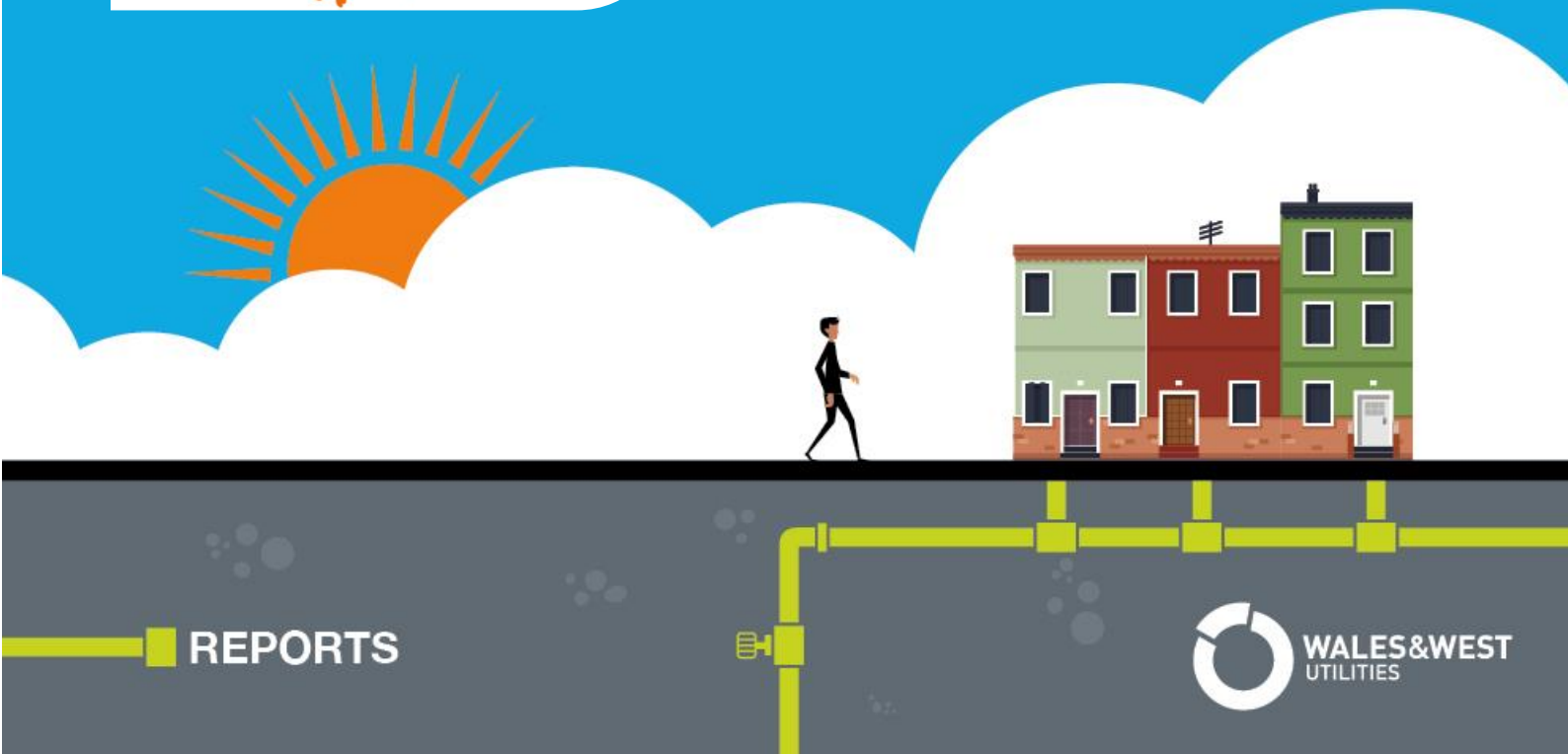
2020 Long Term Development Statement

Wales & West Utilities Ltd



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Foreword

Welcome to our Long Term Development Statement for 2020, a year that will certainly live long in the memory. 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. Coronavirus may have changed the way we work; however, we continue to plan for the future of the gas network.

Andrew Hopkins - WWU
Director of Asset Management, Health, Safety & Environment

The statement reflects our 2020 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 and associated investment.

This past year has been an important one in the designing and developing of our long-term future plans, responding to the Covid-19 pandemic as well spending more time than ever listening and responding to the needs of our customers. The energy sector remains under the spotlight and is clearly central to delivering “Net Zero” by 2050. Our response includes a commitment to deliver a net zero ready network by 2035 and we’re dedicated to working collaboratively to support a Green Recovery out of Covid-19.

We are publishing the statement just a few months before we receive the final determination of our business plan from Ofgem for the period 2021-26. Our plan sets out our ambitious vision, which is for our network to be net zero ready in our regions by 2035. This is our response to the climate change challenges we face, informed by the needs and wants of our stakeholders and underpinned by extensive research (both our own, and that of others). Our vision will also support the UK Government’s commitment to a zero carbon energy system

Our vision takes account of 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. It is based on a broadly defined whole systems approach to decarbonisation.

Turning now to look back at our performance this year, some highlights of 2019/20 include:

- The ENA Pathways project was launched in Wales and South West England in January 2020 and nationally that has progressed into the Gas Goes Green programme of work. The Pathways project report recommended a balanced approach to decarbonising heat, power and transport, with the headlines indicating a strong role for hydrogen for industry and large cities and the remaining areas dominated by wind / biogas hybrids. The Gas Goes Green programme sets out the detailed project areas and the road map to deliver them.
- We continue to play an important role in supporting third parties such as community energy projects and local authorities as they look for solutions to their energy needs and,

in the case of local authorities, seek to act on their climate emergency declarations. This year we are undertaking a Tools of Engagement innovation project. This project will seek to create a set of tools and materials that will help local authorities better understand the energy system and the role they can play in helping to achieve net zero.

Our focus on putting customers first has brought significant success. It has also helped us meet our outputs under our regulatory framework, which we are on track to deliver for the full eight years. Our efforts have been recognised across the board with:

- Reaccreditation from the British Standards Institution, BSI for BS18477 for Inclusive Service Provision; demonstrating that we provide an inclusive service, available, usable and accessible to all consumers regardless of personal circumstance.
- Named winner in the Oil & Gas Industry Sector in the RoSPA Health and Safety Awards – the longest running industry awards scheme in the UK.
- Accreditation for Achilles Health & Safety achieving 100% for the seventh successive year.
- Initiative of the Year award from our Network Awards Partnership for our 'Above and Beyond Project'.

We are proud of all these achievements as we continually seek to further improve the service we provide to customers.

Andrew Hopkins
Director of Asset Management, Health, Safety & Environment

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 UK 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 Transportation Principal Document.

Our forecasting methodology has encompassed the results of our Regional FES innovation project, as well as the final results of our collaborative GDN Gas Demand Forecasting project. Improved forecasting techniques include new approaches for forecasting flexible gas generation using electricity market information. Our forecasts are now presented in a range of low to high growth scenarios owing to some uncertainty in housing and power generation growth.

1.2 Demand and supply outlook

As a result of our modelling our peak demand is now forecast to increase in the range of 3 to 8% 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 19 biomethane sites delivering green gas into our network and although we have not connected any further sites this year, we do have a further 5 accepted enquiries. In total the 24 sites would provide heat to 177,000 homes if fed into a traditional heating system, or around a million hybrids. Our current projections to achieve net zero are for a further 25-35 sites to connect during GD2.

Research[1] suggests that significant feedstock is available to support further growth in this area, and with a high proportion of the country prioritising hydrogen 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, with some success. 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.

[1] https://www.smarternetworks.org/project/nia_nggd0093

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.

1.3 Industry developments

The UK is committed to legally binding obligations to eradicate the UK's net contribution to climate change by 2050. The UK Government's June 2019 decision provided much greater certainty about the timeframes our sector has to deliver a zero carbon energy system.

We are fully committed to achieving these targets and believe that the gas network can contribute to this. Our business plan, which we published in December 2019, set out our ambitious plan to decarbonise heat, power and transport in our regions, delivering a net zero ready network by 2035.

We have a clear vision of the role our network will play, what needs to happen to facilitate this, and how much investment is required in GD2. Our network will be able to support the required quantities of green gas, eliminating the need to use fossil fuels. 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.

This year's UKCCC Annual Progress Report to Parliament noted that "Regulatory frameworks may need to evolve as new vectors emerge and with an increasing integration between systems (e.g. hydrogen, which will need to be produced using CCS or renewable electricity and could supply power generation, heating, transport and industry). Ofgem's recent decarbonisation action plan sets out Ofgem's initial thinking on the impact of Net Zero on its activities. Ofgem should also set out ambitious requirements for reductions in leakage of methane from the gas grid."

These impacts have again been taken into account in the forecasting models and research that we have undertaken this year. A couple of examples are given below and these and other projects are discussed further in Appendix 4.

- **The HyHy** project examined how hydrogen and hybrids could decarbonise the heating of a city sooner and more effectively than alternatives. This model-based feasibility study sets out an achievable path to net zero which keeps disruption to communities and cost to customers as low as possible. The project studied the Welsh capital of Cardiff and simulated the decarbonisation of home heating in several different ways. It showed that using smart-controlled hybrid heating systems – where you pair a boiler with an air source heat pump – can reduce carbon emissions quicker. Hybrid installations of this kind use renewable electricity when it is available, and green gas like hydrogen and biomethane when it is not. It also reduces the amount of green gas needed to heat homes, relying on

electricity for 80% of the time and on hydrogen or biomethane to meet peak heat demand.

- **Our Flexible Generation Forecasting project** is a collaborative 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 to the benefit of control centres managing gas and electricity networks. This is necessary because we are seeing significant changes in the ways in which gas electricity generation is moving 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 ESO, SPEN and NGN and the contractors are Delta-ee and Afry.

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 also 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.

Data from our Regional FES indicates that blended hydrogen will be injected by 2027 in Wales and by 2030 in the south west 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 to Bristol during 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.

In preparing our business plan, and having discussed our proposals with wide-ranging stakeholders, we have determined our innovation focus areas for the 2020s. These areas build on the ENA's Gas Network Innovation Strategy. They are centred on the steps needed to deliver a net zero ready network by 2035, 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 to see Ofgem have allowed the Network Innovation Allowance (NIA) expenditure we requested in our business plan in their draft determinations and are keen 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

If the UK's 2019 adoption of a 2050 net-zero emissions target set a new standard for our country's climate change ambitions, then in 2020 we have started to see the emergence of the options that will help ensure that we all have the best possible set of tools at our disposal to achieve that target. Hydrogen and green gases, such as biomethane, are two of those tools.

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.

This approach is crucial to ensure that in our vital work to decarbonise we build on the strengths of a system that is tried, tested and trusted, rather than simply discarding them. With 85% of properties connected to our gas grid, Britain's world-leading gas network infrastructure allows our homes and offices to reliably access energy quickly and easily, often when we need it the most. The energy it supplies guarantees people's comfort in our homes whilst providing the lifeblood that our businesses need to grow.

As we seek to decarbonise and build a net-zero economy, that role is already beginning to change. Britain's gas network companies are now beginning the process of transitioning from being distributors of energy today to the technology enablers and market-makers for energy tomorrow. Energy Networks Association's Gas Goes Green programme is at the heart of that transition.

Launched in April this year, 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 grid will act as a platform that will enable our homes, businesses and communities to choose those decarbonised technologies that have the least cost and least disruption to them, whilst allowing them to access the energy they need and in the way they are used to. It will help create new markets for the production of hydrogen and biomethane, delivering green investment and jobs that are as spread across regional economies as widely as the infrastructure that transports therm.

Gas Goes Green is following a Pathway to Net Zero, which sets out the steps that gas network companies and the Government need to make to turn this vision in to reality. That Pathway has been developed by not only by independent consultants, but in public consultation with energy industry, Government, consumer groups and academics, with the final outputs peer-reviewed by Imperial College. In its first year, the programme has set out the investment gas networks are seeking to deliver in innovation projects through a Zero Carbon Commitment, the role they are already playing in reducing methane emissions by replacing old iron mains pipes with new

hydrogen-ready plastic pipes, and the technical, safety and operational evidence needed for Government to make the necessary policy decisions to start blending increasing amounts of hydrogen into the gas grid.

By following this Pathway, Britain could save up to £13bn a year by 2050 when compared the alternative of replacing gas with electricity. Research from the programme has shown that Britain's energy billpayers will begin to see a financial return on investment in building a hydrogen economy in the early 2040s, well before we reach our crucial net-zero target.

With the postponed COP26 UN Climate Change Conference being held in Glasgow next year, the world's attention will be on what Britain is doing to reach its ambitious net zero goal. Britain's gas networks are playing their part in pushing forward to provide us all with the solutions we need to play our collective part in tackling the climate emergency.

