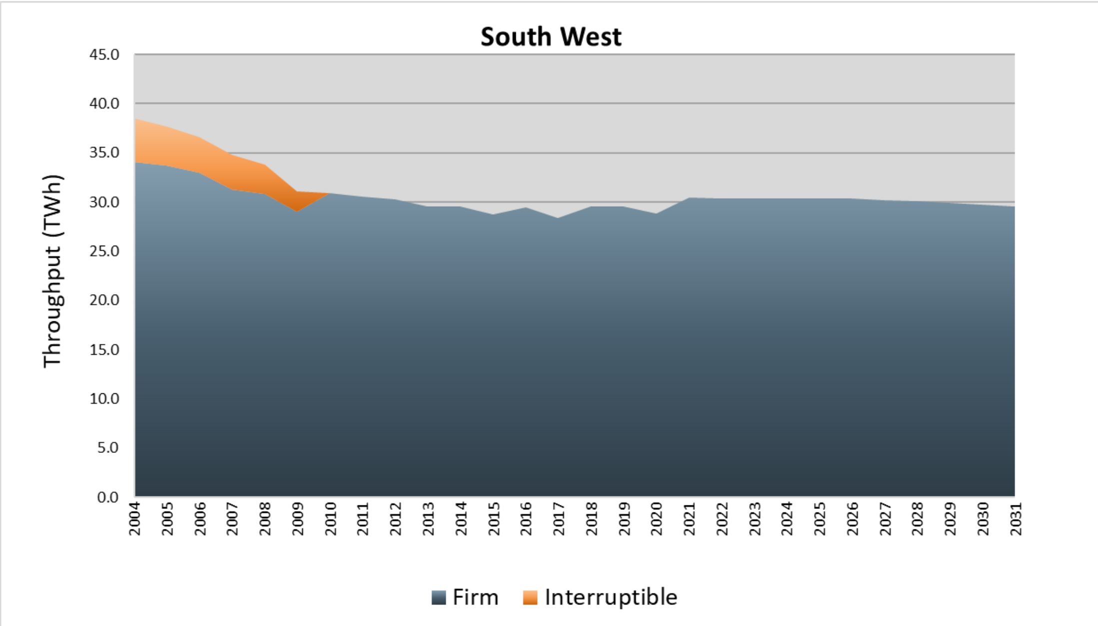
There are several processes that rely on annual gas demand which detail the total quantity of gas we expect to transport through our network in any given year. Going forward these will be increasingly important for determining the carbon emissions associated with the use of fossil gas, as well as for determining any reductions that are a result of green gas displacing current sources.

The seasonal profile of annual demand will also be important if we assume that green gas will continue to be injected into our network at similar rates throughout the year. This is because there may be a requirement for seasonal storage, which is currently not available in our network.

In the Southwest and North Wales LDZs most of the demand is from domestic energy users, whereas in Wales South the demand is more evenly spread between domestic and large industrial users. Throughput in North Wales is significantly less than it is in the Southwest and in Wales South.

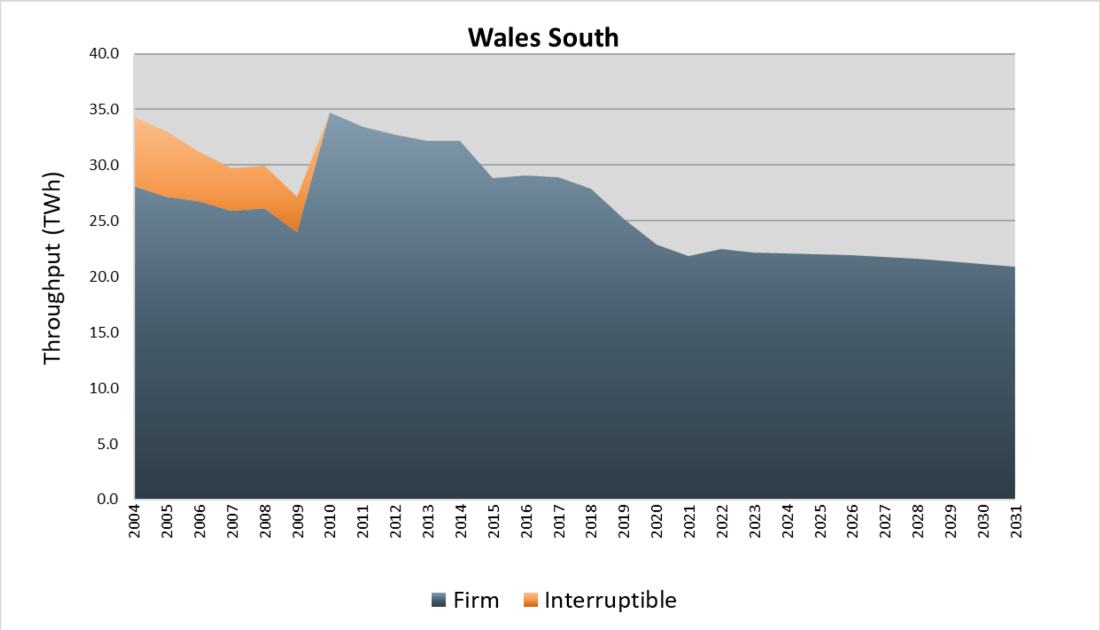
South West

Graph 9: Historical and forecast annual gas demand for South West LDZ



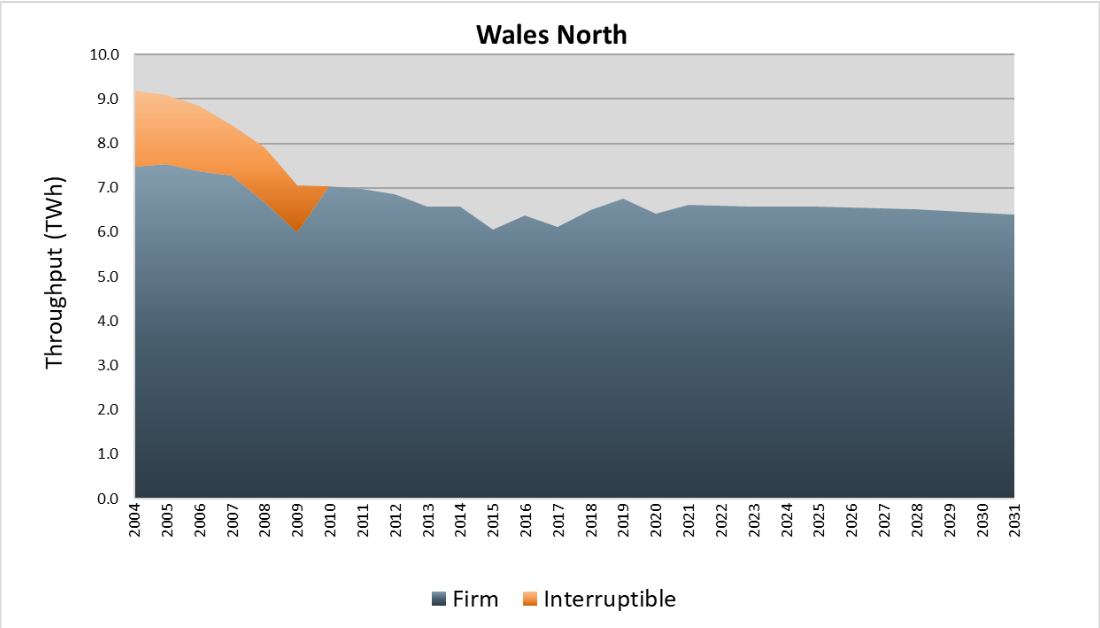
Wales South

Graph 10: Historical and forecast annual gas demand for Wales South LDZ



Wales North

Graph 11: Historical and forecast annual gas demand for Wales North LDZ.



5. Supply

5.1 Key messages

- We have 20 biomethane sites connected to our network which have capacity to meet the needs of around 156,000 customer homes.
- We have a further 6 biomethane sites with booked capacity on our network that would increase the customers supplied to the equivalent of over 190,000 homes.
- We have both reduced and increased NTS Offtake capacity bookings in our network this year in response to customer information and increased peak demand forecasts across the region respectively.
- We are due to be the first network to accept synthetic natural gas (BioSNG) into our network in late 2022 or early 2023 which will be our 21st entry connection.
- We are supporting significant industry work to update industry standards around gas quality so that networks can transport a wider range of gases safely and in doing so support decarbonisation.
- We are working collaboratively with the other DN's to develop network analysis and modelling capability for hydrogen.
- We are proactively encouraging further green gas connections through our work with the ENA and other networks under GGG.

5.2 Overview

We develop the local transmission and distribution systems to meet our customers' requirements. In turn, NGGT will develop the national transmission system (NTS) in line with supply and demand forecasts and this is then detailed within their development statement. NG Gas Ten Year Statement

Our supply is mainly brought into the network from the NTS via the 17 offtake sites; in addition, we now have 20 biomethane supplies, having connected a further site this year. As biomethane feeds are subject to customers' requirements, we do not assume they will be flowing at peak, and we therefore book sufficient NTS capacity to meet peak day demand requirements.

General principles of operation are that supply is delivered to distribution networks at a steady rate for each gasday and that storage within those networks is used to retain it until it is required at specific times of that day by our demand customers. We store gas within our network of pipes in the form of 'linepack' and also in High Pressure Storage Vessels (or bullets). In total we have 54.8 GWh storage available in linepack and 5.2 GWh storage available in bullets.

5.3 Distributed gas

5.3.1 Green gas

We believe in a future integrated energy network and have introduced distributed gas entry standards to support the connection of distributed green gas including biomethane and hydrogen. Injecting gas into the DN directly helps to achieve climate change targets (reducing reliance on fossil fuels) as well as improving the security of supply.

We participate in the Open Networks programme as part of workstream 4 which is supported by both gas and electricity networks. This workstream is investigation opportunities for networks to work together to develop optimal whole system solutions.

In addition, we support two biomethane working groups at the ENA; the Gas Entry Connections Technical Working Group (previously the Biomethane Technical Working Group) which is a network only group and the Entry Customer Network Forum (ENCF) which includes customers participants from across the industry. During 2022 we led some work to standardise capacity studies across GDNs. These are provided to customers and contain sufficient information on available network capacity for the developer to base a business decision on and to book capacity for entry.

We also participate in a number of industry programmes including GGG which are considering changes that will be needed for networks to transport hydrogen either as a blend or 100%. These programmes are considering the impacts on several areas including safety, customers, and regulatory requirements. Work is carried out collaboratively across the UK Networks so that resources are used efficiently, and learning is shared. We collaborated with NGN and completed a biomethane study which explored the potential for bringing existing green gas to grid. This study included a review on the available techniques and methods to facilitate this injection like central hubs and reverse compression. The reports produced are now available via the ENA portal: Biomethane Study | ENA Innovation Portal (energynetworks.org). We are now exploring the potential projects identified as having a high likelihood of wanting to inject the biogas produced as biomethane into our network. Following the publication of this report, we will be holding a green gas event in conjunction with ADBA to pursue the leads recognised in this completed work.

In 2018 we undertook analysis on the likely methods of converting Bristol and Cardiff to 100% hydrogen in the longer term. Work is now underway in collaboration with other networks to complete more wholescale analysis to determine the impact and opportunities of converting the whole networks. Iteration 1 has focussed on identifying the investment needed to ensure the network has sufficient capacity for hydrogen as well as supporting the transition process in sample areas.

Through our Regional Decarbonisation Pathways project, we are building a strategic plan and roadmap for our entire network. This will build on the industry-wide Pathway to Net Zero developed through the GGG project, and provide a vision for the role of hydrogen, biomethane and smart technologies across our region.

5.3.2 Biomethane

We connected our 20th biomethane site in March 2022 which increases the annual connected capacity from 1.82TWh to 1.88TWh – enough to heat around 156,000 domestic properties, or up to 780,000 where hybrid heating systems are deployed. We have received 30 enquiries in the last 12 months which is 19 more than the previous year, indicating an increase of interest in this area.

We currently have 6 further sites that have booked network capacity, offering an additional 0.41TWh annual capacity which is enough to heat another 34,000 domestic homes.

We are expecting to connect the first BioSNG plant in Swindon by the end of 2022 or early 2023, this site will produce synthetic natural gas from a feedstock of residual household waste. It will include up to 1% hydrogen, for which we have successfully secured an exemption to Gas Safety (Management) Regulations from the Health and Safety Executive.

5.3.3 Coal bed methane

We have not received any enquiries for significant quantities of other distributed gas injection in the form of coal bed methane in the past year. As a result, in the short term we are not proposing any investment. However, the challenges of connecting coal bed methane would be similar to those caused by green gas entry.