3. Industry developments

3.1 Key messages

- We are seeing a 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 view is now aligned with industry and government thinking, plans are being developed to set policy needed to drive the change to a global green economy.
- Gas Goes Green project launched including pathways to zero carbon gas networks.
- BEIS are developing a Green Gas Support Scheme (GGSS) and a Clean Heat Grant.
- 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.

3.2 Key industry developments

There have been several key industry developments to note since the 2019 update:

- **Gas Goes Green (GGG)**, we're collaborating with other gas networks on the Gas Goes Green project designed to identify ways to meet the challenges in delivering a low-cost, low-carbon gas network across the UK. The first phase of the GGG project was the pathways project which produced a detailed plan to deliver a zero-carbon gas system that includes the regulatory, technical and operational actions that are needed to deliver this in the UK regions for which each gas network maintains responsibility. This was launched nationally, and we had a local launch in Cardiff in early 2020.

- **Pathfinder Plus**, to support energy planners understand the impact of different decarbonisation options, we developed Pathfinder Plus, 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. This tool is currently being used in support of the Zero 2050, HyHy and Gas Goes Green projects.

- **Fes 2020 scenarios**, this year National Grid have developed a new set of scenarios through extensive industry collaboration. These have net zero at their core and explore how the level of societal change and speed of decarbonisation could lead to a range of possible future pathways. The headline messages from FES 2020 are:
  1. Reaching net zero carbon emissions by 2050 is achievable. However, this requires immediate action across all key technologies and policy areas, and full engagement across society and end consumers.
  2. Hydrogen and carbon capture and storage must be deployed for net zero. Industrial scale demonstration projects need to be operational this decade.

3. The economics of energy supply and demand fundamentally shift in a net zero world. Markets must evolve to provide incentives for investment in flexibility and zero carbon generation.
4. Open data and digitalisation underpin the whole system thinking required to achieve net zero. This is key to navigating increasing complexity at lowest cost for consumers.

- **South Wales Industrial Cluster**, we are currently contributing to the South Wales Industrial Cluster (SWIC) Roadmap and Deployment projects, which seek to identify the best options for cost-effective decarbonisation of industry in South Wales. 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 as well as onsite strategic opportunities specific to each industry. 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.

- **Milford Haven Energy Kingdom**, this project aims to accelerate the transition to an integrated hydrogen and renewable energy system, making use of the deep water port for Hydrogen transportation. 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. It also aims to develop 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 include Pembrokeshire County Council, the Offshore Renewable Energy Catapult, Riversimple, Port of Milford Haven, ARUP and the Energy Systems Catapult.

- **Business Plan**, during late 2019 we submitted our plan for the RIIO-GD2 period. This plan included our vision for a net zero ready network by 2035, we're dedicated to working collaboratively to support a Green Recovery out of Covid-19. The RIIO-GD2 business planning process is well underway and is a clear opportunity for the regulator to aid in our country's goal of achieving Net Zero by 2050. We are committed to working with the regulator through the business planning process and final determinations are expected before the end of the year.

- **Government**, BEIS held a consultation on future support of low carbon heat including proposals for Green Gas Support Scheme (GGSS): increasing the proportion of green gas in the grid through support for biomethane injection and;

  a Clean Heat Grant: support for heat pumps and in certain circumstances biomass, through an upfront capital grant to help address the barrier of upfront cost.

  This year witnessed the highest support from The Climate Assembly in the use of Hydrogen to decarbonise heat.

- The 'Benefits of Hybrid Heat Systems in a Low Carbon Energy System' report has been published by Navigant which is an evidence-based analysis on how hybrids can work alongside green gas and renewable energy to create a balanced approach

- **Future Role of Gas in Transport Pathways**, we are a contributing partner on this project, which examines the part that biomethane and hydrogen can play in a net zero road transport sector, particularly heavy goods vehicles. The project assesses likely developments in the transport sector, in the context of 'high hydrogen' and 'high electrification' scenarios, in a whole system context. It also has a specific focus on biofuels' use in shorter term decarbonisation, in the years prior to the necessary infrastructure being developed for large scale hydrogen fuel cell and battery electric vehicles. Lead consultant Element Energy will incorporate technical assessments of refuelling stations, future markets for zero emission fuels, and the specific requirements of different vehicle types. The project aims to complement the Low Emission Freight and Logistics Trial, inform the Department for Transport decarbonisation consultation, and assist energy networks in their forecasting and planning processes.

Our network planning and business plan proposals for 2021-26 has taken account of these important developments.

3.3 Gas as an essential component of future energy policy

The sector is going through significant change, and clear trends are emerging that have informed our investment proposals for 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 3 to 8% over the next ten years because of 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, 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.

This view was recently confirmed by, among others, the CCC. It was also supported by our own Green City Vision project launched in 2019, in collaboration with SSEN and UKPN.

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

3.4 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 and our first biomethane DN entry site went live in 2013.

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 have connected 19 biomethane sites since 2013 but current uncertainty around the Renewable Heat Incentive has had a significant impact on connection of biomethane sites this year, with none being connected since our last Long Term Development Statement was published. We do, however, have a further five accepted enquiries and are expecting our 20th entry connection in early 2021 As well as being our next connection, it is also our first entry arrangements for synthetic natural gas.

We are already experiencing 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, with some success. 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. We describe our vision to make our network net zero ready below.

3.5 Our net zero ready vision

Our business plan sets out in full the detail of our ambitious vision to support the UK's decarbonisation targets and become a net zero ready network by 2035. Our plan represents a pathway that is both credible and achievable. It assumes:

- an even greater penetration of green gas in our local distribution zones;
- a significant use of hydrogen post 2035 in the UK's largest cities and for big industry – in our region the cities are expected to be Swansea, Cardiff, Newport and Bristol in the south, and Wrexham in the north;
- the use of renewable electricity to decarbonise heat using hybrid heating technology in homes and businesses across our region – as trialled in our Freedom project;
- reduced annual demand for gas as customers adopt more efficient and flexible systems and continue to make improvements to the insulation of their homes and businesses;
- a move to electric cars among consumers and to hydrogen or green gas to fuel heavy goods vehicles, buses and trains;
- the use of renewable electricity, including wind, solar, marine and a small fleet of nuclear power stations, to power the UK and keep the lights on.

The vision is based on our extensive research and stakeholder engagement to consider the future of energy. It is founded on a broadly defined whole systems approach, working together to keep bills low, maintain reliability and minimise householder disruption.

4. Demand

4.1 Key messages

- Peak demands are forecast to increase over the next ten years by 3 to 8%.
- We have connected another three flexible generation sites since we last published our long term development statement and anticipate continued growth of new connections associated with flexible generation.
- Due to some uncertainty around the use of gas in new homes from 2025 we are now forecasting a range of growth forecasts depending upon the level of housing and power generation growth.
- Our High Growth Scenario is based on continued growth in both domestic and flexible generation connections at a similar level as experienced in recent years.
- Our Low Growth Scenario assumes growth in domestic and flexible generation to 2025 with no notable growth in the following year. 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.
- We will continue to monitor the impact of COVID-19 over this winter, and although we expect demand profiles to change (due to home working etc...), we are not expecting a marked change to peak demand.

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. The two key models we have discussed were:

- 2050 Energy Pathfinder, which assesses how different future energy mixes would work in practice, providing hourly information over a year period; and
- a separate investment model which uses projections of gas supply and demand to provide high-level indications of the network investment that would be required to support them.

This year we have continued to develop our thinking through our future of energy research. We are also factoring the impact of COVID-19 into our forecasts, expecting more people to continue to work from home across this winter period and in the future. We will monitor demand this year but are not expecting material impacts on peak because on those severe weather days, schools and businesses are closed and people remain in the home.

4.2.1 Innovation projects:

We are working on several innovation projects that are helping provide further clarity on how our future customers are likely to want to use our network for gas usage or gas injection. We are also developing new and innovative ways to optimise our network so that it can respond to this wider range of requirements.

Many of our projects are carried out with other gas and electricity network partners and further details on the relevant projects are provided in Appendix 4: Our future of energy research.

4.2.2 Stakeholder engagement:

This year we have engaged with a wide range of stakeholders from both 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 and informing and listening at national, regional and local levels.

We again engaged with as many of our major gas users earlier in the year to inform our pre-forecast demand figures as part of the process set out in the UNC. Due to the wider uncertainty during these pandemic times, their responses showed little variance from prevailing views of peak gas demand.

We work closely with high-level decision makers within government, regulatory bodies and other decision makers, including BEIS and the UKCCC, engaging around aspects such as smart hybrid systems and the use of hydrogen. The work around Hydrogen readiness has ramped up this year and we are fully engaged on the Hydrogen Programme Development Group, which seeks to develop a nationally aligned strategy and research delivery programme that will deliver a future hydrogen economy for the UK

This year we have worked on our innovation project HyHy (see section 7) and throughout this project, we engaged fully with UKCCC, Welsh Government, BEIS and Ofgem so that the results can be considered for the UKCCC 6th Carbon budget.

We are active members of the Welsh Government's Energy and Environment sector panel and have committed to forming a Wales Green Gas Forum. This will look to encourage and facilitate increased green gas entry in Wales. We are also supporting the Energy Networks in Wales Forum which is led by Welsh Government.

Other highlights include supporting a conference distributed power generation to share learning and best practice between networks, developers and other industry parties with a view to improving and aligning processes and gaining insight into future requirements for power

generation customers. We are working on improved customer communications via publication of a Future of Energy Brochure, detailing important connection information in response to the changing demands on our network.

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 LDZs within our distribution network.

The chapter 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 belief 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 of Energy and Climate Change 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 3 to 8% in the next 10 years as per our Low and High 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 2020/21 out to 2029/30 for all LDZs. This is primarily due to new connections of domestic customers and smaller loads, along with flexible generation which will off-set reductions we anticipate as a result of efficiency improvements, including improvements to insulation.

The relationship between peak and annual demand is changing as customers are using gas in different ways. 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 varies significantly day to day depending on the availability of renewable generation such as wind and solar.

Our High Growth Forecast is based on continued growth of flexible generation as well as an assumed linear growth in the domestic market based on levels experienced to date in both areas. The Low Growth Forecast takes into account the uncertainty surrounding gas in new homes post 2025 and the possibility of a re-direction away from gas-fired flexible generation; in this forecast, we assume no domestic or power generation growth post 2025 but expect growth from 2020 to 2025 in both markets. There are a number of iterations and possible forecasts for the next 10 years which is why we feel it appropriate to move to a range which will envelop most of these outcomes.

The forecasts within this document take account of national data and assumptions from many sources including National Grid's FES scenarios and our own forecasting models. Last year we continued our forecasting research through our Regional FES project with

our partners Regen which looked at forecasting at sub-LDZ level. This year, we were able to use the outcomes as the basis for producing joint GDN/DNO scenarios for the parts of our regions where our networks have the same geography.

4.3.1 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 Uniform Network Code we are obliged to review the definition and seasonal normal basis of all CWVs, at least once every five years.

From 1 October 2015 Xoserve published revised seasonal normal composite weather variables (SNCWV) for use going forward. This includes a revised shortened weather history than was previously used. We have considered the impact of these revisions in this current iteration of our long term development statement. A CWV review is currently underway.

For more information on the change to the EP2 method and its impacts on the demand forecasting process please see Appendix 1.

4.3.2 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 6; or
- interrupt key sites through bilateral interruption contracts with customers.

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

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. Last year, we considered the parts of our network where interruption would offer the most benefit and we then contacted all the sites that were eligible before the interruption auction to ask them if this would be of interest. Despite this direct engagement, there were still no offers from any of our customers. This year we are participating in an ad-hoc auction currently underway and are again offering to consider any interruption from any of our eligible customers. We await the conclusion of this process and any outcomes in November and will continue to make use of interruption as and where we can in the future.

This year we have made further increases in our bookings for capacity from the National Transmission System as required going forward.

4.3.3 LDZ peak forecasts

This section provides the latest gas demand forecasts through to 2029/30. 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 high growth scenario continues to project significant increases in our peak demands over the next ten years. This is primarily influenced by electricity generation requirements having a significant impact at peak.

Most of our current investment decisions are based on days when our network is under the most stress (that is, on a peak day). It is for this reason that our recent forecasting work has focussed on a process for forecasting peak days directly, rather than deriving them from annual projections of gas demand as we have done in the past.

Annual demand forecasts are still of interest as these will influence other processes including measuring carbon savings through lower use of fossil gas because of either lower demands or increasing supplies of green gas.

4.3.4 Peak day forecasting process

For this year's forecasts we have continued to use the process for flexible generation that is set out in bullet 2 below. However, and as per last year, there were no new examples of severe weather to enable us to repeat the cold day analysis. This means that the work in point 1 could not be repeated and 2018 is still the best example we have of real demands during very cold weather.

1. During the severe weather at the end of February and beginning of March 2018 we were able to validate our assumptions of peak day demand which in the last few years had not included any examples of temperatures anywhere near those used to calculate our peak days. During this period of cold weather, due to issues with supplies to the National Transmission System, a Gas Deficit Warning was issued by National Grid. Gas prices increased rapidly as a result and the consequence was reduced demand for sites that were influenced by daily gas pricing. In our analysis we can clearly see the pricing impact that resulted in zones with a higher proportion of large loads having their demands reduced due to these separate issues on the networks. We have taken this into account during our review.

2. We have responded to the on-going requirement to connect flexible generation onto our network by improving both our understanding of the electricity networks and the way we use data that is publicly available. In this year's process we have mapped information from the National Grid's Market Electricity Capacity Register against sites that are either connected or have enquiries in process on our network. This robust process has allowed us to determine which enquiries to include in our projections. The process also provided us with information about sites that we were not yet aware of that may approach us for capacity.

4.3.5 Peak day forecasting results

The 2020 peak demand forecast for the network is 515 GWh/d. We project that this will increase to 556 GWh/d by 2029/30 under our high growth scenario, which represents an 8% increase. The increase is attributed to the continued growth of domestics and of power generation seen on our network since 2013. We have included:

- loads that have accepted connection offers from us in 2019/20;
- sites that have capacity via the electricity capacity register in 2020/21 (T-1), 2022/23 (T-3) and 2023/24 (T-4).

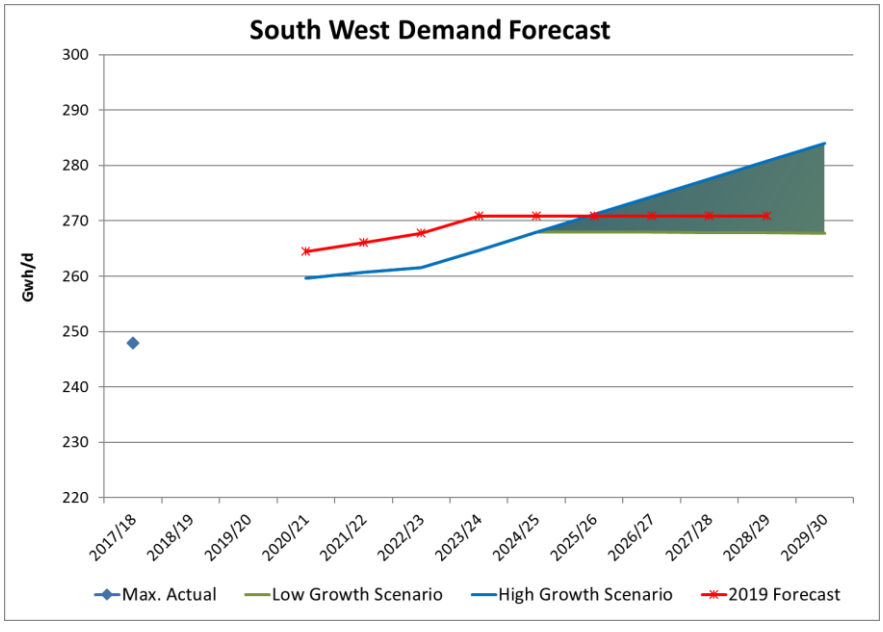
For the years after 2024 and in our high growth forecast, we have assumed similar levels of flexible generation growth in all network areas based on the indications from the capacity market information.

South West:

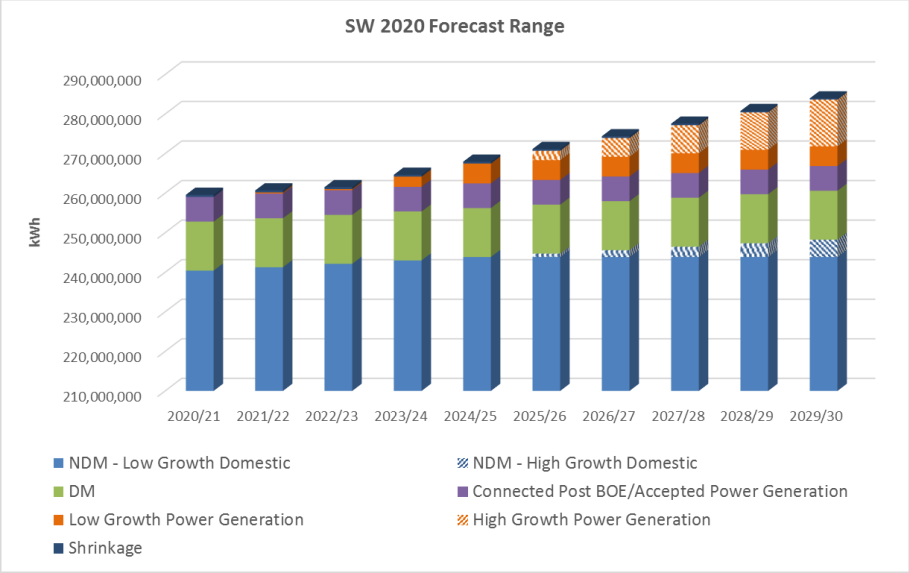
The 2020 peak demand forecast for the South West is 259.6 GWh/d. This is projected to increase by 8 to 24 GWh/d by 2029/30, which represents a range between 3 and 9% for this LDZ.

The maximum demand for 2019/20 was 171 Gwh/d, experienced on 21st January 2020.

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



Graph 2: 2020 peak demand forecast range by load type

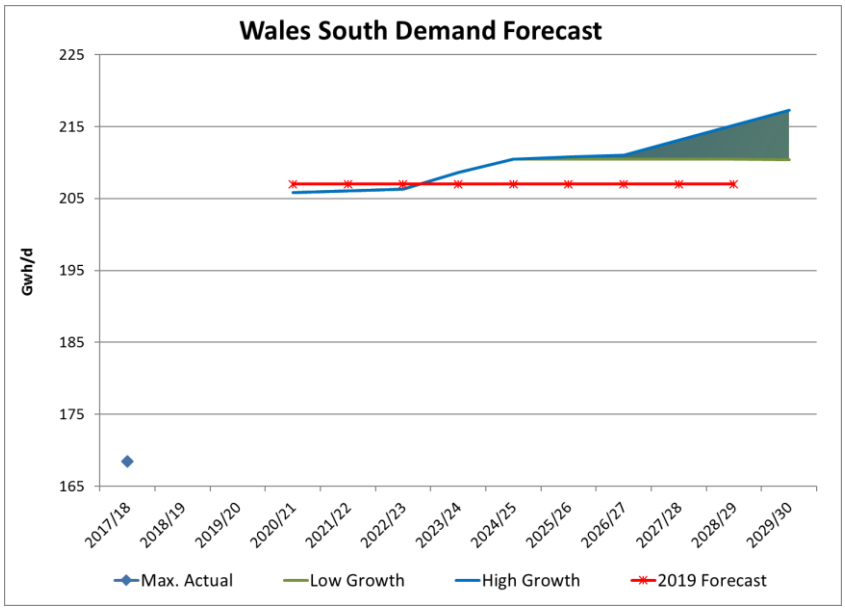


Wales South:

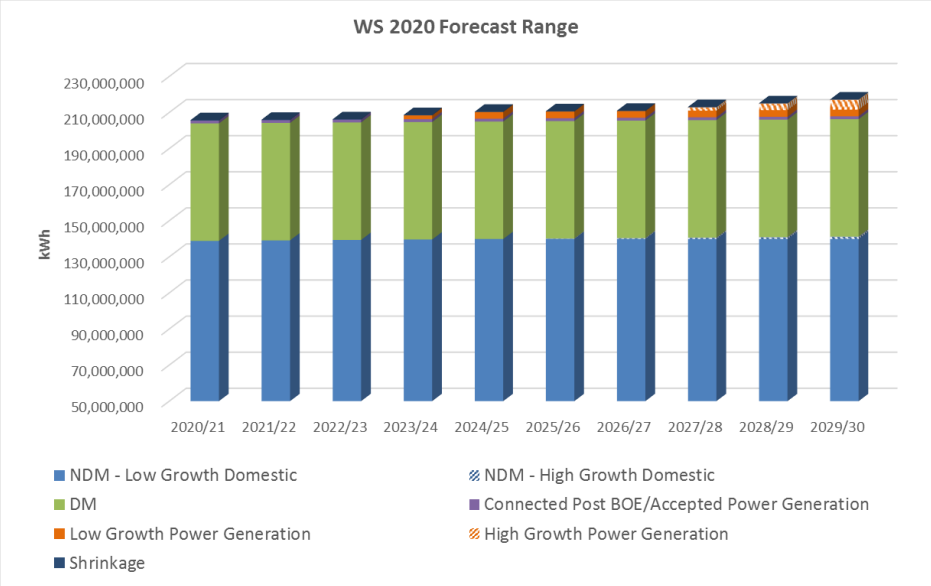
The 2020 peak demand forecast for Wales South is 205.8 GWh/d. This is projected to increase by 5 to 12 GWh/d by 2029/30, which represents a 2 to 6% increase.

The maximum demand for 2019/20 was 132 GWh/d, experienced on 20th January 2020.

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



Graph 4: 2020 peak demand forecast range by load type

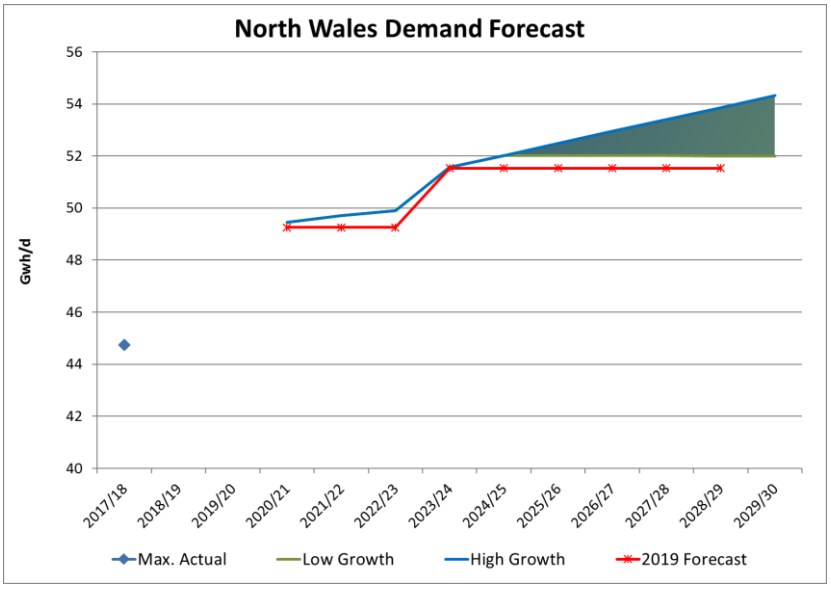


Wales North:

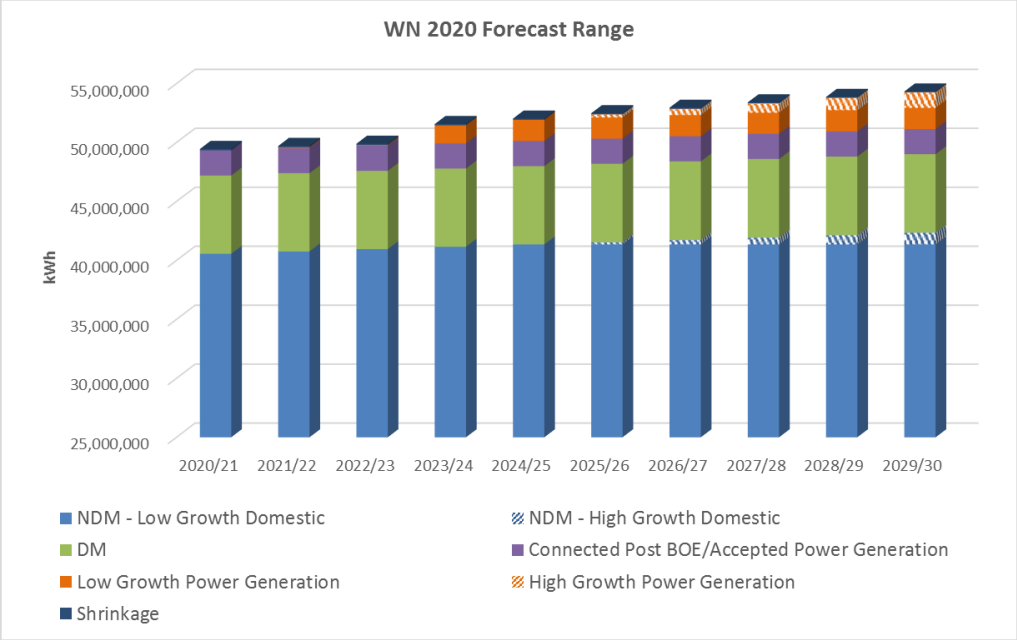
The 2020 peak demand forecast for Wales North is 49.5 GWh/d. This is projected to increase by 2.5 to 5 GWh/d by 2029/30, which represents a 5 to 10% change.