5.3.4 Hydrogen

We have started receiving speculative enquiries for blending hydrogen into our network, we have received 41 to date. To enable network analysis, during 2022, we completed a cross GDN training package delivered by our software suppliers which has allowed us to utilize existing hydrogen-ready modelling tools and start to analyse the network. We have also completed phase 1 of the System Transformation project for BEIS to assess parts of the network for 100% Hydrogen transportation. The outputs from this workstream include reinforcement volume and costs to enable the network to convert from natural gas to Hydrogen.

Work is underway to identify, understand and address the changes that will have to be made to regulations, systems, and processes to accommodate hydrogen in our network.

We are collaborating with all GDNs to assess the case for blending hydrogen and are fully engaged in projects under the GGG umbrella to agree the strategy and functional requirements to enable a blend of up to 20% hydrogen.

5.4 Capacity impacts of distributed gas

The principles of gas distribution are challenged by increasing distributed gas entry. Where this occurs at lower pressure tiers and in less populated areas, we will need to introduce new technology including compression to move this gas to the areas where our customers need it.

Where the proportion of distributed gas increases further, it may also be necessary for seasonal storage to be provided so that gas produced in the summer can be stored for use in the winter. To maximise the capacity that can be made available with current technology and following the introduction of new technology, smarter control systems will be needed to provide dynamic pressure setting changes based on flows of gas into and out of key sites.

We are continuing work on our innovation project OptiNet with Cadent and our partners Passiv to look at innovative ways to make capacity available in a part of our network that is currently unable to accept enquiries we have received for green gas injection. Our Smart pressure control solution has been trialled successfully through this project and we are now looking at extending this automated control more widely on the same network. This will allow the connection of 4 more biomethane sites. Work on the Compressor trial continues and is expected to complete by the end of this year. Further information is available in Appendix 4: Our future of energy research.

We recognise that new commercial and regulatory frameworks will be required to make sure that associated costs are dealt with appropriately. We intend to utilise the reopeners offered by Ofgem where appropriate to allow efficient spend in facilitating more green gas into the network. Continuing to work closely with industry, other GDNs, Ofgem and BEIS will enable us to find the right commercial solution to the current challenges faced with green gas entry.

5.5 NTS supplies

To ensure that we can meet our 1:20 licence condition it is essential that we have booked sufficient capacity from the NTS to meet our peak day demands. While we consider the availability of distributed gas in the locality, this is not currently treated as a firm supply and is not used as a means to off-set our NTS capacity.

The incentive to book NTS capacity efficiently at the lowest cost has been removed from our regulatory mechanism for RIIO-GD2 and a new ECPG process introduced, see below for further details.

5.5.1 Exit Capacity Planning Guidance (ECPG)

In December 2020 OFGEM published their RIIO-2 Final Determinations1 for the transmission and gas distribution price controls. These set out the key elements of the price control from 1 April 2021 to 31 March 2026. This included 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.

Standard Special Licence Condition ("SSC") A57 (Exit Capacity Planning) of the gas transporter licences requires the licence holder ("licensee") to comply with the Exit Capacity Planning Guidance ("the Guidance") which is available here: Exit Capacity Planning Guidance | Ofgem
The Guidance comprises a set of requirements relating to the following areas of capacity booking activity. However, in this initial year specific transition arrangements are in place to confirm a reduced set of requirements.

- Methodology: GDNs must provide information on the structure of their networks known as Network Topology, and both GDNs and NGGT must provide information on their forecasts of demand and the details of the processes in place to calculate these forecasts.
- Engagement: The GDNs and NGGT must collaboratively work with each other and with other stakeholders to maximise booking efficiency across the gas transportation network as a whole.

- Reporting: licensees must report annually to the Authority on capacity booking methodology, stakeholder engagement, decision-making and data to demonstrate efficient booking outcomes.

5.5.2 Network Collaboration

We engage with NGGT and other system Users through forums such as Transmission Workgroup which develops changes to commercial arrangements e.g. 0805 – Introduction of Weekly NTS Exit Capacity Auctions. www.gasgovernance.co.uk/0805. Through these groups we aim to ensure that arrangements allow efficient access to and use of the Total System for our customers.

Figure 2: Physical and commercial capacity through our NTS Offtake sites

Subsystem Name	Offtake Location	Capacity		2022/23 Capacity Bookings (kWh/d)
		kWh/h	KWh/d	
South West (SW)				
Northern	Wiltshire (1)	1,300,000	31,200,000	27,665,930
	Gloucestershire (1)	1,254,861	30,116,667	22,252,226
	Bristol (1)	2,841,042	68,185,000	57,536,239
Central	Bristol (2)	2,166,667	52,000,000	25,368,959
	Somerset	2,031,250	48,750,000	32,951,155
Southern	Exeter (1)	677,083	16,250,000	15,387,131
	Plymouth	3,250,000	78,000,000	46,745,947
Other	Exeter (2)	1,321,667	31,720,000	19,557,396
	Gloucestershire (2)	487,500	11,700,000	8,415,977
Pressure Controlled	Devon	406,250	9,750,000	5,250,000
	Herefordshire	437,847	10,508,333	4,244,351
	Wiltshire (2)	245,917	5,902,000	3,003,974
	Worcestershire	411,667	9,880,000	6,570,000
Wales South (WS)				
South Wales	Cardiff	4,865,972	116,783,333	98,230,762
	Swansea	3,271,667	78,520,000	38,142,019
	Newport	3,423,333	82,160,000	36,133,092
Wales North (WN)				
North Wales	Wrexham	2,708,333	65,000,000	50,540,588

6. Investment in the Distribution Network

6.1 Key messages

- Our stakeholders have told us that maintaining a safe, reliable gas supply is a key priority and that they support initiatives to encourage more green gas to enter the network.
- We are adopting new techniques to ensure efficient investment in network health through use of monetised risk models.
- We anticipate increasing requirements for network capacity, compression, storage, and smart control in the future to accommodate increasing demands for flexible gas usage and injection from our customers.

6.2 Distribution network

We manage the operation and maintenance of the Local transmission system and below 7 Bar distribution networks in three LDZs: Southwest, Wales South, and Wales North.

We will continue to develop and invest in our networks in order to operate a safe and efficient network and to meet current and future customers' requirements and operating behaviours. We are certificated to asset management standard ISO55001 and we plan investment in line with the principles of the standard.

6.3 Network management

To better understand the reliability and condition of our assets and to understand how this will change over time with different investment scenarios, we have used Condition Based Risk Management (CBRM) models during RIIO-GD1. These decision support tools have helped us to successfully plan, justify and target future investment to maintain the current high level of safety and reliability of the gas supply network. The established methodologies have been developed further across the industry through the Network Asset Risk Metrics (NARMs) methodology work. This uses the principles of event tree analysis which helps us assess safety, reliability, and environmental risk for all our assets and gives a monetary value of the risk on our network. We have recently invested in both systems and people to further enhance our assessment of asset health, consequence and risk and our investment strategies to manage this. We have purchased and embedded an asset investment optimisation tool (AIM) and employed a number of data scientists to ensure that we get the most out of this investment in new systems. This enables us to understand the impact of investment on risk and optimise investment decisions, targeting our asset interventions to optimally manage risk. Our RIIO-GD2 plans have been derived using these new skills and tools.

For pipelines, we have implemented an 'as low as reasonably practicable' (ALARP) methodology in assessing the options that are available to us to identify the most cost-effective way to minimise societal risk, specifically targeting high consequence areas.

This will achieve the greatest risk reduction for the minimum expenditure in preference to wholesale replacement of pipelines which would only be progressed where supported by a cost benefit assessment.

6.4 Investment

We will be replacing one 13km section of the Local Transmission System pipeline between Derwenlas and Tywyn in Snowdonia National Park during RIIO-GD2. This pipeline replacement is supported by a cost benefit assessment, and the justification for replacement on the basis of safety, reliability and least whole life cost was accepted by Ofgem in the RIIO-GD2 price control review.

We will continue to invest for reinforcement and new connections consistent with the peak day demand forecast in this document. We will continue to invest in the replacement of our transportation network assets, primarily for the renewal of mains and services within our distribution system. This includes expenditure associated with the three-tier approach initiated by the HSE for metallic mains replacement under the iron risk removal programme. This is our 30-year gas mains replacement programme (from 2000) which requires all iron mains within 30 metres of a building to be replaced. From 2021 to 2026 we will replace around 2,125km of metallic gas mains, at an annual cost of £90 million.

In future years further non-demand driven investment may be required as we start to investigate other requirements such as hydrogen injection, blending services and compression.

7. Innovation

7.1 Key messages

- For today's customers, our innovations have helped us deliver outstanding levels of customer service: reducing the disruption from our essential work while making us more efficient and cost-effective and our network more resilient.
- For tomorrow's customers, our research projects and partnerships make sure we play our part in delivering reliable energy at affordable costs for customers, while helping the UK meet its decarbonisation targets.
- In 2021/22 we invested £1.5m combined in NIA and Carry Over NIA projects.

7.2 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.

Our Energy Innovation Forum set out the networks' priorities for 2022, and showcased the improvements made to provide greater clarity on participating in projects.

All network companies supported the redevelopment of the Smarter Networks Portal. This update will ensure a system to better to facilitate learning and collaboration in the industry.

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

7.3 WWU innovation summary

At Wales & West Utilities we are developing a robust and balanced portfolio of net zero and vulnerable customer projects. These will progress our net zero strategy with research, evidence and pilots that demonstrate the critical role of gas networks in achieving net zero.

The innovation project portfolio currently represents early research and development projects as we evidence the role of gas in net zero decarbonisation, but this will evolve as we develop through future price control periods, moving to delivery of commercial solutions to support the ambitious government 2050 net zero decarbonisation targets in later price controls. Every NIA project is assessed using our new Vulnerable Customer Tool, which ensures a just transition for all, including the most vulnerable in our society.

These projects will enable us to provide future of energy evidence and options for consumers and future delivery, aligning with one or more of the following:

- Our business plan
- The Energy Networks Association (ENA) strategy, developed alongside all gas and electricity networks
- The evolving Wales & West Utilities internal strategy for net zero
- Consumer and stakeholder research and outputs.

Collaboration with the other gas and electricity distribution and transmission networks and external innovation partners is key to our journey to net zero, as is taking the best global innovation and learnings from other industries.

We're focused on generating new ideas by having an innovation culture across our organisation, other networks and partners and we want to work with you.

In 2021/22 we invested £1.5m combined in NIA and Carry Over NIA projects.

For further information on our innovation portfolio to date, please read our innovation report for 2021/22.

7.4 WWU innovation strategy

Our strategic interest for innovation projects is focused in the following four areas:

7.4.1 Our business plan

- **Meeting the needs of consumers and network users**: support projects that bear uncertainty or where benefits are valid to society but difficult to commercialise
- **Delivering an environmentally sustainable network**: deliver customer benefits and provide the lowest cost pathway to heat decarbonisation
- **Maintaining a safe and resilient network**: support projects that help our business to adapt to a changing environment that will be fit to provide energy for generations to come

7.4.2 ENA strategy

The Energy Networks Association (ENA) key strategic areas are:

- Data & Digitalisation
- Flexibility & Market Evolution
- Net Zero and the Energy System
- Transformation
- Optimised Assets and Practices

- Supporting Consumers in Vulnerable
- Situations
- Whole Energy System

7.4.3 Our strategy

From a Wales & West Utilities (WWU) perspective, the five innovation priority areas are:

- Hydrogen: this includes the role of hydrogen at blended and 100% levels and involves research, evidence building, practical demonstration and delivery of commercial solutions
- Data & Modelling: future evidence for forecasting and capacity, sharing of data and data to support local area planning, particularly in reference to our Pathfinder Project
- Transport: understanding and exploring the role of gas in transport and investigating fuel choices, particularly our own fleet, to provide consumer choice and fuel solution options, especially around hydrogen
- Consumer Heating Solutions: exploring consumer options for use of hydrogen to support hybrid heat development
- Biomethane: connecting new production capacity to our network

7.4.4 SIF: Strategic innovation challenges

For SIF, the Round 2 challenges for 2022 (Data & Digitalisation weaves through all themes) are:

- Supporting a Just Energy Transition
- Improving Energy System Resilience and Robustness
- Preparing for a Net Zero Power System
- Accelerating Decarbonisation of Major Demands

7.4.5 Innovation for customers of tomorrow

Our research projects and partnerships make sure we play our part in delivering reliable energy at affordable costs for customers, while helping the UK meet its decarbonisation targets.

With more than 80% of heat and power demand at peak times currently met by the gas network, we are planning for the future – to make sure we continue to deliver reliable energy at affordable costs for customers, while helping the UK meet its decarbonisation targets.

Our research has told us that the full electrification of heat comes at an excessive cost. Alongside our partners, we are committed to delivering an energy future that addresses the UK energy trilemma: providing consumers with affordable, secure, and low carbon energy. Some of the research made possible by the incentive funding is detailed in Appendix 4: Our future of energy research.