The maximum demand for 2019/20 was 33.4 GWh/d, experienced on 11th February 2020.

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



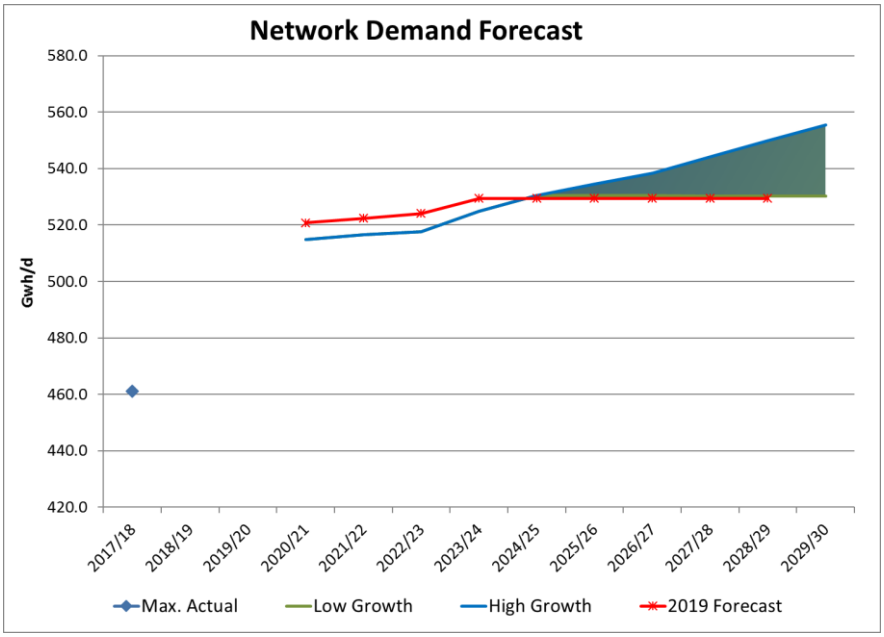
Graph 6: 2020 Demand forecast range by load type



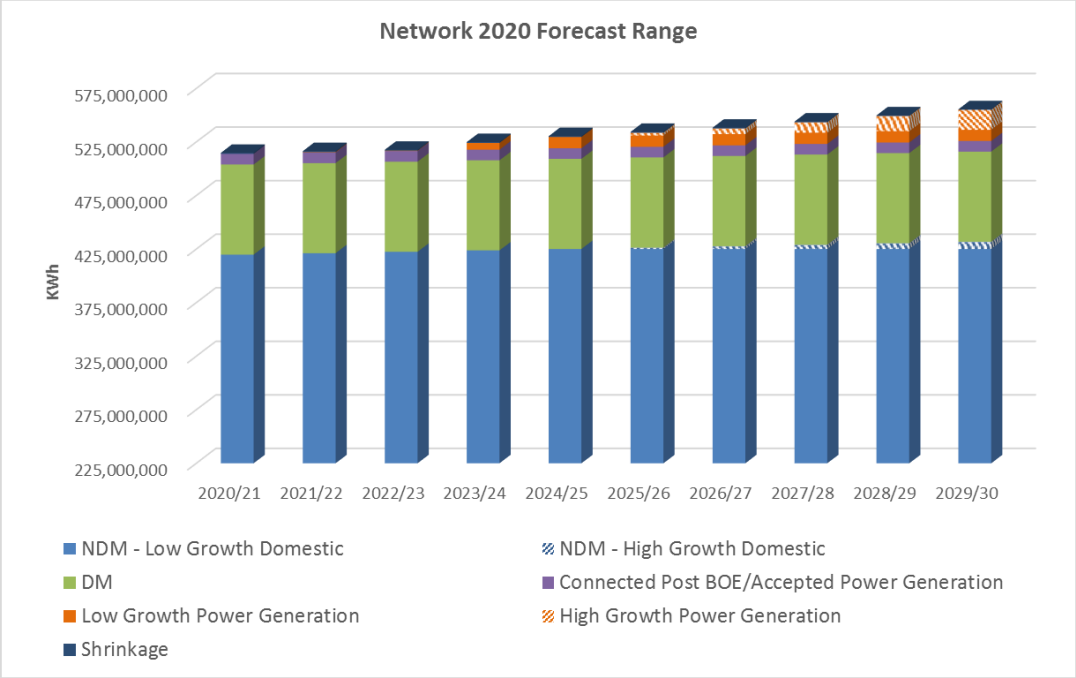
WWU network:

The graphs below show the data for the network considered for all three of our LDZs.

Graph 7: Peak demand forecast range for the network



Graph 8: 2020 network demand forecast range



4.3.6 Future projections

In recent years we have updated our processes and developed new models to consider the impacts of improved boiler efficiency and home insulation on residential peak demand. We have also taken account of available information from public sources and stakeholder engagement to assess the impact of flexible generation at specific locations in our network.

This year we have completed additional research to provide further certainty for other loads on our networks as follows:

HyHy, is an ongoing research project, with the objective of assessing the combined energy demands of a select region within GB, and understanding how the deployment of hybrid heating technology in combination with bulk hydrogen supply is able to achieve carbon compliance with respect to national carbon emission targets. The project uses Cardiff as a case study of a city region with limited access to carbon storage options, within the context of a net zero scenario informed by engagement with BEIS and the CCC. It has developed to incorporate a comparison with a full electrification counter-factual, and an exploration of how scales of hydrogen storage and production can be adjusted to find the most cost-effective approach. It is expected that the final report will be issued later in 2020. Find more information on the Smarter Network Portal: https://www.smarternetworks.org/project/nia_wwu_060

Zero-2050: South Wales, the most efficient way to meet “Net Zero” target is a whole system design approach and cross-sector collaboration. This project will bring diverse stakeholder groups (utilities, industry, academia, SME, consultants, Government, regional experts etc.) together to design a pathway to address decarbonisation needs of the South Wales region. A

multi-energy vector modelling exercise (Pathfinder Plus) will be carried out to estimate the impact on utilities' networks for different scenarios. The project will recommend a pathway to decarbonise South Wales supported by solid analytical work and taking in to account the regional socio-economic aspects. This work can form the framework for how other regions of England and Wales will meet the zero-carbon challenge in the future, and influence approaches across a range of sectors. The final report will be published in 2021

The learning from these projects will inform our net zero vision as outlined in section 3.5.

4.3.7 Annual gas demand

There are a number of 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.

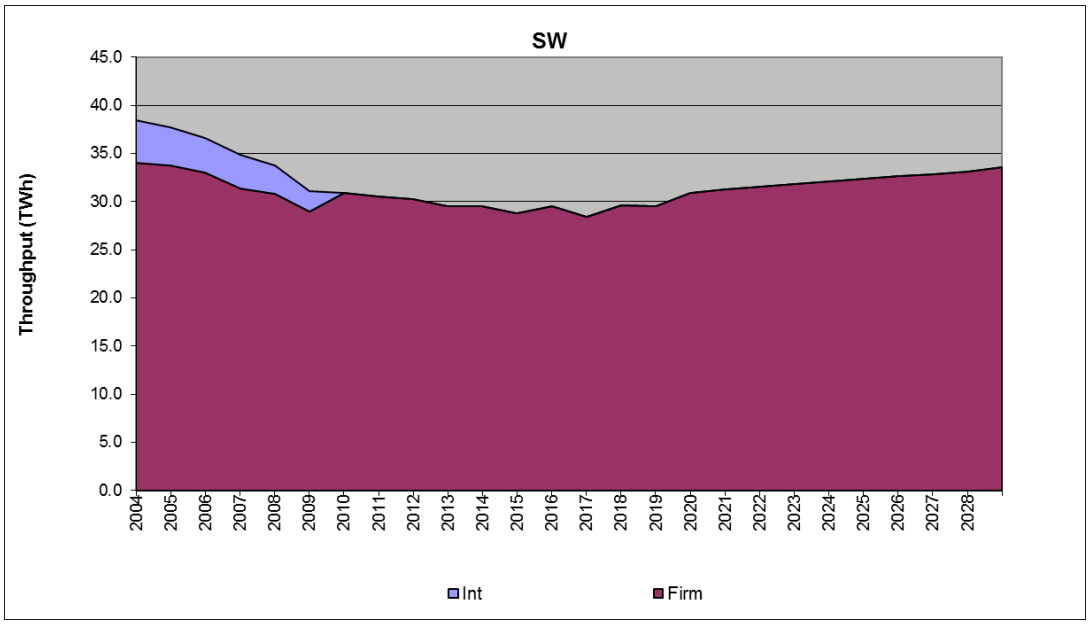
The seasonal profile of annual demand will also be important if we assume that green gas will continue to be injected into our network at similar rates throughout the year. This is because there may be a requirement for seasonal storage, which is currently not available in our network.

While our analysis of peak demand shows increases in the short term, we agree with the more general view that annual gas demand may reduce – although current policies have not been successful in delivering this. This reduction would be a result of general building and appliance efficiency improvements and a decrease in load factors as some gas generation is displaced with other sources, including renewables on sunny and windy days. Our forecasts are detailed below.

In the South West 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 South West and in Wales South.

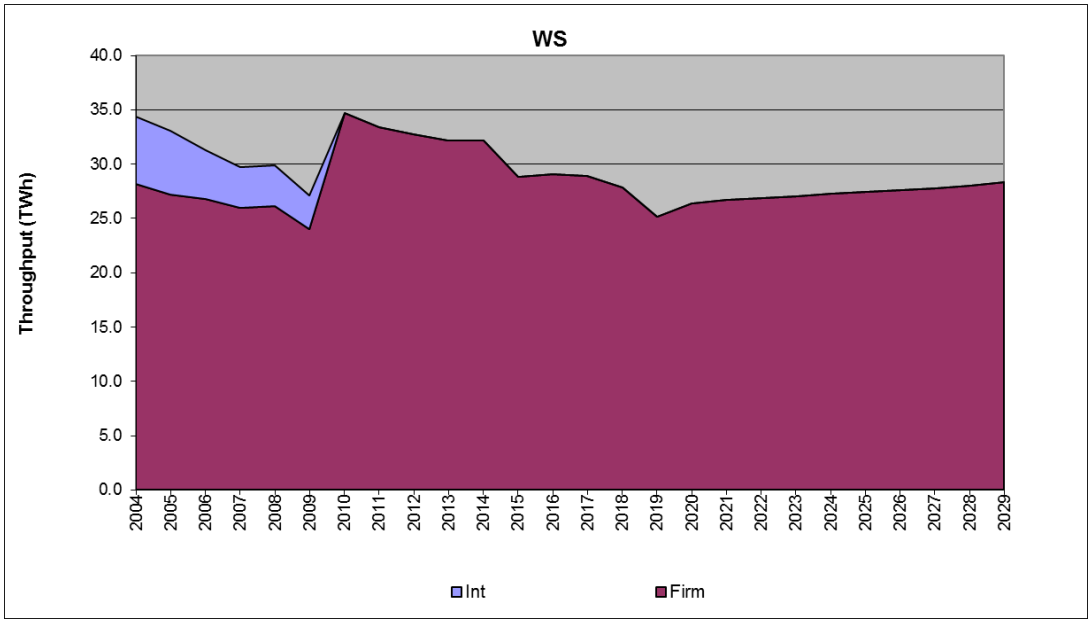
South West

Graph 7: Historical and forecast annual gas demand for South West LDZ



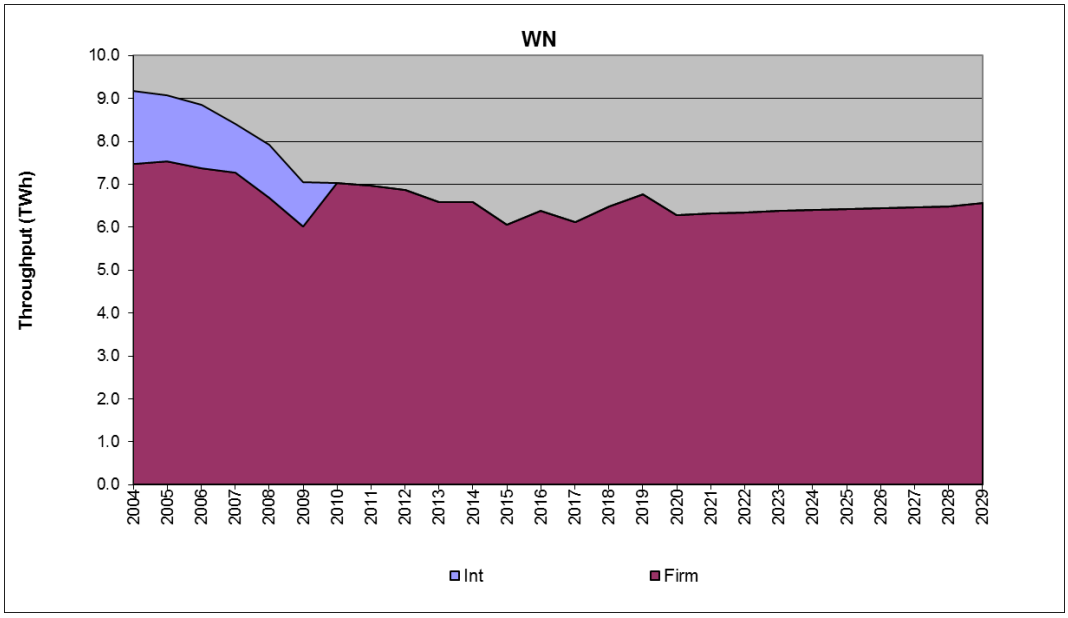
Wales South

Graph 8: Historical and forecast annual gas demand for Wales South LDZ



Wales North

Graph 9: Historical and forecast annual gas demand for Wales North LDZ



5. Supply

5.1 Key messages

- We have 19 biomethane sites connected to our network which have capacity to meet the needs of more than 145,000 customer homes, an increase on last year due to expansion at one of our existing sites.
- We have increased NTS capacity bookings in most areas this year in response to increased peak demand forecasts across the region.
- We are due to be the first network to accept synthesis gas into our network in early 2021.
- 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 leading innovation projects to forecast how gas supplies might change in the longer term and how we can maximise entry capacity on our networks including for hydrogen.