7.5 Governance and delivery

We have been committed to innovation since day one. This is led from the top by our leaders who believe that investing appropriate commitment and resources into innovation will help us improve our performance year on year. Our innovation team ensures that innovation is delivered at pace and that benefits are recorded and shared across all relevant parts of the business. With a small innovation team supported by a large delivery team – the business – our innovation is driven by our five business priorities which reflect the stakeholder outputs we deliver, as well as making sure we meet the needs and expectations of all our customers and stakeholders today and in the future.

7.6 Collaboration and sharing

Collaboration is central to delivering our business innovation strategy. We are proud that two-thirds of our NIA project portfolio since 2013 has been delivered in collaboration with one or more other network licensees. We are now working with more partners than ever before. Since 2013, we have formed relationships with more than 350 organisations such as suppliers, academia, and businesses of all sizes. We continue to facilitate collaborative innovation within the energy sector alongside our own contractors and other utility companies.

Our project partners are always ready to rise to our challenges and make our innovation programme a success. Working with partners is important to help us deliver innovation with tangible benefits for our customers and the industry.

We launch our problems and challenges through a call for innovation process, using a variety of methods which include responding to Strategic Innovation Fund (SIF) challenges, and working with partners directly to understand our needs and priorities. This open and transparent process generates interest and action from businesses large and small who produce efficient competitive solutions to problems – helping us deliver value for money to our customers.

We share our project successes and learning experiences with other networks and industry in the UK, as well as other organisations further afield. Our colleagues are fully engaged in challenging and shaping our future too.
We focus on innovation to drive business efficiency and make the best use of our available resources to target problems through engagement with external organisations. We share our challenges by launching calls for innovation on specific problems, publishing our industry challenges and taking opportunities to communicate these challenges at events and workshops.

7.7 Looking ahead

Innovation is core to our business strategy. We rely on innovation to drive efficiency, while delivering against all our business priorities and output targets and we will continue to do this in the future.
Guided by the publication of the Gas Network Innovation Strategy, we will use innovation funding to build on and keep pace with the critical changes brought about by a changing energy system.

Appendix 1: Load and Demand Forecasting

A1.1 Annual Demand

Demand forecasts have been developed using the methodology defined within Uniform Network Code OAD Section H, for more information refer to Joint Office OAD Section H.
We use NG forecasts for our expected annual volumes, these are produced in line with the TD76 requirements and consider econometrics, Gas Demand Forecasting Methodology (nationalgrid.com)

However, over the last decade we have recognised that the relationship between peak and annual was changing and made the decision to develop our own forecasting for peak demand independently of annual demand.

A1.2 WWU Process Background to Peak Forecasting

In 2010, a review of forecasting capability was carried out in WWU because of significant divergence in the scenario data received from NG ESO from year to year. As part of this project a peak-day model was produced by Delta-EE to forecast future demands for non-daily metered loads. The model considers factors including load growth, weather sensitivity, projected improvements to boiler efficiencies and the latest Composite Weather Variables from the Xoserve process.

Peak-day forecasts for larger sites are derived based on available data as detailed in the engagement section.

A1.3 Forecast Scenario Development

WWU develop a range of sensitivities to consider the following key factors:

- Growth of key sites such as flexible generation and CNG Fuelling sites
- Impacts of any future homes' standard on growth of domestic connections

Information on the various sensitivities is shared with our Network Management Committee and the selection of sensitivities to be used in our planning forecast, which is subject to exec sign-off. A summary of our resulting forecast scenarios from this year's process and considerations is as follows:

Figure A1: Forecast Scenarios

	Process Step	Growth	Non-Domestic Growth	No Growth - post 2025
1	Historical Actual Demand	√	√	√
2	WWU Forecast Unidentified Gas (UIG) Data – Shrinkage plus other, accounted for in the Non Daily Metered load band	√	√	√
3	Updated Composite Weather Variable (CWV) per LDZ	√	√	√
4	A Review on Industrial Load and changes in their usage	√	√	√
5	Average Historical Domestic Growth applied up to 2025	√	√	√
6	Capacity Market Info. for forecast Power Generation & Compressed Natural Gas (CNG) data for vehicle fuelling connections to 2025	√	√	√
7	Continued low level Domestic Growth applied from 2025	√		
8	Power Generation & CNG Fuel projected forecast growth from 2025	√	√	

A1.4 Population of Network Analysis and Other Models

Software Used

Synergi Gas, we utilise Synergi Gas Unsteady State Model (USM) v 4.9.2 to carry out our transient analysis and Local Transmission System (LTS) modelling which can use the following flow equations: Smooth pipe law; AGA; Chen, Colebrook-White; GERG and Sancham flow. The software is developed and supported by DNV.

Capacity Models, GasCalc v 5.0 is used to calculate our pressure reduction station (PRS) and Offtake capacities at a component level with results being compiled and saved in excel on a site basis by LDZ. PRISM is also available to us to calculate site capacities and identify component constraints. However, we await training on PRISM from the software developer DNV to be able to use this tool more frequently. Our PRS Capacity Spreadsheet is used to identify capacity constraints of individual components within our pressure reduction stations by comparing anticipated peak flow with capacities. We utilise a further DNV tool called HTREC to calculate heating requirements at our sites, heat recovery distances on outlet pipework and heating capacity available from the heating systems installed.

Consus Model (Storage Simulation), our Consus model is used to determine the storage required for most sites in our LDZ's. Storage requirements for specific sites may be modelled individually where they have unique operating patterns. This is the case for most of our generation sites whose behaviour is increasing dynamic as they respond to electricity market signals.

A1.5 Annual Model Build

Model Build

Data from the approved planning forecast is imported into our transient analysis models in Synergi Gas. Models are built annually for peak demand days to meet our 1:20 licence obligation as well as for D13, D46, D150 & D300 (where days are put in the highest demand order for the year from day 1 to 365). This is done by scaling down the peak model to the D13 demand level, the scaling the D13 model to D46, etc.

These models are geographical representations of our LDZ's and include:

- relevant network infrastructure parameters including length, diameter, material, roughness, wall-thickness, altitude and
- balancing parameters including supply and demand nodes and behaviours e.g., for electricity generation as detailed above.

Model Validation

Our LTS models are validated in line with the agreed industry standards documents:

- IGEM/GL/2 Edition 3: Planning of gas transmission and storage systems operating at pressures exceeding 16 bar,

and company policies and procedures namely:

- T/PM/NP/2: Management Procedure for Validation of High-Pressure Distribution Network Analysis Models

We have 3 LTS models and have determined that a total revalidation of each model every 3 years is a reasonable frequency on the high-pressure network. A partial or full validation will also happen on an ad-hoc basis should any material changes occur, or significant discrepancies are highlighted in between this time frame.

Reinforcement Assessment

Our models are built to determine:

1. How the LTS network can be optimised for storage within pressure parameters to maintain supplies to downstream distribution and directly connected customers, and
2. Where any pipeline or offtake constraints may exist (physical or commercial)

Where the analysis identifies constraints in capacity the following options for resolution are considered:

1. Network reconfiguration
2. Network reinforcement
3. Commercial services such as interruption
4. Use of additional NTS Capacity (Flat, Flex, Pressure)

If we identify a pressure or storage constraint, then we would first look to optimise and reconfigure the network to either drive more linepack or meet pressures as required at extremities within the existing parameters of the physical network e.g., can we reduce extremity pressures to increase storage or conversely can we increase PRS pressures to meet extremity minimums whilst maintaining our storage position.

Following on from the first step described above, we would also consider Interruption as well as additional products from the NTS prior to designing any reinforcement of the pipelines or equipment. In our view, this method drives network solutions that are least cost and most optimal for our customers.

The outputs from the annual modelling process are saved in the model data Form per LDZ and assurance checks are carried out to ensure that the models have been built and balanced correctly in line with the agreed strategy.

Section H Model Build

As per requirements set out in the Offtake Arrangement Document of the Uniform Network Code and the Exit Capacity Planning Guidance A57, we provide NGGT with capacity and pressure requirements away from peak 1 in 20. This is known as the Section H requirements and sets out our flat, flex and pressure requirements for a range of demand requirements away from peak:

Day 13, Day 46, Day 150, and Day 300 (summer) with Day 0 or 1 being peak 1 in 20

To produce this data output, we build a suite of demand models down the demand curve for each year of the forecast period and send this back to NGGT by the end of October.

The latest NTS Exit Capacity Substitution and Revision Methodology Statement confirms that NTS Exit Capacity required as a result of demand forecasts provided via Exit Capacity Planning processes as per Standard Special Condition A57 and the Exit Capacity Planning Guidance, will not be Substitutable, NGGT will use the data provided.

Network Planning Policies & Procedures

In addition to the industry standard IGEM/GL/2 Edition 3: Planning of gas transmission and storage systems operating at pressures exceeding 16 bar and our model validation procedure listed above, we adhere to the following internal planning policies and procedures throughout the annual plan cycle:

T/PL/NP/18.1 - Network Planning.

T/PL/NP/4 - Above 7 bar Network Analysis

T/PM/NP15 - Management Procedure for Planning and Network Analysis Requirements

T/PM/NP24 - Management Procedure for Network Planning Policy (T/PL/NP18.1)

A1.6 Network Considerations

Southwest

The Southwest part of our network covers a vast area of mainly domestic demand. There can be significant temperature differences between the Northern and Southern extremities of the network which can result in volatility in the gas usage by temperature sensitive loads during shoulder months.

The LTS is made up of 4 volumetric systems and several pressure-controlled networks. The pressure control networks are difficult to manage as they do what they need to maintain their set point and they make use of significant NTS Flex due to the absence of system linepack.

Southwest is the only area in the WWU network where the volumetric systems are fed by multiple offtakes, these need to be balanced efficiently in order to drive out as much storage as possible while keeping the system within its pressure parameters.

There are also several Bullet Storage sites to take into consideration and that interact with these volumetric systems. The Southwest Network is at an extremity of the NTS and so flexibility from the NTS is limited which means LDZ options to relieve constraints are usually required.

North Wales

We have a single offtake feeding our North Wales LDZ, a network which is split into two systems of large diameter pipelines covering a large geographic area but with relatively low overall demand in comparison to its size. These features result in a network with quite low gas velocities due to the distance that the network covers. There can be significant pressure drops across the network from Offtake to extremity and time of flight means that it can take a while for any adjustments at the offtake to be seen at the system extremity. The coastal part of the supply system is unique in that it contains a large HP Volumetric System within larger HP Volumetric system which means you must manage both sections together to drive out the most storage.

South Wales

In South Wales, all three offtakes are fed by the same NTS feeder main making flow swaps easier. It contains more industrial commercial loads than the other LDZ's, including a higher concentration of connected power generation and CNG fuelling connections/enquiries. One of our linepack systems also has a connected power generation load that doubles the amount of demand in the area when the site is operational. Unique in that some offtakes have both a Volumetric and a Pressure control outlet feeding different parts of the network. Our West Wales feed sees high pressures drops across the network but lower velocities at its extremities. Some parts of the network under summer conditions can see higher pressures at the extremity then at the offtakes due to altitude difference and the large diameter of the LTS mains.

Commercial Solutions

We target interruption to the areas with constraints identified but have not had any bids for interruption in the recent years of participation in the annual auction. This has reinforced the message that our customers reiterate year after year that a reliable and constant gas supply is important to them.

Since 2012, we have introduced network entry agreements (NExAs) which allow us to connect customers even if we are unable to secure small additional amounts of storage required by the site at peak demand. These agreements are for small intermittent loads and set out the

processes so that we communicate with the site at times of high demand which may cause us an issue in providing the storage associated with their full load. There are several steps that we go through in order to support these sites; we ask NGGT for the small additional amount of flex via Offtake Profile Notice (OPNs) and if that is not available then; we ask the site to run flat or at an agreed profile that we can support within our commercial bookings. We brought this commercial solution into play because the alternative pipeline or other storage physical solutions presented an efficient spend for the very small amounts of storage, we require per site e.g., Typically 0.01 mcmd.
Prior to signing a NExA, we pursue the ad-hoc flex request route with NGGT to secure enduring increments of Flex product. This is often declined which leads us to inserting a constraint clause in the NExAs.