5.2 Overview

We develop the local transmission and distribution systems to meet our customers' requirements. In turn, National Grid Transmission (NGT) 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 have 19 biomethane supplies. 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 biomethane gas. Injecting gas into the distribution network directly helps to achieve climate change targets (reducing reliance on fossil fuels) as well as improving the security of supply.

During our consultation processes in 2019 we have increased our stakeholder engagement through our Regional FES project. We also carried out other specific stakeholder events to support the production of our GD2 business plan and to test our proposals to support decarbonisation plans for the UK.

Based on a number of engagements with more than 21,000 stakeholders, it is clear that our commitment is viewed as the right thing to do to help reduce emissions across the UK. There is clear stakeholder interest and approval for projects, such as HyHy, that support this commitment. We are therefore now recommending steps that would roll this work out, striving towards industry-wide decarbonisation. Based on this feedback and government support, we are committing to deliver a net zero ready network by 2035 as shared in our business plan at the end of 2019.

This year the ENA Pathways project was launched in Wales and South West England in January 2020 and nationally that has progressed into the Gas Goes Green programme of work. The Pathways project report recommended a balanced approach to decarbonising heat, power and transport, with the headlines indicating a strong role for hydrogen for industry and large cities and the remaining areas dominated by wind / biogas hybrids. The Gas Goes Green programme sets out the detailed project areas and the road map to deliver them.

The scenarios used in the Future Energy Scenarios produced by National Grid ESO and published during the summer of 2020 now includes a System Transformation scenario in which the use of hydrogen and green gas plays a key role in the UK meeting it's net zero ambitions.

We have seen an increase in connected capacity of green gas during 2020 due to expansion at one of our existing entry sites taking the number of equivalent homes heated from 130,000 to 145,000.

5.3.2 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.

5.3.3 Hydrogen

In 2018 we undertook analysis on the likely methods of converting Bristol and Cardiff to 100% hydrogen in the longer term. Following the increase in ambition for UK decarbonisation and new information from our stakeholders received as part of our Regional FES process, we anticipate that blended hydrogen will be injected by 2027 in Wales and by 2030 in the south west 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 to Bristol during GD4.

South Wales Industrial Cluster, we are contributing to the South Wales Industrial Cluster (SWIC) Roadmap and Deployment projects, which seek to identify the best options for cost-effective decarbonisation of industry in South Wales. 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 as well as onsite strategic opportunities specific to each industry. 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.

Zero 2050, as part of the Zero 2050 South Wales project, WWU and Progressive Energy are collaborating on a work package that focuses on hydrogen and CO2 production and infrastructure. This work aims to explore demand and supply, transport and storage requirements, together with the investment required to reinforce the current gas network in South Wales and/or build new pipelines to deliver this.

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. 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 have included proposals for this in our GD2 submission that went in to Ofgem in December last year. This plan included our vision for a net zero ready network by 2035, and we're dedicated to working collaboratively to support a Green Recovery out of Covid-19. The RIIO-GD2 business planning process is well underway and is a clear opportunity for the regulator to aid in our country's goal of achieving Net Zero by 2050. We are committed to working with the regulator through the business planning process and final determinations are expected before the end of the year.

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.

Included in our current RIIO framework is an incentive to book NTS capacity efficiently at the lowest cost. However, current arrangements mean that increases to our enduring capacity bookings result in us being 'locked in' to capacity for four years under User Commitment arrangements. This can result in us having more capacity than we need – either in specific locations or in some cases at an LDZ or network level.

Following a requirement in Ofgem's sector specific methodology decision document in May 2019, NTS were asked to review system capacity access arrangements. This capacity access review began earlier in 2020 and discussions are ongoing between GDNs and NTS via the Transmission Workgroup.[2]

As part of the draft determinations published this year OFGEM have proposed the removal of the existing incentive mechanism for NTS Flat Capacity and have not set an exit capacity output in RIIO-GD2. However, given stakeholders' views on the importance of whole system impacts being factored into booking strategies, and the role played by the current incentive in helping to keep capacity available for use, as required by other parties it was felt there would be a risk in relying purely on existing legislative and licence obligations.

OFGEM propose to introduce an enhanced obligations framework, covering both GDNs and NGGT with the following objectives:

- GDNs' booking processes should be efficient
- The National Transmission System (NTS) and GDNs should be provided with the information necessary to make appropriate investment decisions.

We are working with OFGEM and Industry to develop these proposals and are supportive of revised arrangements which would allow transmission and distribution networks to improve processes for the benefit of whole system optimisation.

[2] www.gasgovernance.co.uk/0705

Figure 1 provides details of the physical and commercial capacity through our NTS Offtake sites:

Subsystem Name	Offtake Location	Capacity		2020/21 Capacity Bookings kWh/d
		kWh/h	KWh/d	
	LDZ:- SW			
Northern	Wiltshire (1)	1,322,569	31,741,667	27,072,091
	Gloucestershire (1)	1,254,861	30,116,667	19,662,708
	Bristol (1)	2,632,500	63,180,000	56,346,079
Central	Bristol (2)	1,625,000	39,000,000	24,447,923
	Somerset	1,895,833	45,500,000	29,988,051
Southern	Exeter (1)	677,083	16,250,000	14,410,673
	Plymouth	3,250,000	78,000,000	43,231,392
Other	Exeter (2)	1,318,056	31,633,333	18,538,754
	Gloucestershire (2)	487,500	11,700,000	8,113,486
Pressure Controlled	Devon	379,167	9,100,000	4,951,514
	Herefordshire	270,833	6,500,000	4,109,831
	Wiltshire (2)	230,660	5,535,833	2,785,149
	Worcestershire	410,764	9,858,333	5,928,377
	LDZ:- WS			
South Wales	Cardiff	4,702,118	112,850,833	95,648,400
	Swansea	2,545,833	61,100,000	36,335,708
	Newport	3,423,333	82,160,000	73,826,284
	LDZ:- WN			
North Wales	Wrexham	2,708,333	65,000,000	49,451,577
Assumned CV 39.2				

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: South West, 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.

In 2019/20 we have carried out significant stakeholder engagement:

- Based on several engagement surveys including over 21,000 stakeholders we have gathered consistent feedback that safety and reliability of service are of paramount importance and that we have broad support for our continued efforts to improve our mains replacement programme. Based on this feedback we are committing to significantly reduce the safety risk for over half a million people living in the vicinity of an ageing metallic gas mains, by continuing to invest in our mains replacement programme.

- From a number of engagements, including over 2,400 stakeholders, we are seen as playing a central role in creating a sustainable energy future. Customers would like us to incorporate their views in the development of initiatives to achieve this ambition. We are therefore committing to ensuring that the investments we make today will support future energy scenarios and therefore represent a 'no regrets' energy solution as set out in our Business Plan.

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 to date. These decision support tools help us to 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 Output Measures (NOMs) methodology work. 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. Our 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.

6.4 Investment

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 2013 to 2021 we will replace around 3,360km of metallic gas mains, at an annual cost of £70 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.

Through our OptiNet project we are investigating ways to optimise our network through a combination of storage, compression and smarter pressure control. Further information is available in Appendix 4: Our future of energy research.

7. Innovation

7.1 Key messages

- Since the start of the current gas network price controls in 2013, the networks have delivered over 400 innovation projects.
- 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.

7.2 GDN innovation

In March 2020, Britain's gas network companies joined with electricity network companies to set out their latest vision for innovation projects and priorities as part of their network innovation strategies.

The documents set out the principles that energy network companies will adhere to as they commission a new generation of innovation projects up and down the country, helping Britain reduce its carbon emissions between now and 2050, reduce costs and deliver better services to consumers.

This year, they have been joined by a new 'whole systems' Energy Networks Strategy, which will help find new ways for Britain's gas and electricity grid infrastructure to work together in a more integrated way, as the country looks towards an expansion of zero carbon technologies across a range of different sectors.

Between 2008 and 2019 gas and electricity network companies delivered over 1,100 different projects in communities and regions across Great Britain. These projects have underpinned the country's renewables revolution, whilst driving up efficiency of Britain's energy network infrastructure to keep down costs for the public.

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

Input from wider industry is crucial to shape our Innovation Strategies. We consult widely during their development and encourage third parties to participate directly in innovation projects and present new ideas to network operators. You can find out more or submit your proposals via https://www.nicollaborationportal.org/.

7.3 WWU innovation summary

We have invested in more than 300 business improvement and innovation projects since 2013, representing a total investment of £21.4m. Our innovation has delivered the following value:

- Improvements in safety, reliability and customer service.
- Providing real evidence of the way in which the gas network plays a critical enabling role in achieving net zero.
- A framework to roll-out out proven innovation – 100 projects embedded through our innovation programme have delivered overall cost savings or costs avoided to the value of c£13m. These costs savings will continue into GD2.

For further information on our innovation portfolio to date, please read our innovation report for 2019/20.[3]

7.4 WWU innovation strategy

Our strategy is simple. We innovate to make sure we can deliver the highest possible levels of safety, reliability and service for today and tomorrow's customers. These challenges can be summarised as:

- Delivering a smart, reliable, low cost and low carbon network to meet the future energy needs of our customers;
- Supporting customer needs and expectations in a changing environment;
- Effectively managing an ageing infrastructure to keep the gas flowing to our customers' homes and businesses;
- Continuing to review, develop and demonstrate technological advances to keep our colleagues and customers safe while delivering value for money.

7.4.1 Innovation for customers today

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.

We put our customers first, and target innovation to deliver value for money and real results for our customers. Our values have helped innovation thrive, with 100 NIA projects started since 2013/14.

Not all of our projects have been successful, but we have learnt from each and this has helped us deliver for our customers in the long term. We have used the incentive funding to pursue a number of solutions to real problems including:

- Hybrid-Hydrogen (HyHy), to further the solutions needed to decarbonise heat for homes, this project examined how hydrogen and hybrids could decarbonise the heating of a city sooner and more effectively than alternatives.

[3] https://www.wwutilities.co.uk/report/index.html#p=1

- ESEAL, (Enhanced Stub End Abandonment Live) is one of the latest innovative ways of replacing mains efficiently and in the least disruptive way possible.
- OptiNet is in response to the many challenges facing the gas industry as we transition to a cleaner energy system – it is a collaborative project to help us balance green gas supply with demand to maximise the green gas transported and keep homes heated.

7.4.2 Innovation for customers of tomorrow

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.

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.

There has been a marked increase in the number of research and demonstration projects in the energy futures space since 2013. In 2013/14 we had just one project in this category – but today a significant proportion of our NIA funding has been committed to innovating for the customers of tomorrow. To date, we have invested in 34 decarbonisation R&D projects.

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 Our team

7.5.1 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.

7.5.2 Collaboration and sharing

Collaboration is central to delivering our business innovation strategy. We are proud that 65% 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 our collaboration partners the Energy Innovation Centre. 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 have a voluntary team of innovation champions who endorse our innovation strategy and advocate the continual growth and development of an innovative culture. They work closely with our innovation team supporting the implementation of solutions designed to deliver for our customers. We are proud that a significant source of innovation is from our colleagues – more than 40% of ideas come from our own colleagues.

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.

7.6 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. Our strategy will stay the same: innovating for customers today and tomorrow, with an innovation portfolio split between projects that develop solutions to solve today's problems and those that plan for the UK energy system of the future.

There are a growing number of successful projects that have been developed across and beyond the industry that we want to adopt and we will be embracing these projects, working closely with other networks to implement their successful projects in our network where appropriate. We will build on our drive to fully embed our projects to business as usual, making use of our innovation champions to promote, roll out, communicate and support people as they respond to the changes.

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: Process methodology

A1.1 Introduction

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.

A1.2 Demand forecasts for Wales & West Utilities planning

Models have been built for each load band that relates weather correct demand to economic variables using established econometric techniques. For large loads local information is used where available, for example information on new loads or known future changes in demand.

Forecasts are produced for annual demand and peak day demand. Different models and techniques are used for these two purposes. The forecasts of peak day demand is a forecast of demand under extreme conditions and therefore uses statistical distributions designed to model extreme values. Peak day modelling uses the full historical weather from 1928/29 through to present. The weather data is used in conjunction with seasonal normal demand and a simulation technique to produce a 1 in 20 peak demand for each LDZ. This can then be applied to the previously forecast annual demands to produce peak daily demand across the ten-year forecast period.

A1.3 NDM profiling and Composite Weather Variable

Demand Estimation parameters are calculated based on SNCWV. From 1st October 2015 Xoserve have published revised SNCWV for use going forward. This includes a revised shortened weather history than was previously used. We have considered the impact of these revisions in this current iteration of our Long Term Development Statement.

A1.4 Supply

NG own and maintain the NTS which supplies our network through 17 offtakes. Exit Capacity bookings at these offtakes are made by us as per the arrangements in Uniform Network Code and further information regarding the release of capacity by NTS is described at the following location; National Grid Exit Capacity

Where available, Biomethane sites are also providing gas injection directly into our network. Whilst the number of sites are few and in the absence of historic data, we do not consider that these volumes can be assumed to be available at peak, with no commitment from these suppliers to provide flat capacity and as such bookings for equivalent NTS capacity are also made to ensure security of supply. However, as the number of sites increases this will be reviewed.

A1.5 LTS planning

We use a forecast of demand to model system flow patterns and produce capacity plans that take account of anticipated changes in system load and within-day demand profiles.

The options available to relieve LTS capacity constraints include:

- Uprating pipeline operating pressures.
- Constructing new pipelines or storage.
- Constructing new supplies (offtakes from the NTS), regulators and control systems.
- DN Entry when available and secure.
- Offering customer interruption via the interruption capacity auctions

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

A1.5.1 Below 7 Bar distribution planning

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

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

A1.6 Investment procedures and project management

All investment projects must comply with our Investment Procedures, which set out the broad principles that should be followed when evaluating high value investment or divestment projects. Governance is carried out by our Committee structure.

The investment procedures define the methodology to be followed for undertaking individual investments and cover the following stages:

- Project Planning
- Financial Appraisal
- Project Approval
- Project Monitoring
- Project Completion

Primarily the purpose of investment is to maintain the safe supply of gas to the customer. Projects are either mandatory or discretionary investments and are considered on the basis of:

i) Maintenance of security of supply,
ii) Financial & commercial impact, and
iii) Mandatory requirements such as legal or HSE obligations.

All investment proposals fully account for the technical, safety, environmental and financial aspects.

The successful management of major investment projects is central to our business objectives. Our project management strategy involves:

- Determining the level of financial commitment.
- Monitoring and controlling the progress of the project to ensure that financial and technical performance targets are achieved.
- Post Completion Reviews and Post Investment Appraisals to ensure compliance and capture lessons learnt.

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

Appendix 2: Gas demand & supply volume forecasts

A2.1 Demand

NB: Volumes are estimated using CWV derived on the EP2 basis implemented in 2016. Figures may not sum due to rounding.

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

LDZ	2020/21	2021/22	2022/23	2023/24	2024/25	2025/26	2026/27	2027/28	2028/29	2029/30
South West	260	261	262	265	268	271	274	278	281	284
Wales North	49	50	50	52	52	52	53	53	54	54
Wales South	206	206	206	209	210	211	211	213	215	217
Network Total	515	516	518	525	530	534	538	544	550	556

Figure A2.2 – Forecast 1 in 20 Peak Day Firm Demand Low Growth (GWh per day)

LDZ	2020/21	2021/22	2022/23	2023/24	2024/25	2025/26	2026/27	2027/28	2028/29	2029/30
South West	260	261	262	265	268	268	268	268	268	268
Wales North	49	50	50	52	52	52	52	52	52	52
Wales South	206	206	206	209	210	210	210	210	210	210
Network Total	515	516	518	525	530	530	530	530	530	530

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

Calendar Year	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029
0 - 73.2 MWh	20.26	20.26	20.26	20.27	20.29	20.30	20.31	20.31	20.33	20.36
73.2 - 732 MWh	3.52	3.85	4.04	4.22	4.45	4.67	4.89	5.11	5.31	5.50
>732 MWh	4.17	4.23	4.28	4.33	4.37	4.38	4.42	4.44	4.49	4.65
NDM Consumption	27.95	28.34	28.58	28.82	29.10	29.35	29.62	29.87	30.13	30.51
DM Firm Consumption	2.93	2.95	2.97	2.98	2.99	2.99	3.00	3.00	3.01	3.08
Total LDZ Consumption	30.89	31.30	31.54	31.81	32.09	32.34	32.62	32.87	33.14	33.59
Total Shrinkage	0.21	0.21	0.25	0.27	0.27	0.27	0.27	0.28	0.28	0.28
Total Throughput	31.10	31.50	31.80	32.07	32.36	32.60	32.89	33.15	33.42	33.87
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	30.79	31.02	31.30	31.39	31.63	31.69	31.91	32.01	32.16	32.23

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

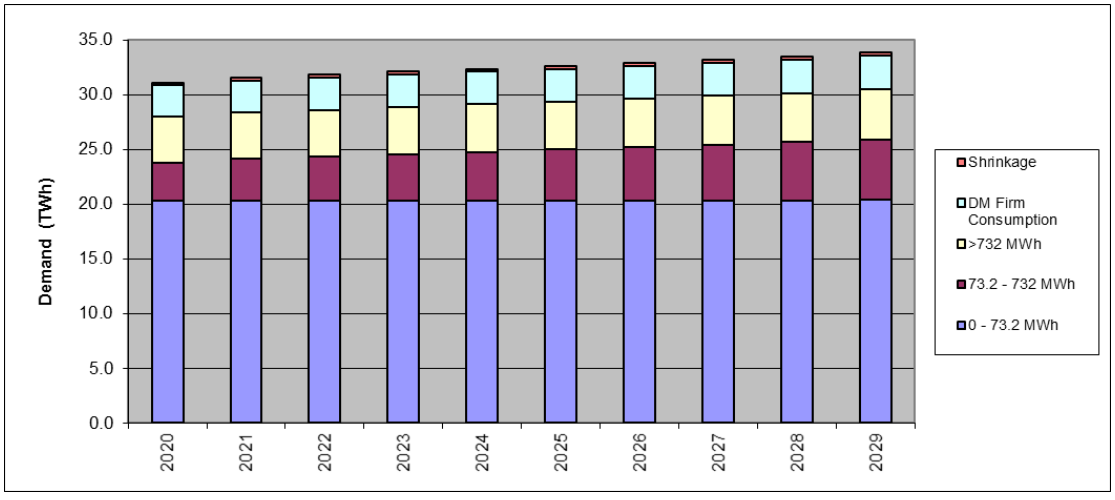


Figure A2.5 – Wales South LDZ Forecast Annual Demand Table by Load Categories (TWh)

Calendar Year	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029
(a) 0 - 73.2 MWh	11.94	11.94	11.94	11.95	11.96	11.97	11.98	11.98	11.99	12.00
(b) 73.2 - 732 MWh	2.19	2.58	2.78	2.99	3.26	3.52	3.79	4.04	4.29	4.50
>732 MWh	2.67	2.72	2.75	2.78	2.80	2.81	2.83	2.85	2.88	2.98
NDM Consumption	16.81	17.24	17.47	17.72	18.03	18.30	18.60	18.87	19.15	19.49
DM Firm Consumption	9.55	9.49	9.38	9.31	9.22	9.12	9.03	8.93	8.85	8.83
Total LDZ Consumption	26.36	26.73	26.86	27.03	27.25	27.42	27.63	27.81	28.01	28.32
Total Shrinkage	0.11	0.10	0.17	0.19	0.19	0.19	0.21	0.22	0.22	0.22
Total Throughput	26.47	26.84	27.02	27.21	27.43	27.61	27.84	28.03	28.23	28.54

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	29.88	28.55	28.48	28.28	28.57	28.35	28.25	28.30	28.38	28.35

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

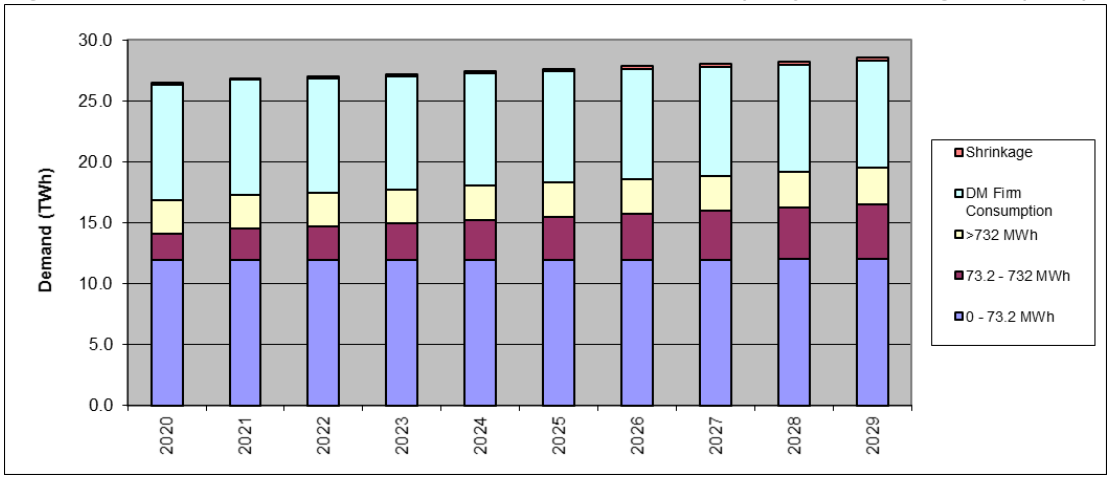
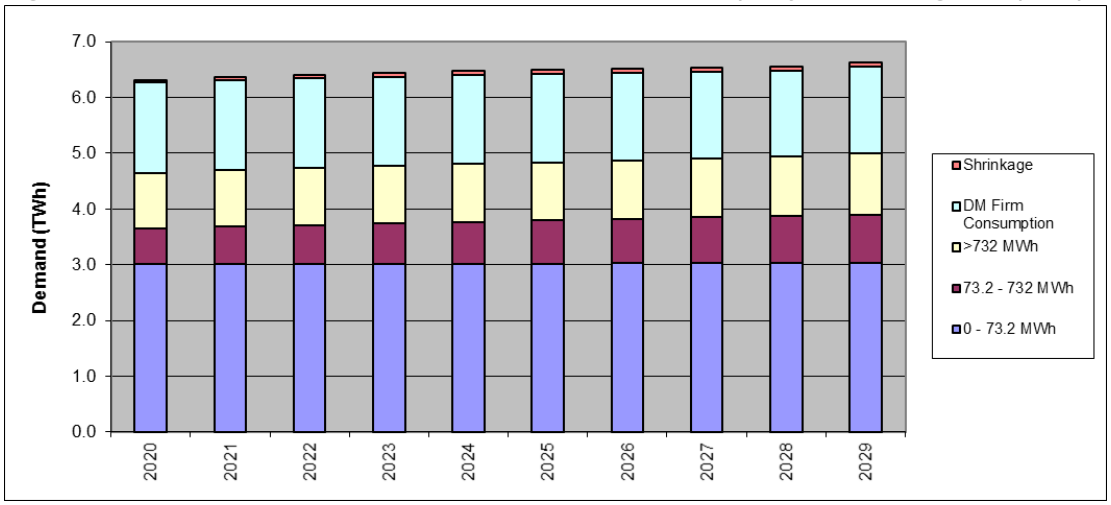


Figure A2.7 – Wales North LDZ Forecast Annual Demand Table – Split by Load Categories (TWh)

Calendar Year	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029
(a) 0 - 73.2 MWh	3.02	3.02	3.02	3.02	3.02	3.02	3.03	3.03	3.03	3.03
(b) 73.2 - 732 MWh	0.63	0.67	0.70	0.72	0.74	0.77	0.80	0.82	0.85	0.87
>732 MWh	0.99	1.00	1.02	1.03	1.04	1.04	1.05	1.06	1.06	1.10
NDM Consumption	4.64	4.70	4.73	4.77	4.80	4.83	4.87	4.90	4.94	5.01
DM Firm Consumption	1.63	1.62	1.62	1.61	1.60	1.58	1.57	1.56	1.54	1.55
Total LDZ Consumption	6.27	6.32	6.35	6.38	6.40	6.42	6.44	6.46	6.48	6.55
Total Shrinkage	0.05	0.04	0.07	0.07	0.07	0.07	0.08	0.08	0.08	0.08
Total Throughput	6.32	6.36	6.41	6.45	6.48	6.49	6.52	6.53	6.56	6.63

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	6.78	6.82	6.90	6.91	6.94	6.96	6.99	7.00	7.02	7.02

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



Appendix 3 : Actual flows 2019

A3.1 Annual flows

As forecasts are made without knowledge of what weather conditions will prevail into the future they are made at 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 Network Code requires a revision to seasonal normal values every five years and as such the basic seasonal normal temperatures were revised during 2015/16 and implemented on the 1st October for gas years 2016/17 onwards. A review is underway with Xoserve to update these values.