A1.7 Production of offtake-level capacity and pressure requirements

Principles

The following principles and assumptions are applied when producing offtake level capacity and pressure requirements:

- Offtake capacity must be available to satisfy our 1:20 licence condition
- NTS Flat Capacity must be guaranteed through purchase of annual or enduring capacity as there are circumstances where NTS may not release capacity through daily auctions See: Exit Capacity Release (nationalgrid.com); paragraph 162
- NTS Flat Capacity cannot be offset by embedded biomethane supply as these supplies are not subject to flow obligations
- NTS Assured Pressure is more valuable than NTS Flex because of the notice periods / restrictions around use of NTS Flex Capacity
- NTS Assured Pressure and NTS Flex are discretionary products, so a high level of certainty is needed before it is released back to NTS on a permanent basis
- Requirements signalled through the provision of UNC Section H to NGGT name in the methodology statement] provide protection against NTS substitution
- It is appropriate to use information from modelling as well as actual flow data, operating strategies and information from stakeholders and wider industry to manage uncertainty and to determine final bookings.

Network Co-operation Requirements

We recognise the provisions of the Offtake Arrangements, Section I, and the System Flexibility Restriction Notice (SFRN) which provide for cooperation between the GDN and NTS control centres in relation to flow swaps, assured pressure adjustments and the release of additional NTS Flex capacity to support daily operation and maintenance requirements.

Assured offtake pressure assessment T-4

Following significant growth in embedded flexible gas generation over the past few years to support deployment of intermittent renewable generation across the UK, our storage requirements including from our own Linepack (reliable on Assure Offtake Pressure from the NTS) and from NTS Flex Capacity have increased significantly.

As detailed in the principles above, the use of LDZ Linepack is a much better option for GDNs than the use of NTS Flex, which is subject to notice periods under the Offtake Arrangements Document, Section I and can be withdrawn through processes defined in the SFRN.

Since NTS Flex and NTS Assured Offtake Pressures are discretionary products a high degree of certainty would be required before agreement was made for a permanent reduction of assured offtake pressure (AOP) including where NTS Flex Capacity was available instead.

Where NGGT request a reduction in AOP, analysis will be undertaken to determine whether this can be agreed based on our forecasts of future requirements.

Assured Offtake Pressure (AOP), Flat and / or Flex bookings for years T-3 to T-1

Our considerations for bookings for years T-3 to T-1 take account of requirements in later years and the implications of User Commitment should we need to increase bookings. We also consider the risk of substitution of capacity away from our offtakes if we reduce capacity and subsequently need to increase our holding

Recent changes to the NTS Exit Methodology in reducing User Commitment to 2 years where the requirement is in baseline and in the NTS substitution methodology which now takes account of data provided in our Section H data and excludes Exit Capacity Planning (ECP) forecasted capacity from 'Substitutable Capacity' mean that there may be cases where we can reduce bookings which would not have been efficient under previous arrangements.

However, we are still unable to fully optimise our bookings between different offtakes given even a 2-year user commitment could still mean we would need to retain capacity we might not need in the future.

As noted above, in considering reductions to pressure and flex capacity there is no guaranteed way to recover the capacity whose release is subject to NTS discretion.

In many cases a reduction in 1-in-20 demand forecast does not result in a reduced need for storage or assured offtake pressure because the new loads which are connecting have a more dynamic profile than existing loads, e.g., a power station moving from 24-hour operation to 16 hour operation would have a 1/3 reduction in flat capacity but a significant increase in storage required.

Cost implications of T-4 capacity booking patterns

Following the implementation of UNC Code Modification 0678 the cost implications of different (T-4) booking patterns have reduced with consistent NTS Flat Capacity prices being applied at all NTS Offtakes.

WWU book NTS Flat Capacity for T-4 to meet requirements for our 1-in-20 demand forecast excluding any future loads which are visible e.g., through customer discussions or via entries on the Capacity Market for Flexible Generation site but for which no financial commitment has been made.

Following the implementation of the ECPG and the ability to use the UNC Section H process to protect offtake capacity up to baseline the forecasts shared through that process would include those sites for which no financial commitment has been made.

The key consideration of cost implications is around the 2 or 4 year User Commitment which are currently in place for capacity bookings below baseline and the 4 year User Commitment for increases above baseline. Changes to capacity bookings to optimise our system where not strictly required are likely to be avoided where user commitment would be incurred are avoided and on the day flow swap arrangements would be used instead.

Scenarios considered as part of the booking process

The key factors that would feed into booking scenarios mean that there are usually few options to consider. To summarise:

- Where User Commitment is in place at Offtakes, we are unable to reduce bookings
- The absence of a definitive way to recover Flex and / or Pressure reductions means that these are avoided on an enduring basis.
- AOP is valued over NTS Flex
- NTS Baseline Capacity and Physical Capacity headroom will constrain bookings in some locations
- Several of our Offtakes are single feed
- Injection from Green Gas sites cannot be relied upon to meet our 1-in-20 requirements as their contracts are not for firm flow.

Comparison to FES Scenarios generated by NG-ESO

Demand scenario projections are provided by NG ESO to GDNs in May each year. These are produced by NG ESO in line with the FES process for each of the 4 Future Energy Scenarios. A five-year central forecast is also supplied. The NG projections and forecast are subject to review to ensure differences can be explained.

Comparisons are also undertaken with data received in previous years to understand how NG drivers are changing. In addition, significant attention is paid to the large load projections. These are often different to assumptions within the GDN e.g., for peak generation, figures NG may apply diversity so that the national generation figure reflects national requirements whereas GDN 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 NG-ESO would call into operation.

Appendix 2: Gas Demand & Supply Volume Forecasts

A2.1 Demand

Note: Volumes are estimated using CWV derived using EP2 data implemented in 2020. Figures may not sum due to rounding.

Figure A2.1 – Forecast 1 in 20 Peak Day Firm Demand Growth (GWh per day)

LDZ	2022/23	2023/24	2024/25	2025/26	2026/27	2027/28	2028/29	2029/30	2030/31	2031/32
South West	271	272	272	275	276	277	277	278	279	279
Wales North	51	51	51	51	52	53	53	53	54	54
Wales South	173	200	200	201	202	202	203	203	204	205
Network Total	494	522	524	527	529	531	533	535	537	538

Figure A2.2 – Forecast 1 in 20 Peak Day Firm Demand No Growth (GWh per day)

LDZ	2022/23	2023/24	2024/25	2025/26	2026/27	2027/28	2028/29	2029/30	2030/31	2031/32
South West	271	272	272	275	275	275	275	275	275	275
Wales North	51	51	51	51	51	51	51	51	51	51
Wales South	173	200	200	201	201	201	201	201	201	201
Network Total	494	522	524	527	527	527	527	527	527	527

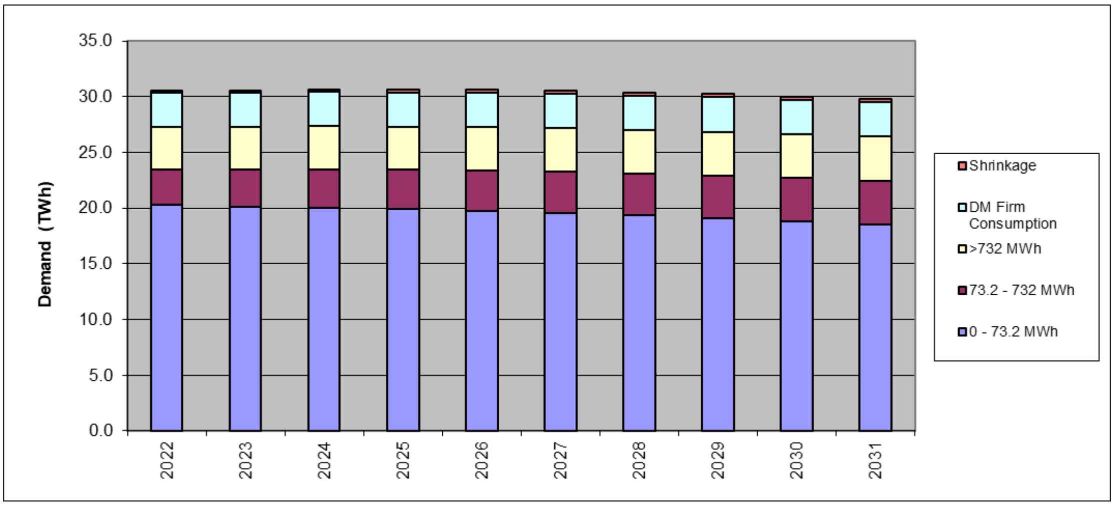
A2.2 South West Annual Demand

Figure A2.3 – Southwest LDZ Forecast Annual Demand Table by Load Categories (TWh)

Calendar Year	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031
0 - 73.2 MWh	20.27	20.15	20.03	19.90	19.75	19.55	19.33	19.10	18.84	18.55
73.2 - 732 MWh	3.17	3.32	3.45	3.54	3.63	3.69	3.75	3.80	3.84	3.90
>732 MWh	3.87	3.85	3.88	3.87	3.89	3.91	3.92	3.95	3.95	3.96
NDM Consumption	27.31	27.33	27.36	27.31	27.27	27.15	27.01	26.84	26.63	26.41
DM Firm Consumption	3.05	3.03	3.06	3.05	3.07	3.08	3.09	3.11	3.11	3.11
Total LDZ Consumption	30.36	30.36	30.41	30.37	30.34	30.23	30.10	29.95	29.74	29.52
Total Shrinkage	0.20	0.20	0.20	0.24	0.26	0.27	0.27	0.28	0.28	0.28
Total Throughput	30.56	30.55	30.62	30.60	30.60	30.50	30.37	30.22	30.02	29.80

Gas Supply Year	2020/21	2021/22	2022/23	2023/24	2024/25	2025/26	2026/27	2027/28	2028/29	2029/30
Total Throughput	30.01	30.03	30.19	30.11	30.22	30.23	30.31	30.28	30.15	30.01

Figure A2.4 – Southwest LDZ Forecast Annual Demand Graph by Load Categories (TWh)



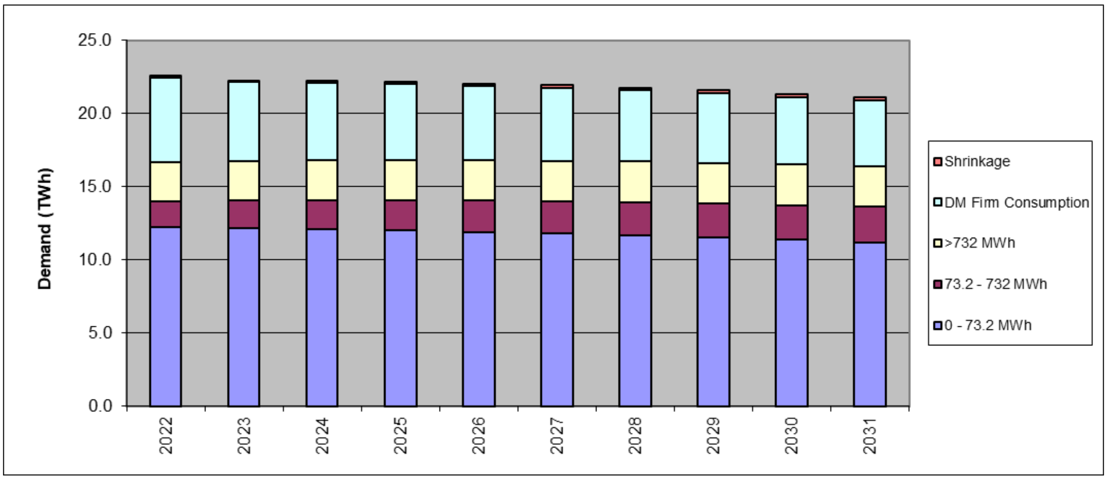
A2.3 Wales South Annual Demand

Figure A2.5 – Wales South LDZ Forecast Annual Demand Table by Load Categories (TWh)

Calendar Year	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031
(a) 0 - 73.2 MWh	12.21	12.15	12.08	12.00	11.91	11.79	11.66	11.51	11.36	11.19
(b) 73.2 - 732 MWh	1.76	1.89	2.01	2.09	2.17	2.23	2.29	2.34	2.39	2.43
>732 MWh	2.73	2.71	2.73	2.72	2.74	2.75	2.76	2.78	2.78	2.79
NDM Consumption	16.70	16.76	16.81	16.81	16.81	16.77	16.71	16.63	16.52	16.40
DM Firm Consumption	5.77	5.41	5.30	5.23	5.11	4.99	4.87	4.76	4.61	4.47
Total LDZ Consumption	22.47	22.17	22.11	22.04	21.92	21.76	21.58	21.39	21.14	20.88
Total Shrinkage	0.10	0.10	0.10	0.10	0.14	0.17	0.18	0.19	0.20	0.21
Total Throughput	22.57	22.27	22.21	22.14	22.06	21.93	21.76	21.58	21.34	21.09

Gas Supply Year	2020/21	2021/22	2022/23	2023/24	2024/25	2025/26	2026/27	2027/28	2028/29	2029/30
Total Throughput	22.42	30.42	30.19	30.73	30.15	29.04	27.34	25.33	25.11	25.50