Figure A3.1 – South West LDZ Annual Demand 2019 (TWh)

	2019 Actual Demand	Weather Corrected Demand	2019 Forecast Demand
0 – 73 MWh	19.35	19.80	18.59
73 – 732 MWh	2.98	3.03	2.73
> 732 MWh Firm	7.21	7.26	7.87
Interruptible	0.00	0.00	0.00
Total Consumption	29.54	30.09	29.20
Unidentified Gas	0.60	0.60	0.00
Shrinkage	0.20	0.20	0.27
Total Throughput	30.35	30.90	29.46

Figure A3.2 – Wales South LDZ Annual Demand 2019 (TWh)

	2019 Actual Demand	Weather Corrected Demand	2019 Forecast Demand
0 – 73 MWh	11.55	11.78	11.79
73 – 732 MWh	1.38	1.40	1.49
> 732 MWh Firm	12.24	12.27	2.42
Interruptible	0.00	0.00	0.00
Total Consumption	25.17	25.46	28.40
Unidentified Gas	0.49	0.49	0.00
Shrinkage	0.10	0.10	0.19
Total Throughput	25.76	26.05	28.59

Figure A3.3 – Wales North LDZ Annual Demand 2019 (TWh)

	2019 Actual Demand	Weather Corrected Demand	2019 Forecast Demand
0 – 73 MWh	3.54	3.49	3.34
73 – 732 MWh	0.53	0.53	0.55
> 732 MWh Firm	2.69	2.68	0.88
Interruptible	0.00	0.00	0.00
Total Consumption	6.76	6.69	6.19
Unidentified Gas	-0.05	-0.05	0.00
Shrinkage	0.04	0.04	0.07
Total Throughput	6.75	6.69	6.26

The weather corrected demand gives the expected level of demand for 2019 had the weather been at its seasonal normal value. As can be seen in the tables above the Actual Demand in 2019 was very similar to the Seasonal Normal in the Wales South and South West areas but higher in Wales North.

A3.2 Maximum and peak flows

In 2019/20 our most severe weather occurred on 21st January 2020 in the South West and Wales South LDZ's but it occurred earlier in the winter period for Wales North on 1st December 2019. The maximum firm demand for the whole network this gas year also occurred on the 21st January and was 30.59 mcm. This was 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 and Minimum Flows (GWh)

LDZ	Maximum Day 20/01/2020	1 in 20 Forecast peak 2019/20	Minimum Day 08/08/2020
Wales South	135	200	24
LDZ	**Maximum Day 11/02/2020**	**1 in 20 Forecast peak 2019/20**	**Minimum Day 27/06/2020**
Wales North	34	50	7
LDZ	**Maximum Day 21/01/2020**	**1 in 20 Forecast peak 2019/20**	**Minimum Day 08/08/2020**
South West	174	260	28

Appendix 4 : Our future of Energy Research

A4.1 Introduction

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 impact on future negotiations for funding allowances within regulatory timelines.

We have completed a number of 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 research projects

Project	Stakeholder engagement	Network collaboration	Modelling/ analysis	Live trial	Project summary	Key findings/output
Bridgend Study (2015)			✓		Work to explore willingness to pay considering the likely payback period that would encourage investment in new heating technology.	80% of households would be unable or unwilling to pay to transition to a heat network.
Cornwall Energy Island (2016)	✓		✓		Modelling and analysis of proposals put forward by the Energy Island group using renewable generation.	Improved understanding of storage requirements and costs associated with electrification scenarios.
2050 Energy Pathfinder (2016/18)			✓		Creation of a high resolution whole energy model to assess how future energy mixes would work in practice.	Development of a whole system model which is used extensively within WWU and by external projects under licence.
Freedom (2017/18)	✓	✓	✓	✓	Installation of air source heat pumps alongside gas boilers in 75 homes along with smart functionality to optimise both appliances.	Hybrid heating systems can be used to optimise use of electricity and gas resulting in reductions in cost and CO2.
Gas demand forecast project (2017/18)		✓	✓		Development of long-term projections for gas supply and demand changes by individual load types to feed our planning processes.	Significant change to energy usage is only likely as a result of significant incentive or deterrent.
Regional FES (2018/19)	✓		✓		Production of regional forecasts based on the NG 2018 future energy scenarios framework.	Forecasts in a format that can be combined with similar forecasts produced for WPD.
KESS – advanced research into anaerobic digestion			✓	✓	Academic research aimed at making biogas production more in line with gas network supply and demand profiles	Two projects have been progressed; one to provide variable output from an AD; the other to produce higher chain alkanes to enable biogas CV matching to existing network levels.
Green City Vision (2018/19)	✓	✓	✓		Case study demonstrating whole system thinking using Pathfinder to determine feasible solutions for decarbonisation in a real location, Swindon.	Detailed whole network analysis will be essential to ensure that effective decarbonisation strategies are implemented.
Optinet (2018/19)		✓		✓	Assessing the potential for lower investment solutions including compression solutions to be used to improve network capacity.	In progress.
Consumer economics of hybrid heating	✓		✓		To create an economic calculator for consumers to evaluate hybrid heating systems	A series of case studies have been assessed and a calculator being made available for consumers to use.

Project	Stakeholder engagement	Network collaboration	Modelling/ analysis	Live trial	Project summary	Key findings/output
Gas Decarbonisation Pathways Project (2019)	✓	✓	✓		Defining clear pathways to meet the challenges associated with decarbonisation of the gas networks	Project to be launched at the end of October - interim messages are that decarbonisation of the gas networks could save up to £214bn by 2050 compared with full electrification
Bridgend Phase 4 (2019)			✓	(✓)	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	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.
Hybrid Hydrogen – HyHy (2019/20)	✓		✓		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.	Report currently being finalised for launch
Zero 2050 South Wales (2019/20)	✓	✓	✓		Zero2050 is an initiative led by National Grid to speed up progress of the decarbonisation of South Wales to hit government targets of 'Net Zero' by 2050. Its partnership between business, community and other like-minded organisations who are committed to working collaboratively to achieve this target.	This project continues to ensure results can be used properly in Pathfinder and the Coliapy model ARUP will use for their optimisation
Milford Haven Energy Kingdom (2020/21)	✓		✓	✓	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.	Project in progress
Flexible Generation Forecasting (2020/21)	✓	✓	✓		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	Project in progress

Some of our more recent projects are detailed here and all other earlier projects are as per the description given in last year's statement:

Gas Decarbonisation Pathways Project The ENA Pathways project was launched in Wales and South West England in January 2020 and nationally that has progressed into the Gas Goes Green programme of work. The Pathways project report recommended a balanced approach to decarbonising heat, power and transport, with the headlines indicating a strong role for hydrogen for industry and large cities and the remaining areas dominated by wind / biogas hybrids. The Gas Goes Green programme sets out the detailed project areas and the road map to deliver them.

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.

HyHy Project – Hybrid-Hydrogen The HyHy project examined how hydrogen and hybrids could decarbonise the heating of a city sooner and more effectively than alternatives.

This model-based feasibility study sets out an achievable path to net zero which keeps disruption to communities and cost to customers as low as possible.

The project studied the Welsh capital of Cardiff and simulated the decarbonisation of home heating in a number of different ways. It showed that using smart-controlled hybrid heating systems – where you pair a boiler with an air source heat pump – can reduce carbon emissions quicker. Hybrid installations of this kind use renewable electricity when it is available, and green gas like hydrogen and biomethane when it is not. It also reduces the amount of green gas needed to heat homes, relying on electricity for 80% of the time and on hydrogen or biomethane to meet peak heat demand.

The existing gas network is already able to transport various amounts of hydrogen as it has done in the past. If Government mandate that all boilers should be hydrogen-ready, then the conversion process will entail little more than a short visit from a gas engineer. First rolling out heat pumps for use alongside existing gas boilers (fuelled by an increasingly green gas supply) means we can start to decarbonise home heating sooner using existing infrastructure, before switching to hydrogen in the future. The main findings also show local hydrogen production is a viable and affordable alternative to a national supply. This solution could significantly reduce the amount of hydrogen required to meet Cardiff's energy demand, simplifying the transport and storage of carbon dioxide from the hydrogen production process.

Zero 2050 South Wales is an initiative led by National Grid to speed up progress of the decarbonisation of South Wales to hit government targets of 'Net Zero' by 2050. Its partnership between business, community and other like-minded organisations who are committed to working collaboratively to achieve this target.

As part of the Zero 2050 South Wales project, WWU and Progressive Energy are collaborating on a work package that focuses on hydrogen and CO2 production and infrastructure. This work aims to explore demand and supply, transport and storage requirements, together with the investment required to reinforce the current gas network in South Wales and/or build new pipelines to deliver this.

The results of this project will be used in Pathfinder and the Coliapy model that ARUP will use for their optimisation. The partners and main contractors also include PE, Regen, National Grid Gas Transmission, Western Power Distribution, National Grid Electricity Transmission.

Milford Haven Energy Kingdom (MH: EK) This project 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 hybrid heating systems with a hydrogen-ready boiler into one of the Port's commercial buildings. 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.

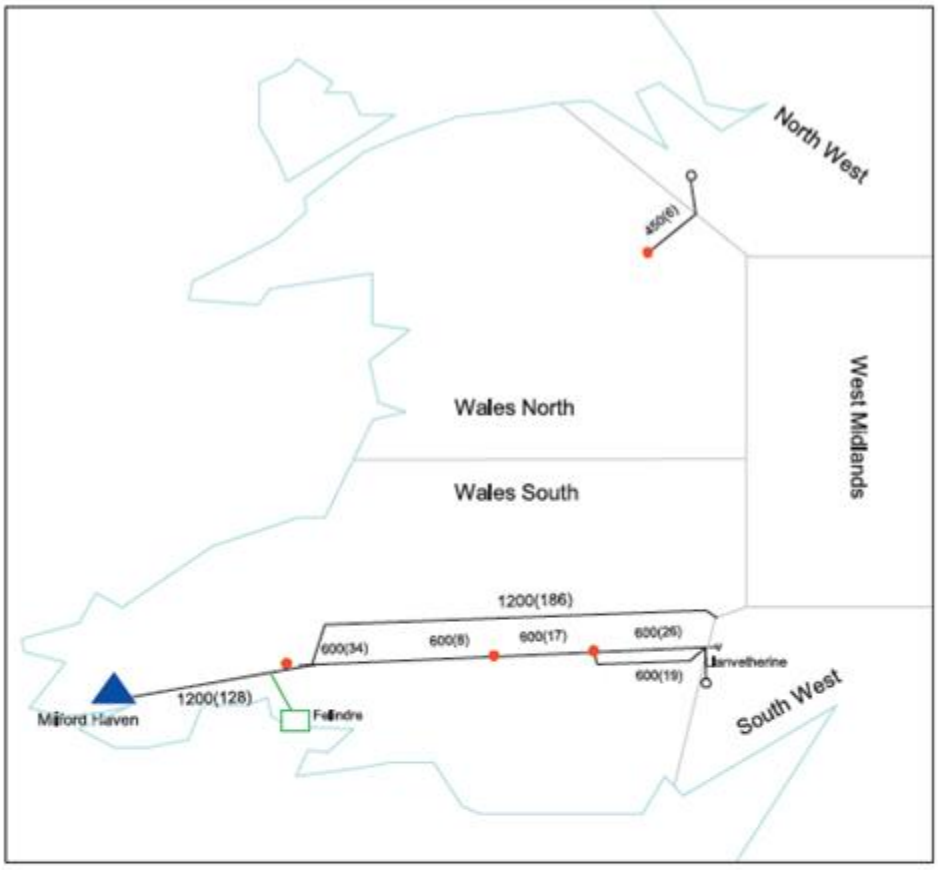
Working with a consortium of partners, the project aims to spearhead the transition to hybrid hydrogen and renewable energy production. The partners and main contractors also include Pembrokeshire County Council, the Offshore Renewable Energy Catapult, Riversimple, Port of Milford Haven, ARUP and the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

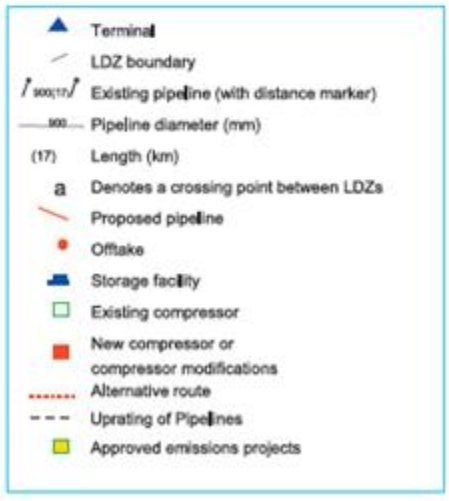
Flexible Generation Forecasting This is a project to identify the key drivers and datasets that will enable us to improve whole system forecasting and network planning / operation in close to real time. This is necessary because we are seeing significant changes in the ways in which gas is used for electricity 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 ESO, SPEN and NGN and the contractors are Delta-ee and Afry.

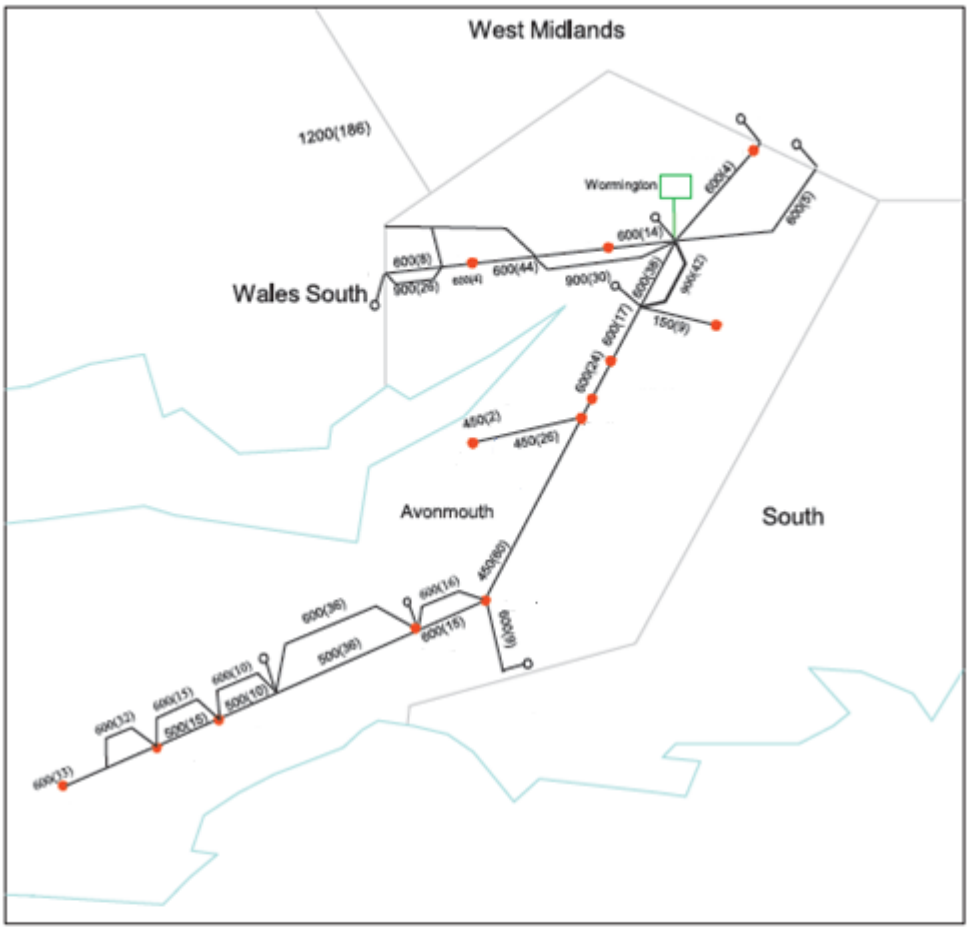
Appendix 5 : The Gas Transportation System

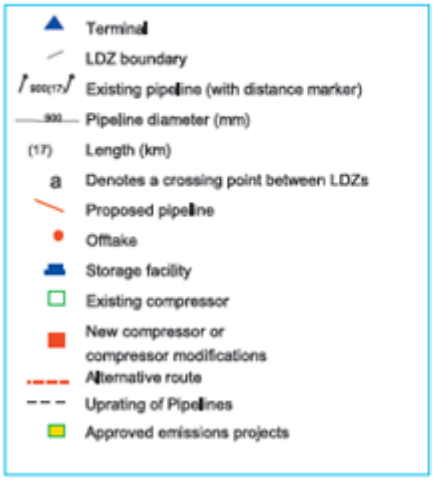
A5.1 Wales North and Wales South (WN & WS) NTS



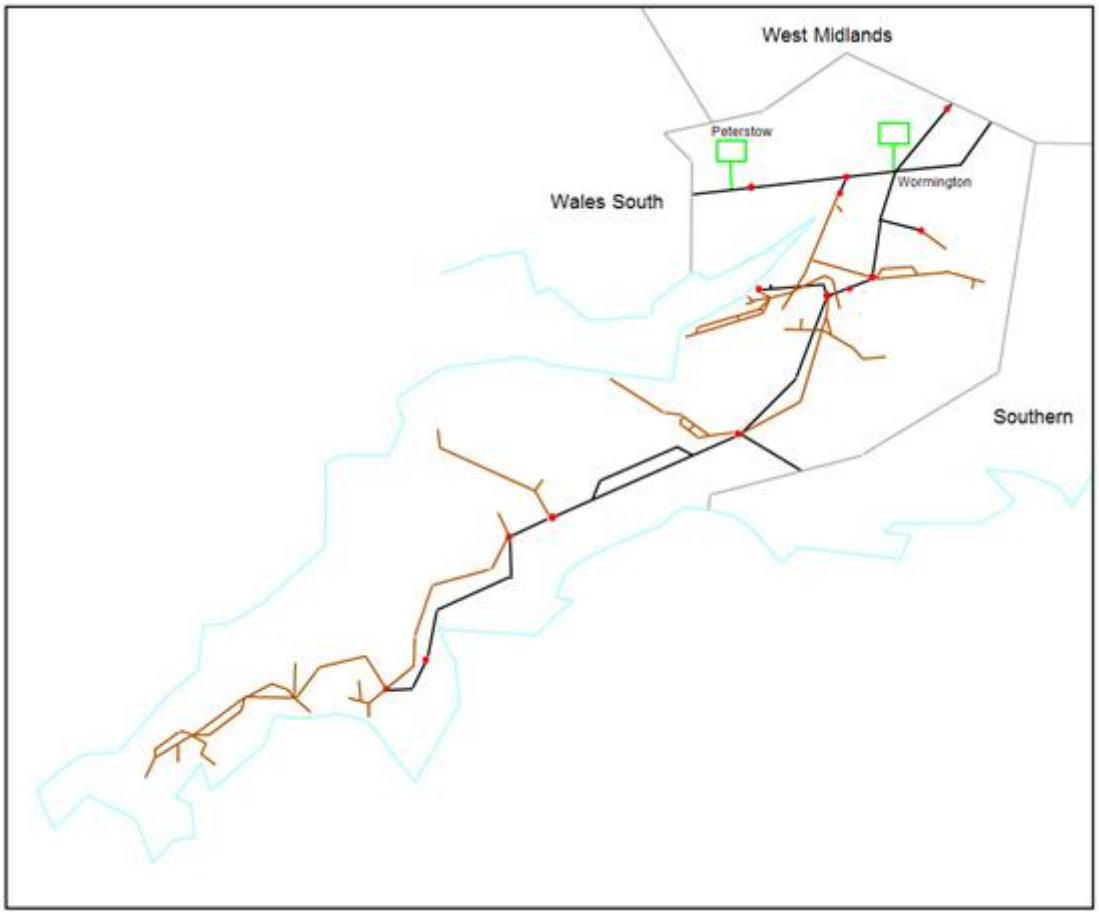


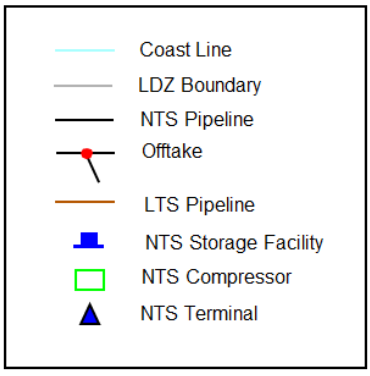
A5.2 South West (SW) NTS



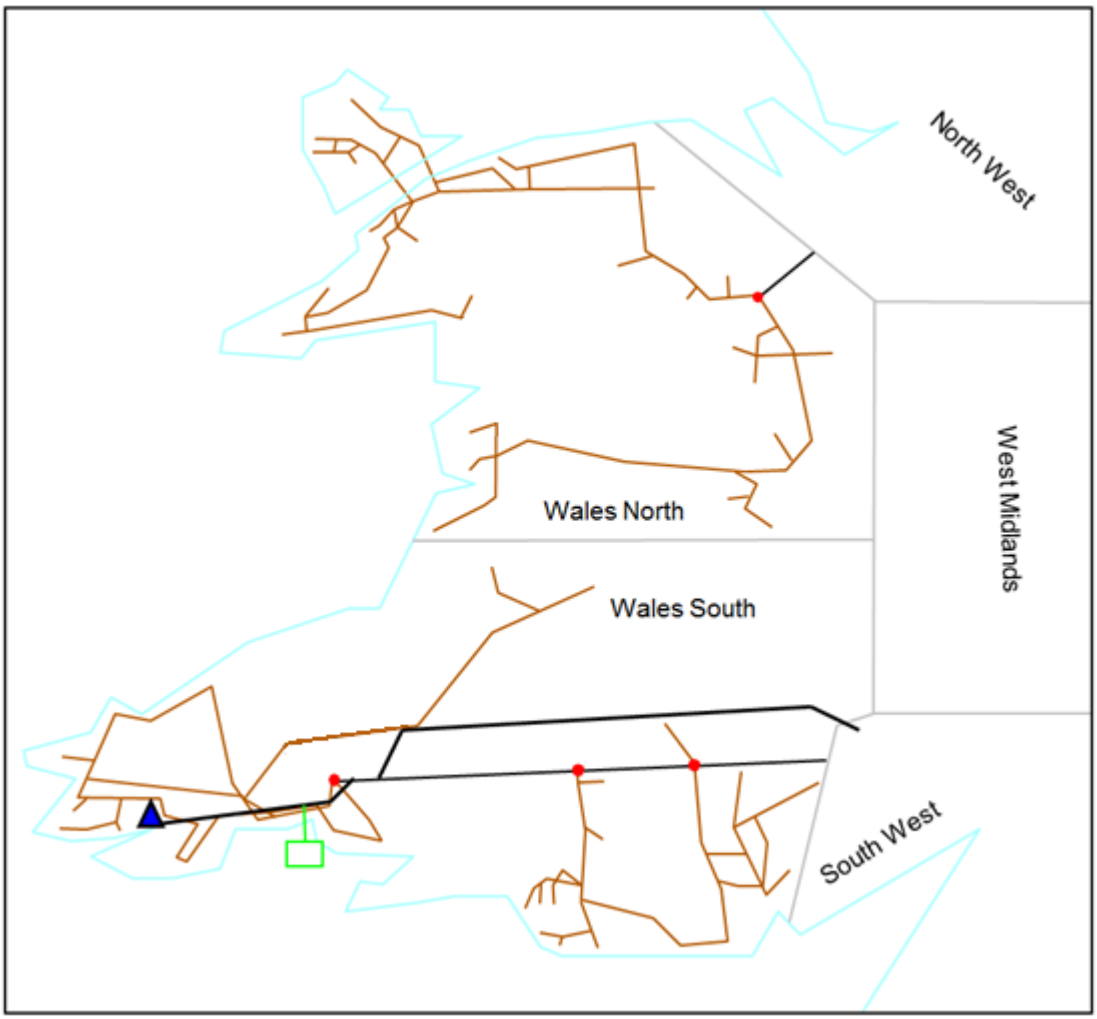


A5.3 South West (SW) LDZ - LTS

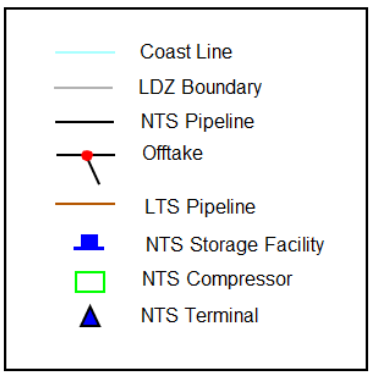




A5.4 Wales North and Wales South (WN & WS) LTS



A5.5 Code LDZ Maps



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. Both documents can be downloaded from our web site (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 38°C
18. Siloxanes
    - Tests for siloxanes and the determination of safe limits are subject to ongoing work.

      The limits and testing regime will be updated as industry best practice develops

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 Advanced Reservation of Capacity Agreement (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 vest in us once the connection to the 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.

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.

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