Figure A2.6 – Wales South LDZ Forecast Annual Demand Graph by Load Categories (TWh)



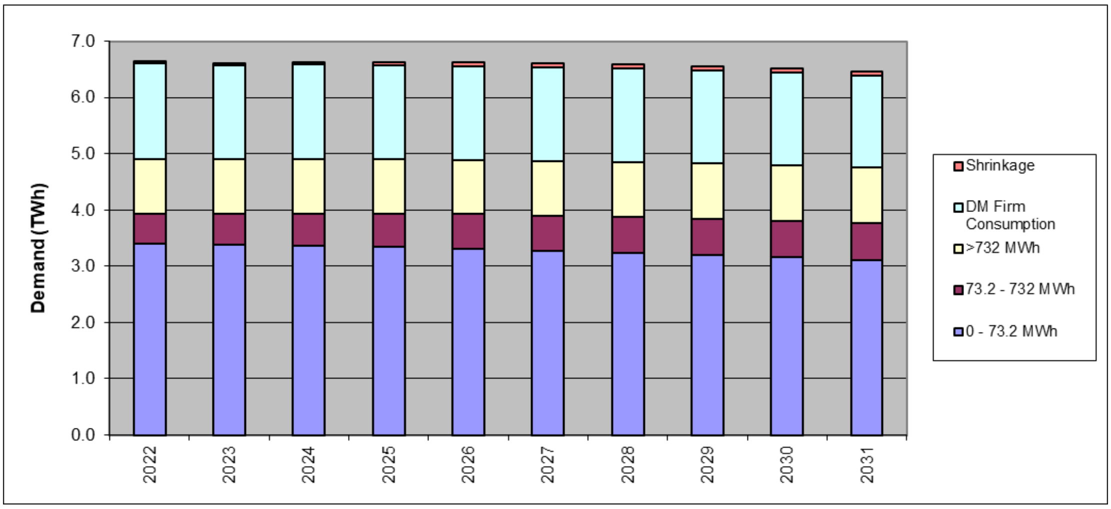
A2.4 Wales North Annual Demand

Figure A2.7 – Wales North LDZ Forecast Annual Demand Table – Split by Load Categories (TWh)

Calendar Year	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031
(a) 0 - 73.2 MWh	3.40	3.38	3.36	3.34	3.31	3.28	3.24	3.20	3.16	3.11
(b) 73.2 - 732 MWh	0.53	0.56	0.58	0.60	0.61	0.62	0.63	0.64	0.65	0.66
>732 MWh	0.96	0.96	0.97	0.96	0.97	0.97	0.98	0.98	0.98	0.99
NDM Consumption	4.90	4.90	4.90	4.90	4.89	4.87	4.85	4.82	4.79	4.75
DM Firm Consumption	1.71	1.68	1.68	1.68	1.67	1.67	1.66	1.66	1.65	1.63
Total LDZ Consumption	6.60	6.57	6.58	6.57	6.56	6.54	6.51	6.48	6.44	6.39
Total Shrinkage	0.04	0.04	0.04	0.06	0.07	0.07	0.08	0.08	0.08	0.08
Total Throughput	6.65	6.62	6.63	6.63	6.63	6.62	6.59	6.56	6.51	6.46

Gas Supply Year	2020/21	2021/22	2022/23	2023/24	2024/25	2025/26	2026/27	2027/28	2028/29	2029/30
Total Throughput	6.58	6.60	6.64	6.62	6.64	6.64	6.65	6.65	6.62	6.59

Figure A2.8 – Wales North LDZ Forecast Annual Demand Graph by Load Categories (TWh)



Appendix 3 : Actual Flows 2021

A3.1 Annual flows

As demand forecasts are made without knowledge of what weather conditions will prevail in the future, they are prepared using seasonal normal temperatures. To compare actual throughput with forecast values, the impact of weather needs to be removed from the figures. This is known as weather corrected demand.

The weather corrected demand gives the expected level of demand for 2021 had the weather been at its seasonal normal value. As can be seen in the tables below the actual demand in 2021 was very similar to the seasonal normal in the Wales North but was lower in Wales South and the Southwest areas.

Figure A3.1 – Southwest LDZ Annual Demand 2021 (TWh)

	2021 Actual Demand	Weather Corrected Demand	2021 Forecast Demand
0 – 73 MWh	20.52	19.95	19.40
73 – 732 MWh	2.87	2.82	3.27
> 732 MWh Firm	4.47	4.42	4.38
DM Consumption	3.15	3.13	3.12
Total Consumption	31.01	30.33	30.17
Unidentified Gas	0.35	0.35	0.00
Shrinkage	0.20	0.20	0.21
Total Throughput	31.55	30.88	30.38

Figure A3.2 – Wales South LDZ Annual Demand 2021 (TWh)

	2021 Actual Demand	Weather Corrected Demand	2021 Forecast Demand
0 – 73 MWh	11.91	11.80	11.70
73 – 732 MWh	1.31	1.31	1.82
> 732 MWh Firm	2.82	2.81	2.77
DM Consumption	5.80	5.80	6.03
Total Consumption	21.85	21.72	22.33
Unidentified Gas	0.20	0.30	0.00
Shrinkage	0.10	0.10	0.10
Total Throughput	22.15	22.12	22.43

Figure A3.3 – Wales North LDZ Annual Demand 2021 (TWh)

	2021 Actual Demand	Weather Corrected Demand	2021 Forecast Demand
0 – 73 MWh	3.48	3.36	3.26
73 – 732 MWh	0.48	0.47	0.57
> 732 MWh Firm	1.01	0.99	1.06
DM Consumption	1.75	1.74	1.70
Total Consumption	6.72	6.57	6.59
Unidentified Gas	0.10	0.10	0.00
Shrinkage	0.04	0.04	0.04
Total Throughput	6.87	6.72	6.63

A3.2 Maximum and peak flows

In 2021/22 our most severe weather occurred on the 20th January 2022 in the Southwest, the 24th January 2022 in the Wales South LDZ, and a few day later for Wales North on the 25th January 2022. The maximum firm demand for the whole network this gas year occurred on the 21st February 2022 and was 29.05 mcm. This was lower than 2020/21 total demand, and still significantly lower than the peak demand of 2018 during on the 1st March when extreme weather led to demands of 42.57 mcm.

The maximum and minimum for the LDZs are shown in the following table.

Figure A3.4 – LDZ Peak, Maximum & Minimum Flows (mcm)

South West	Maximum Day 20/01/2022	1 in 20 Forecast peak 2021/22	Minimum Day 13/08/2022
	16.06	24.32	2.12
Wales South	Maximum Day 24/01/2022	1 in 20 Forecast peak 2021/22	Minimum Day 17/07/2022
	10.15	15.34	2.08
Wales North	Maximum Day 25/01/2022	1 in 20 Forecast peak 2021/22	Minimum Day 13/08/2022
	2.97	4.44	0.63

Appendix 4 : Our Future of Energy Research

A4.1 Introduction

We remain committed to exploring innovative ways of designing and implementing a greener network for our customers. Maintaining a consumer-focus to this work and ensuring a just transition is crucial for us, For a comprehensive summary of our research and innovation work towards decarbonisation and a net zero gas distribution network, please see our annual report: WWU Innovation Report 2021/22.

This appendix provides further information about the research that we have undertaken into the future of energy.

The future of gas debate is critical in deciding future investment policy and asset lifespans. As such, it has an impact on investment decisions and will influence future negotiations for funding allowances within regulatory timelines.

We have completed several projects with a number of different approaches to help us understand how our customers will want to use our network in the future. These have ranged from desktop analysis to live trials. Where possible we have sought input from stakeholders to inform our approach and the projects' outcomes.

A4.2 Projects summary

Overview of our recent research projects	
Project name	**Project summary**
SWIC Hydrogen Supply Pipeline Infrastructure	Develop a study to perform an early identification and evaluation of supply and demand scenarios for hydrogen in south Wales and the pipeline infrastructure required to meet potential demand.
SWIC Market-Accelerating Hydrogen Distribution and Storage	Evaluate market-accelerating hydrogen distribution and storage options to connect large-scale production with demand as an alternative to gas network development.
Tools of Engagement phase 2	Engage with a group of potential stakeholders to test the Energy Systems Toolkit, which was created in GD1, in real-life situations.
SWIC: Assessment of potential hydrogen demand in 2030 - 2050	Assess the development of hydrogen infrastructure in south Wales under the SWIC Deployment Phase 2.
Regional Decarbonisation Pathway	Provide a strategic plan to decarbonise Wales and the southwest of England (strategic plan) and provide details of the future gas network requirements to achieve the optimal energy system for the Wales & West Utilities network (conceptual plan).

Project name	Project summary
SWIC – Hydrogen Peaking Plant Feasibility Study	Develop a study to assess the interaction of gas-fired peaking plants connected to Wales & West Utilities' network when the plant is converted to hydrogen.
Industrial Fuel Switching (IFS2)	Identify barriers and solutions to allow industrial users, within the GDN and new connections, to accelerate their decarbonisation.
HyPark Discovery	Assess the part gas could play in helping to power EV charging stations in commercial and local authority properties and in areas where the electricity network is unable to support EV charging at scale.
OptiNet	Assessing the potential for lower investment solutions including compression solutions to be used to improve network capacity.
Bridgend Phase 4	This project assessed case studies which consider whether Smart Hybrid Heating System(s) are part of the solution to decarbonise UK Home Heating, whenever it is technically and economically practicable to 'retrofit' these Systems into existing UK homes Although this project wasn't a live trial it did use the data from our Freedom Project which was a live trial.
Milford Haven Energy Kingdom	Centred in Milford Haven, the project will focus on developing diverse, local seed markets to support the transition to hydrogen and renewables from fossil fuels.
Flexible Generation Forecasting	This is a project to identify the key drivers and datasets that will enable us to improve whole system forecasting and network planning / operation in close to real time.
Hybrid Hydrogen – HyHy	HyHy will look to assess the combined energy demands of a selected region (Cardiff) to understand how the deployment of hybrid heating technology in combination with bulk hydrogen supply is able to achieve carbon compliance with respect to national carbon targets.

WWU continues its ground-breaking work looking into the future role of gas from a consumer's perspective and has published a range of short papers which are available on the Future of Energy Section of our website. The following list covers ongoing and recently closed projects that WWU are leading or contributing to:

2050 Pathfinder & Energy Systems Toolkit, we continue to develop the 2050 Pathfinder model that enables low carbon alternatives to be evaluated at individual property level. The recently upgraded model allows us to view the impact of increased integration of the gas and electricity networks, and to provide impacts in terms of costs and CO_2 reduction for customers.

2050 Pathfinder is a key part of our Energy Systems Toolkit, which offers local communities, local authorities, and government at all levels the opportunity to design a future energy system that reaches Net Zero in a way that is affordable and reliable. Combining our innovative whole systems simulator, 2050 Pathfinder and a Net Zero knowledge and guidance document, the Energy Systems Toolkit is an accessible tool that simulates carbon emissions, bill costs and local supply availability, allowing users to assess impacts of Net Zero plans. Developed alongside independent consultancy DeltaEE and taking into account feedback from local authorities and interest groups, the toolkit can support local energy planning – no matter where an organisation is in strategy or plan development – ranging from initial capability building, scoping and initial development – to much later stages: supporting with stakeholder engagement and public consultation.

Redcar Hydrogen Community, we have partnered with Northern Gas Networks (NGN) to support delivery of the Redcar Hydrogen Community, one of two proposed 'Hydrogen Village Trials' in the UK. The project, currently in detailed design phase, aims to convert up to 2,000 properties from natural gas to hydrogen heating by 2025. The project aims to show that existing gas networks can be safely and effectively converted to 100% hydrogen with minimal cost and disruption to customers provide enough information for government to make a policy decision in 2026 on the long-term role of hydrogen in heating in homes; support the development of hydrogen supply chains; and create green jobs and training programmes and support the development of local economies.

While the Redcar Hydrogen Community is in NGNs geography, a number of Wales & West Utilities colleagues are seconded to the project, playing a part in driving forward the hydrogen agenda and bringing back valuable insights and knowledge to our business.

The Freedom Project, we are committed to developing solutions which contribute to all areas of the energy trilemma based on our understanding using the models already described above. In January 2019 we completed a project which we led, with Western Power Distribution our local Distribution Network Operator ("DNO") and other partners, where a number of homes had smart hybrid heating systems installed which optimised heat production through the use of an air source heat pump or gas boiler depending on the relative efficiency and tariff associated with each.

The results of The Freedom Project are a breakthrough and have demonstrated that by optimising the use of renewable electricity when it's available, with a back-up of renewable gas stored and flexibly available for peak demand, a complete decarbonisation of domestic heat is possible – delivering secure heat at the lowest possible cost with minimal disruption to consumers and achieving the best performance out of existing utility infrastructure. This is reflected in the latest gas networks' project 'Pathways', which recognises smart hybrid heating systems as the dominant domestic heating installation in 2050, with the boiler either fuelled by hydrogen or bio- methane with a hydrogen blend – depending upon the gas that is available in different regions of GB, which is linked to locations of industrial clusters fuel-switching to hydrogen at-scale and the ease of access to CCS.

Freedom has collected 6 national awards, from IGEM, Business Green, Regen, Network and two from the UK Energy Innovation Awards.

HyCompact, further developing the technology explored in the Freedom Project, HyCompact aims to demonstrate the efficiencies of installing a single-unit hybrid heating system to further develop customer acceptability, minimise disruption, improve cost efficiency and enhance smart controls with boiler modulation. The project is a collaboration with UK Power Networks and is expected to demonstrate system benefits of large-scale deployment of such low cost, integrated hybrid heating systems with an aggregated control system. The project has successfully installed these hybrid heating systems in consumers' homes and has been testing innovative smart switching signals, including marginal carbon intensity forecasts and minimum Conference of the Parties (COP) thresholds.

Milford Haven Energy Kingdom ("MH-EK") aims to accelerate the transition to an integrated hydrogen and renewable energy system by creating diverse, local, community-based markets that integrate with, and benefit from, the cluster of major energy infrastructure along the Milford Haven Waterway. The project will build and demonstrate hydrogen-ready features and technologies such as fuel cell RASA cars with an electrolyser providing green hydrogen for refuelling and a hydrogen-ready hybrid heating system into one of the Port's commercial buildings. We plan to test the hydrogen boiler with a hydrogen blend and 100% hydrogen later in 2021. The project is also developing the early hydrogen market architecture with smart energy systems to link up supply with demand and to utilise local renewable electricity via virtual private wire.

Working with a consortium of partners, the project aims to spearhead the transition to hybrid hydrogen and renewable energy production. The partners and main contractors also include Pembrokeshire County Council, the Offshore Renewable Energy Catapult, Riversimple, Port of Milford Haven, ARUP, and the Energy Systems Catapult.

South Wales Industrial Cluster (SWIC), we are partners on the SWIC Plan and Deployment projects. We have recently received Innovate UK funding to develop the plans for a South Wales hydrogen distribution network to supply industry and other sectors including domestic heating. The projects will look at the infrastructure required for the development of the hydrogen economy, for large scale CO2 capture, usage, and storage (CCUS) and transport/shipping as well as onsite strategic opportunities specific to each industry. SWIC comprises a diverse set of industries including oil refining, paper, nickel, insulation, chemicals, liquid natural gas (LNG) import, coin production, general manufacturing, steel, and cement. The further benefits of decarbonising transport and power generation are also included within the cluster activities.

The project website can be accessed via the following link: https://www.swic.cymru/

Regional Decarbonisation Pathways, this recently commenced collaboration with Energy Systems Catapult (ESC) and Costain seeks to develop our vision for the decarbonised future of our network into a more detailed conceptual design. Following literature review and expert interviews, ESC will model multiple scenarios based on whole-system approaches, developing pathways out to 2050 at five-year intervals, going into sub-regional geographical level. This will feed into Costain's conceptual design work, which will establish best approaches for our network locally, taking into consideration existing and evolving network configuration. The project is expected to complete in Spring 2022.

WWU Net Zero-ready gas network by 2035, the WWU vision enables decarbonisation of heat, as part of a wider, whole system pathway to mitigate the threat of climate change.

Our ambitious whole system plan will decarbonise heat, power, and transport in our regions, delivering a net zero ready network by 2035. Based on a broadly defined whole system approach, our plan will facilitate low cost, reliable and sustainable energy for generations today and in the future.

We are responding to the clear steer from consumers, organisations such as local authorities, and public opinion in general that society must act now to mitigate the threat of climate change. This steer, combined with our own ambitions, provides the basis for our net zero ready vision and for the timeline to achieve this by 2035 – a pathway that while ambitious, is both credible and achievable.

Our plan is founded on extensive research and live trials and reflects the view from wider research and opinion formers that a variety of solutions, applied on a regional basis, will be required. Our approach will support the development by Local Authorities of their Local Area Energy Plans (LAEPs). These plans will provide substantial value to consumers by ensuring that energy system solutions offer the lowest cost pathway and least disruption. Pathfinder and Pathfinder Plus, our ground-breaking energy system simulator, described above, will enable this best value to be extracted.

Bridgend Phase 4, this project assessed case studies which consider whether Smart Hybrid Heating System(s) are part of the solution to decarbonise UK Home Heating, whenever it is technically and economically practicable to 'retrofit' these Systems into existing UK homes Although this project wasn't a live trial it did use the data from our Freedom Project which was a live trial.

A number of case studies were considered including private homes on and off the gas grid, investors, and private and public sector landlords.

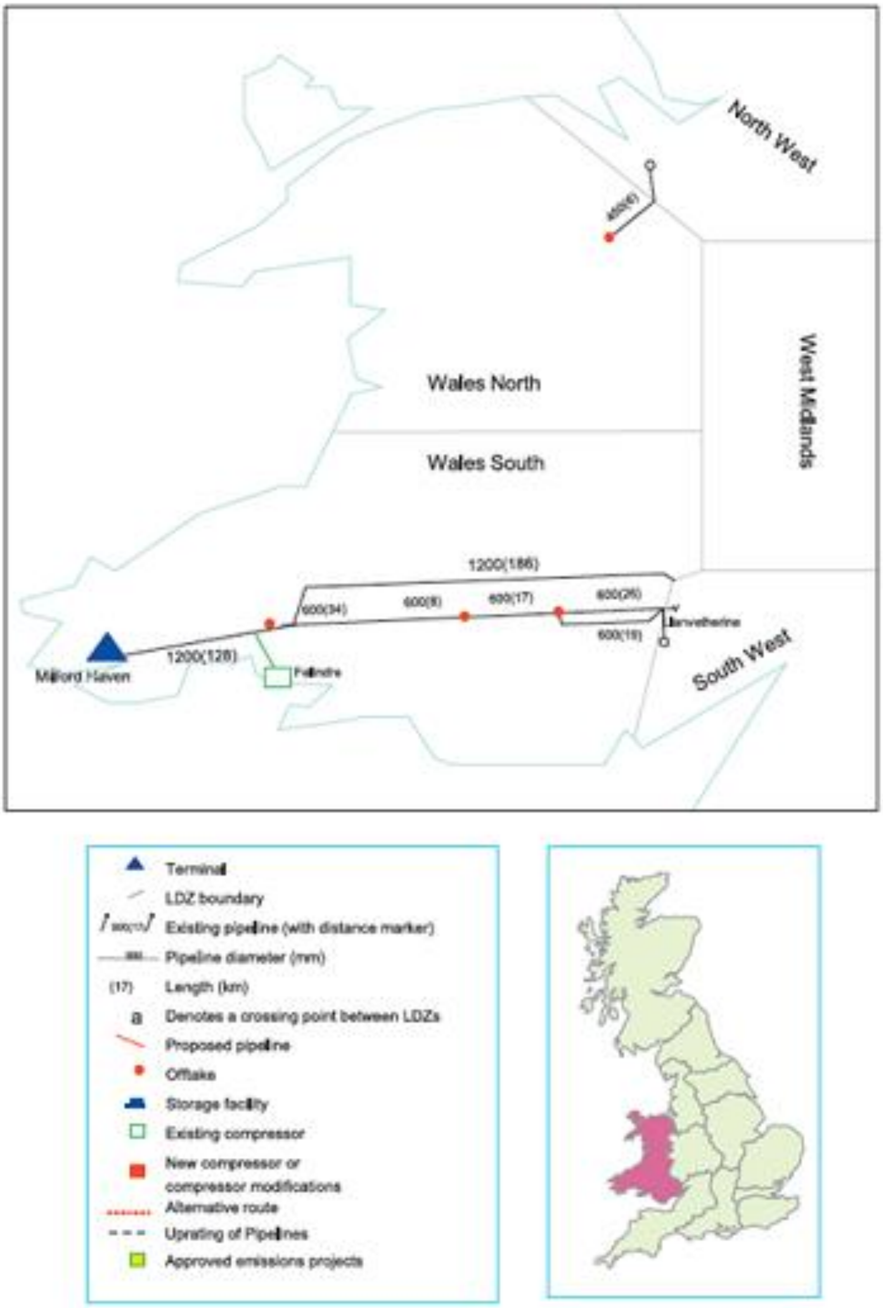
The outputs show that in many cases hybrid heating systems will be the preferred solution when decarbonising homes compared with a full air source heat pump solution. In addition, a calculator was produced to assess any individual case.

Flexible Generation Forecasting, this is a project to identify the key drivers and datasets that will enable us to improve whole system forecasting and network planning / operation in close to real time. This is necessary because we are seeing significant changes in the ways in which gas is used for electricity generation as gas generation moves from base load to a more flexible responsive mode of operation as it is used to balance the intermittency of renewable generation supplies.

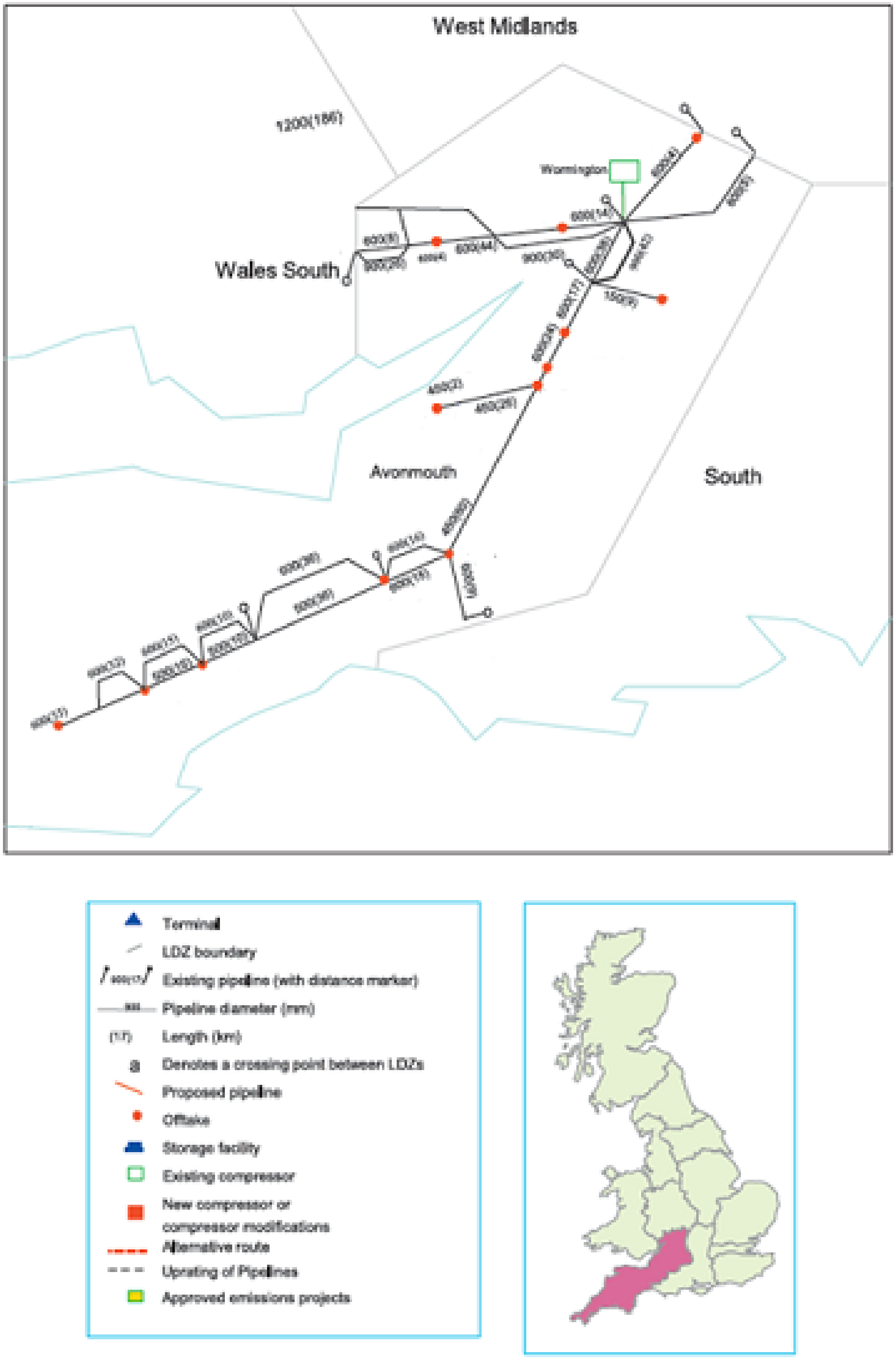
We are partnering with NG-ESO, SP Energy Networks and NGN and the contractors are Delta-ee and Afry.

Appendix 5 : The Gas Transportation System

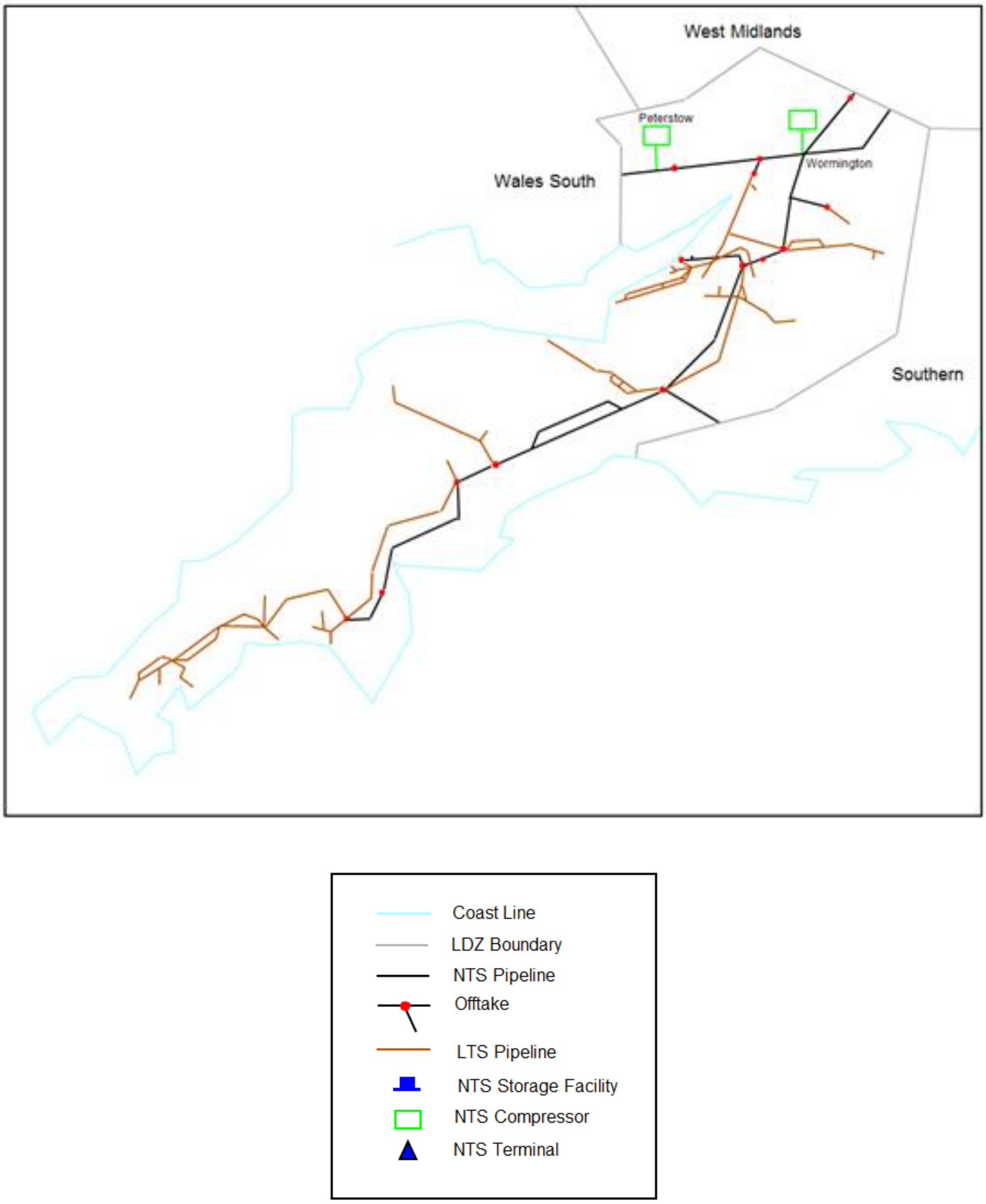
A5.1 Wales North and Wales South (WN & WS) NTS



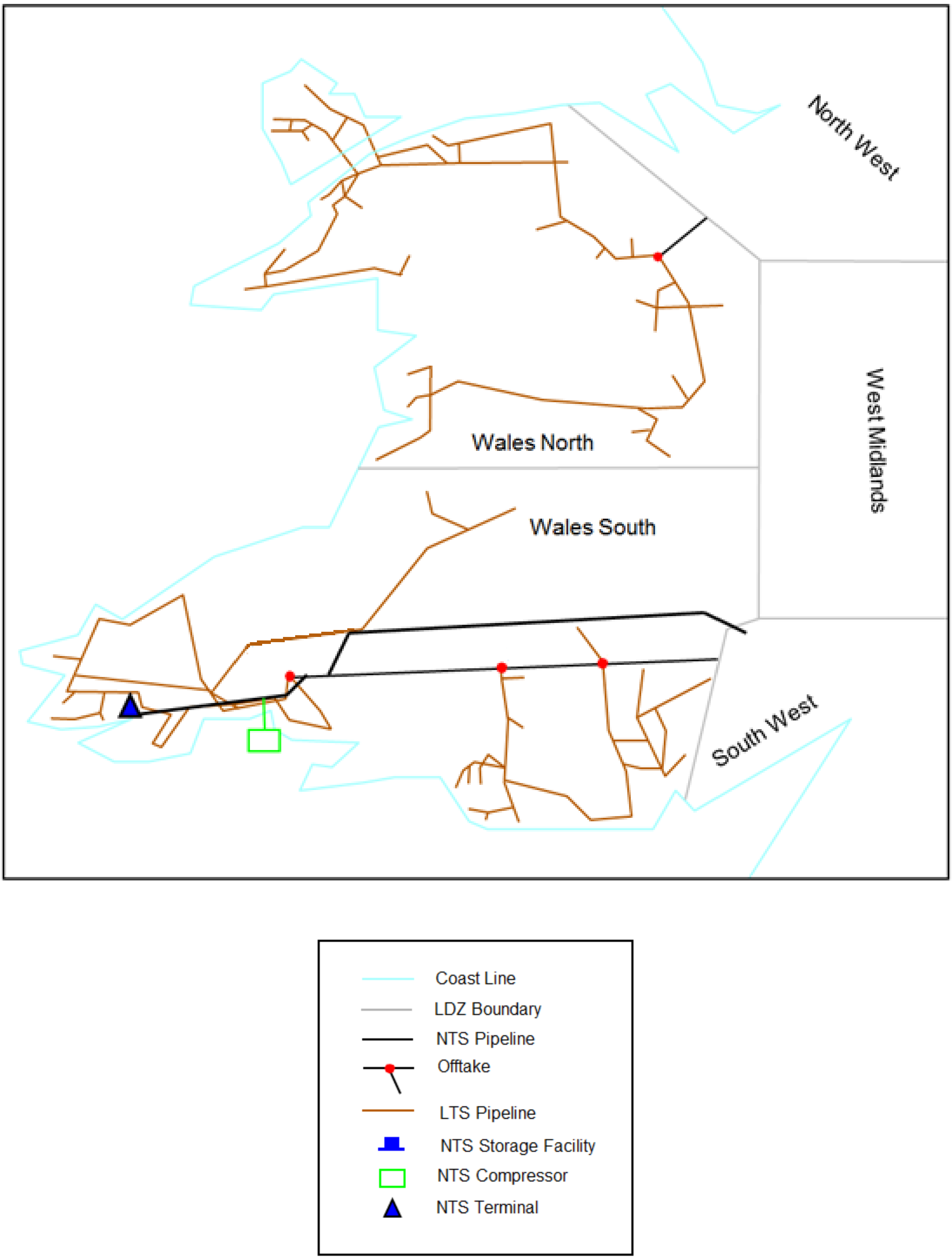
A5.2 South West (SW) NTS



A5.3 South West (SW) LDZ - LTS



A5.4 Wales North and Wales South (WN & WS) LTS



Appendix 6 : Connections to WWU's System

A6.1 Introduction

We offer connection services in line with our Gas Act obligations. System entry connections conditions are detailed in Section A6.3 below.

Our exit connections allow gas to be 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-WWU pipeline transporting gas to premises consuming more than 2,196 MWh per annum.

Please note that in addition to new pipes being termed connections, any requirement to increase the quantity of gas delivered to or taken from the system is also treated as a new connection.

A6.2 General information regarding connections

Our connection charging policy for all categories of connection is set out in the publication 'Standard Condition 4B of the Gas Transporter Licence – Statement of Principles and Methods to be used to determine charges for Gas Distribution Connections Services', which is supported by our Connections and Other Distribution Services Charges Document. We have now introduced an administration charge for connection enquiries. Further information can be found on our website (www.wwutilities.co.uk).

Additional information relating to the connection process, including contact details, can also be found on the website. It should be noted that any person wishing to connect to our system or requiring increased flow should contact us as early as possible to ensure that requirements can be met on time, particularly if system reinforcement is required.

A6.3 Information for system entry connections

We require a Network Entry Agreement (NEA) or Connection Agreement with the respective operator 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.

A6.3.1 Network entry quality specification

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

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

For indicative purposes, the specification 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.

1. Hydrogen Sulphide
    - Not more than 5mg/m3
2. Total Sulphur
    - Not more than 50mg/m3
3. Hydrogen
    - Not more than 0.1% (molar)
4. Oxygen
    - Not more than 1% (molar) - HSE has now issued a class exemption to GS(M)R to allow network conveyance of gas with an oxygen content <= 1% (molar) at pressures up to 38 barg
5. Hydrocarbon Dewpoint
    - Not more than -2°C at any pressure up to 85barg
6. Water Dewpoint
    - Not more than -10°C at 85barg
7. Wobbe Number (real gross dry)
    - The Wobbe Number shall be in the range 47.20 to 51.41MJ/m3
8. Incomplete Combustion Factor (ICF)
    - Not more than 0.48
9. Soot Index (SI)
    - Not more than 0.60
10. Gross Calorific Value (real gross dry)
    - The Gross Calorific Value (real gross dry) shall be in the range 36.9 to 42.3MJ/m3, in compliance with the Wobbe Number, ICF and SI limits described above. Subject to gas entry location and volumes, we may set a target for the Calorific Value within this range
11. Inerts
    - Not more than 7.0% (molar) subject to
    - Carbon Dioxide: not more than 2.0% (molar). Please note that there is a proposal by NG to modify the UNC to a limit of 2.5% (as mentioned above the limit is indirectly limited by the GS(M)R)
12. Contaminants
    - The gas shall not contain solid, liquid, or gaseous material that may interfere with the integrity or operation of pipes or any gas appliance within the meaning of regulation 2(1) of the Gas Safety (Installation and Use) Regulations 1998 that a consumer could reasonably be expected to operate
13. Organo Halides
    - Not more than 1.5 mg/m3
14. Radioactivity
    - Not more than 5 Becquerels/g

15. Odour
    - Gas delivered shall have no odour that might contravene the statutory obligation not to transmit or distribute any gas at a pressure below 7 barg, which does not possess a distinctive and characteristic odour
16. Pressure
    - The delivery pressure shall be the pressure required to deliver natural gas at the Delivery Point into our Entry Facility at any time taking into account the back pressure of our System at the Delivery Point as the same shall vary from time to time
    - The entry pressure shall not exceed the Maximum Operating Pressure at the Delivery Point
17. Delivery Temperature
    - Between 1°C and 20°C
18. Siloxanes
    - We, along with the other GDNs have now adopted the new limit on siloxanes of 0.23mg per cubic metre of gas entered into the network from 1st May 2021.

Please note that the Incomplete Combustion Factor (ICF) and Soot Index (SI) have the meanings assigned to them in Schedule 3 of the GS(M)R. In addition, where limits on gas quality parameters are equal to those stated in GS(M)R (Hydrogen Sulphide, Total Sulphur, Hydrogen, Wobbe Number, Soot Index, and Incomplete Combustion Factor), we may require an operational tolerance to be included within an agreement to ensure compliance with the GS(M)R.

Due to continuous changes being made to the system, any undertaking made by us on gas quality prior to signing an agreement will normally only be indicative.

A6.4 Additional information specific to system exit connections

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

We require a Network Exit Agreement (NExA) for intermittent, unpredictable loads wanting to connect onto the distribution network. The NExA sets out the terms and parameters associated with the exit connection. In order to enforce the NExA, we require the installation of a logger to be able to monitor hourly and daily flows as set out in the agreement.

We may require an ARCA for exit connections. An ARCA will always be required for any load that is expected to consume more than 58.6 GWh a year. For loads of 58.6 GWh and below, WWU may require an ARCA where the cost of WWU funded Specific Reinforcement upstream of the Connection Charging Point (that is the total cost of the Specific Reinforcement minus any customer contribution) is £100,000 or more.
The period for which capacity can be reserved under and ARCA will be decided on a case-by-case basis to reflect the time reasonably required to complete the project.

A Customer may request an ARCA from WWU for any load over 73,200kWh a year if it wishes to guarantee the capacity and is willing to accept the commitments in the ARCA.

A6.4.1 Offtake pressures - distribution network connections

Gas will normally be made available to consumers at a pressure that is compatible with a regulated metering pressure of 2 mbar. Information on the design and operating pressures of distribution pipes can be obtained by contacting us.

A6.4.2 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 2,196 MWh per annum or less, ownership of the pipe will transfer to us once the connection to our system has been made.

Where the connection is for a self-laid pipe to premises with an expected consumption of more than 2,196 MWh per annum or the connection is to a pipe in our system which is not a relevant main, these pipes do not automatically belong to 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 the published Licence Condition 4B Statement and make contact prior to the planning phase of any project.

A6.4.3 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. However, 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. In particular, we will typically require two 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.

Appendix 7 : Gas Transporter Licence

A7.1 Overview

Our Gas Transporter (GT) Licence arrangements include a number of incentives, which are there to incentivise the networks to focus on specific outputs valued by Stakeholders. We have an Exit Capacity Incentive which is there to encourage us to minimise our Flat Capacity bookings with the NTS. In the longer term, if we can reduce our flat capacity requirements from the NTS, the NTS may be able to avoid additional investments and therefore minimise costs to gas users.

A7.2 Distribution Network Exit Incentive

Following a robust and transparent price control review process we have been given baseline volume capacity allowances. Each October we agree with the NTS our flat capacity requirements for the gas year ahead (Oct to Sept). Each year, our booking requirements then are compared to the upfront volume allowances and if we are able to book less than the allowances, we can earn additional revenues but if we have to book more than the baseline up front allowances, we will have revenue deducted. The incentive is symmetrical and does not have any caps or collars. Any gains or losses are shared with gas consumers.

For further details on our incentives please refer to our Gas Transporter licence and the Ofgem website.

Appendix 8 : Glossary

Annual Quantity (AQ)

The AQ of a supply point is its annual consumption over a 365-day year, under conditions of average weather.

Bar

The unit of pressure that is approximately equal to atmospheric pressure (0.987 standard atmospheres). Where bar is suffixed with the letter g, such as in barg or mbarg, the pressure being referred to is gauge pressure, i.e., relative to atmospheric pressure. One millibar (mbar) equals 0.001 bar.

Calorific Value (CV)

The ratio of energy to volume measured in Mega Joules per cubic meter (MJ/m^3), which for a gas is measured and expressed under standard conditions of temperature and pressure.

Climate Change Levy (CCL)

Government tax on the use of energy within industry, commerce, and the public sector in order to encourage energy efficient schemes and use of renewable energy sources. CCL is part of the government's Climate Change Programme (CCP).

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.

Combined Cycle Gas Turbine (CCGT)

A Combined Cycle Gas Turbine is a unit whereby electricity is generated by a gas powered turbine and also a second turbine. The hot exhaust gases expelled from the first turbine are fed into the heat exchanger to generate steam, which powers the second turbine.

Combined Heat and Power (CHP)

The simultaneous generation of electricity and heat for use within buildings or processes, by recovery of the heat produced in the power generation process.

Conference of the Parties (COP)

United Nations climate change conference involving states that have signed on to the United Nations Framework Convention on Climate Change.

Connected System Exit Point (CSEP)

This is a connection to a more complex facility than a single supply point. For example, a connection to a pipeline system operated by another Gas Transporter.

Cubic Metre (m^3)

The unit of volume, expressed under standard conditions of temperature and pressure, approximately equal to 35.37 cubic feet. One million cubic metres (mcm) are equal to 10^6 cubic metres, one billion cubic metres (bcm) equals 10^9 cubic metres.

Daily Metered Supply Point

A supply point fitted with equipment, for example a datalogger, which enables meter readings to be taken on a daily basis. Further classified as SDMC, DMA, DMC or VLDMC according to annual consumption.

Datalogger

An electronic device that automatically records, stores, and transmits meter readings (such transmission usually being via PSTN lines).

Distribution Network or Independent Distribution Network (iDN)

An independent gas transporter responsible for the operation and maintenance of the LTS and <7barg DNs within a defined geographical boundary.

Distribution System

A Network of mains operating at three pressure tiers: intermediate (2 to 7barg), medium (75mbarg to 2barg) and low (less than 75mbarg).

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 bullets and gasholders, or in the form of Linepack within transmission, i.e., >7barg, pipeline systems.

Energy phase 2 (EP2)

A joint project between the Hadley Centre, EDF Energy, E.ON, C.E. Electric, Centrica, National Grid, Northern Ireland Electricity, npower, Scottish Power, Scottish and Southern Energy, United Utilities and Western Power Distribution to look at the impact of climate change on the energy industry.

Exit Zone

A geographical area (within an LDZ) that consists of one or more Offtakes that, on a peak day, receive gas from the same NTS pipeline.

Formula Year

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

Gas Transporter (GT)

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

Gas Supply Year

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

Interconnector

A pipeline transporting gas to another country. The Irish interconnector transports gas across the Irish Sea to both the Republic of Ireland and Northern Ireland. The Continental Interconnector transports gas between Bacton and Zeebrugge. The Continental Interconnector is capable of flowing gas in either direction.

Interruptible Service

A service where the transporter can interrupt the flow of gas to the supply point in return for lower transportation charges.

Kilowatt hour (kWh)

A unit of energy used by the gas industry. Approximately equal to 0.0341 therms. One Megawatt hour (MWh) equals 10^3 kWh, one Gigawatt hour (GWh) equals 10^6 kWh, and one Terawatt hour (TWh) equals 10^9 kWh.

Linepack

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

Liquefied Natural Gas (LNG)

Gas stored in liquid form.

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 from the NTS. Consists of LTS and distribution system pipelines.

Local Transmission System (LTS)

A pipeline system operating at >7barg that transports gas from 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, pipeline systems and offtakes. Designed to operate at pressures up to 85 bar. NTS pipelines transport gas from terminals to Offtakes.

Non-Daily Metered (NDM)

A meter that is read monthly or at longer intervals. For the purposes of daily balancing, the consumption is apportioned, using an agreed formula, and for supply points consuming more than 73.2MWh pa, reconciled individually when the meter is read.

Odorisation

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

Office of Gas and Electricity Markets (Ofgem)

The regulatory agency responsible for regulating the UK's gas and electricity markets.

Offtake

An installation defining the boundary between NTS and WWU Network or a very large consumer. The offtake installation includes equipment for metering, pressure regulation, etc.

Own Use Gas (OUG)

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

Price Control Review (PCR)

Ofgem's periodic review of our allowed returns, the current PCR runs for the period 2013/14 to 2020/21

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 a 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.

Shipper or Uniform Network Code Registered User (System User)

A company with a Shipper Licence that is able to buy gas from a producer, sell it to a supplier and employ a GT to transport gas to consumers.

Shrinkage

Gas that is input to the system but is not delivered to consumers or injected into storage. It is either Own Use Gas or Unaccounted for Gas.

Supplier

A company with a Supplier's Licence contracts with a shipper to buy gas, which is then sold to consumers. A supplier may also be licensed as a shipper.

Supply Hourly Quantity (SHQ)

The maximum hourly consumption at a supply point.

Supply Offtake Quantity (SOQ)

The maximum daily consumption at a supply point.

Supply Point

A group of one or more meters at a site.

Therm

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

Transporting Britain's Energy (TBE)

NG's annual industry-wide consultation process encompassing their Ten Year Statement, targeted questionnaires, individual company and industry meetings, feedback on responses and investment scenarios.

Unaccounted for Gas (UAG)

Gas lost during transportation. Includes leakage, theft, and losses due to the method of calculating the Calorific Value (Flow Weighted Average CV cap is set at 1 MJ/m^3 above the lowest CV).

UKCS

United Kingdom Continental Shelf

Uniform Network Code (UNC)

The document that defines the arrangements between WWU, NG, the other DNs and System Users.

Appendix 9 : Conversion Matrix

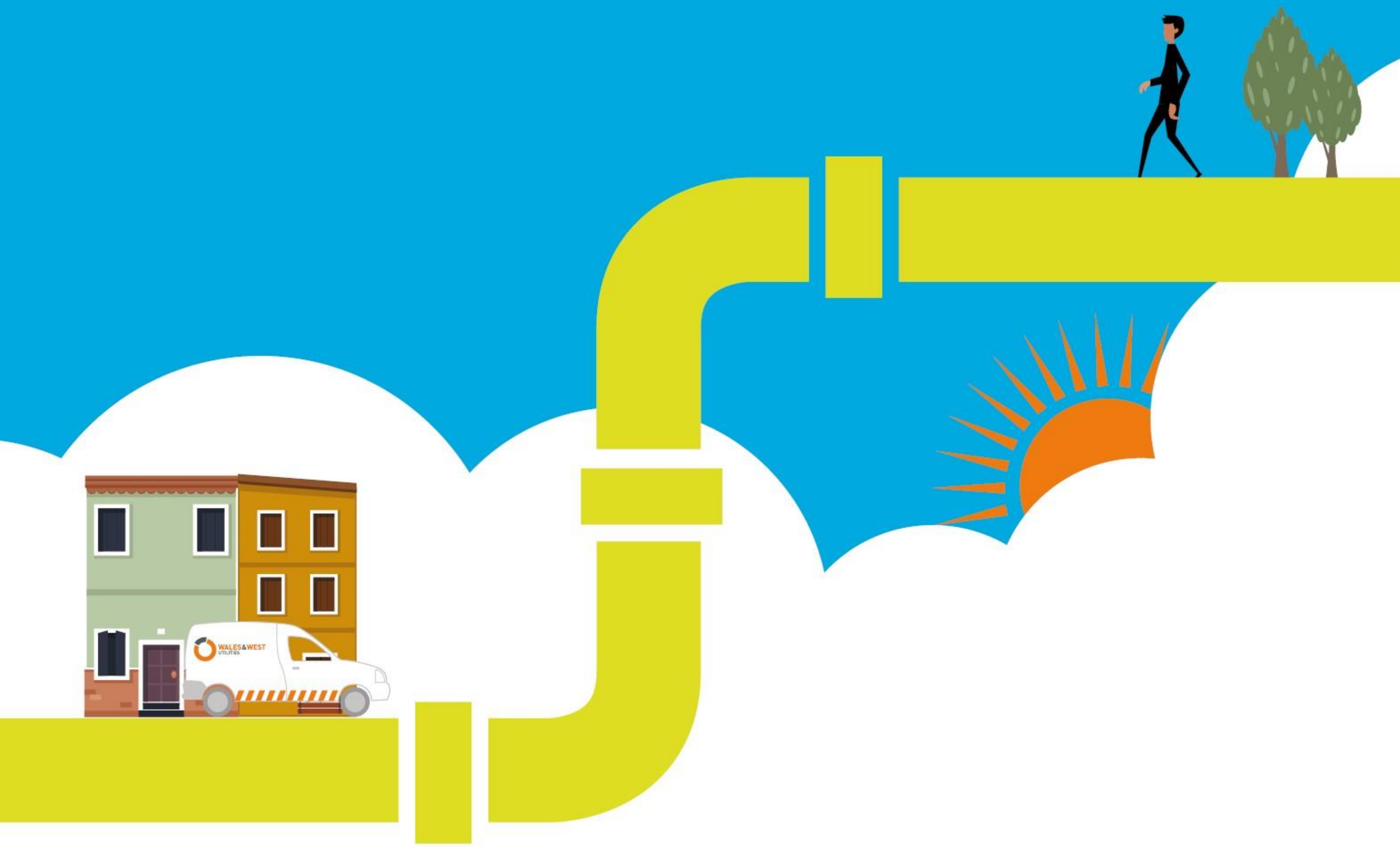
To convert from the units on the left hand side to the units across the top multiply by the values in the table.

Note
All volume to energy conversions assumes a CV of 39 MJ/m^3.

To: Multiply	GWh	mcm	Million therms	Thousand toe
GWh	1	0.092	0.034	0.086
mcm	10.833	1	0.370	0.932
Million Therms	29.307	2.710	1	2.520
Thousand toe	11.630	1.073	0.397	1

All conversions are to 3 decimal places and therefore may not include the full conversion factor.
GWh = GigaWatt Hours
mcm = Million Cubic Metres
Thousand toe = Thousand Tonne of Oil Equivalent

Remember, if you smell gas, call us free on 0800 111 999 !



Wales&West Utilities