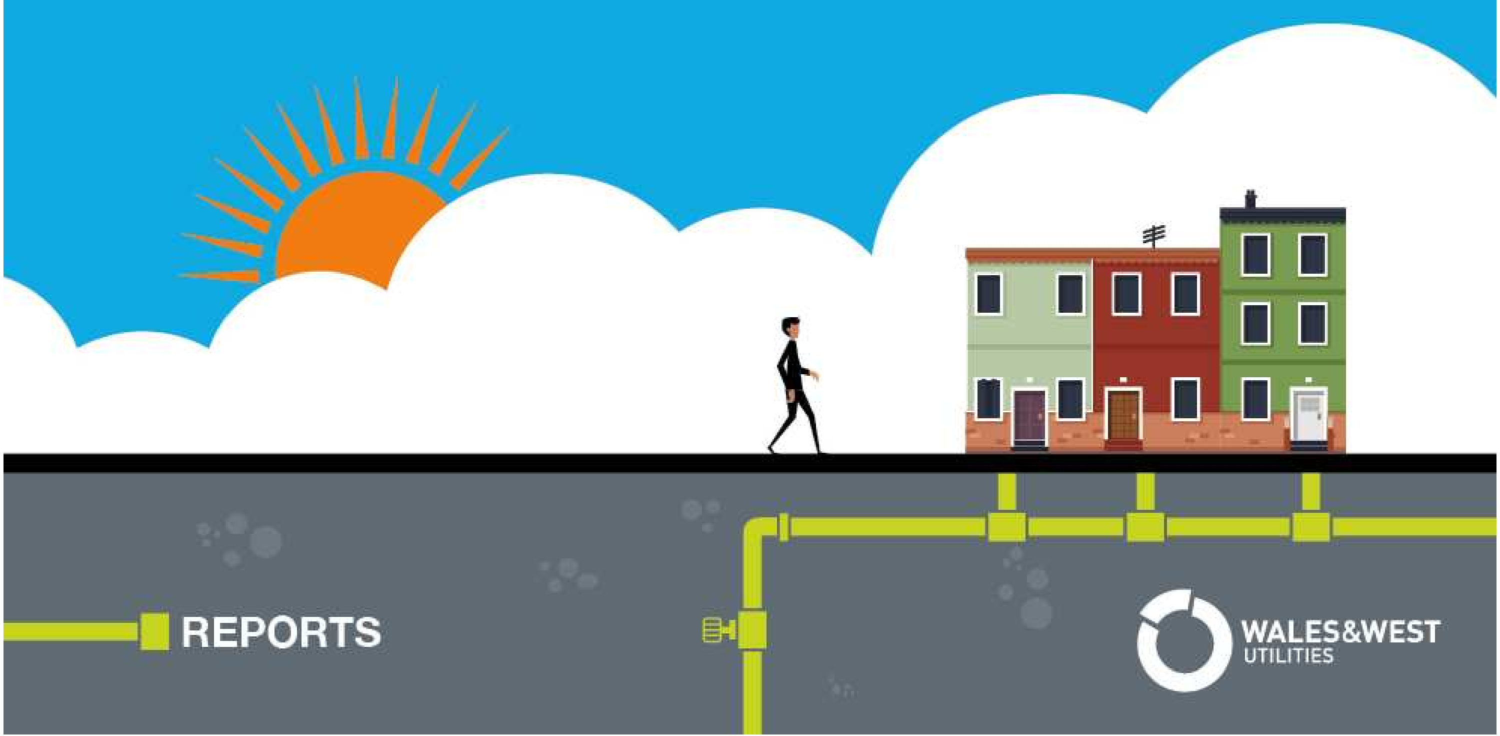
Wales & West Utilities

2018 Long Term Development Statement



1. Contents

Foreword

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

The 2018 Long Term Development Statement is published in accordance with Standard Special Condition D3 of our Gas Transporters Licence and Section O4.1 of the Uniform Network Code (UNC) Transportation Principal Document (TPD). These require that a Long Term Development Statement is published annually.

The Statement provides an indication of the usage for our pipeline system and likely developments. Companies that are contemplating connecting to our system or entering into transportation arrangements can use the statement to help identify and evaluate opportunities. It has been published at the end of the 2018 planning process following a reappraisal of our analysis of the market and demands on our Network within the South West (SW), Wales North (WN) and Wales South (WS) Local Distribution Zones (LDZs).

The Statement contains information on actual volumes, the process for planning the development of the system, including demand and supply forecasts, the impact of increased integration of electricity and gas networks, system reinforcement projects and associated investment.

As the use of our network expands to new user groups in a changing energy system we're continuing to build on our successes to deliver for all our customers – including the most vulnerable across our region.

Some of our 2017/18 performance headlines include:

- Project Freedom – We have delivered one of the most ambitious and innovative projects to support the decarbonisation of heat in the UK. 75 hybrid heating systems with smart functionality are now live in a town in South Wales delivering lower cost, lower carbon and more secure energy for those most in need.
- We now have 19 biomethane sites delivering low carbon gas into our network, which provides enough heat, light and power for around 130,000 homes, more than three times the amount the Swansea barrage would have produced at a fraction of the cost.

- We now have 36 power generation sites which generate just under 2 GW electricity, providing the flexibility required as renewable electricity sources increase their proportion within the energy mix.
- Physical Site Security Upgrades – We have largely delivered a comprehensive and efficient upgrade to all sites as identified by the Centre for the Protection of National Infrastructure (CPNI).

Our focus on putting customers first has brought significant success, as well as helping us meet our Outputs under our regulatory framework RIIO which we have delivered year to date and are on track to deliver for the full eight years.

Once again our efforts have been recognised across the board with:

a "ROSPA Gold" award for the fifth year in a row.
the company of the year award at the IGEM / EUA national awards;
reaccreditation by the Institute of Customer Service at Distinction level
Investors in People Silver Status at the first attempt.; and
IGEM/EUA Environment award for project Freedom

You will also recall that we became the first gas network to meet the requirements of British Standard 18477 for the support we provide to vulnerable customers and we have also become the first GDN to achieve ISO 45001

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

Andrew Hopkins
Director of Asset Management, Health, Safety & Environment
Wales & West Utilities Limited

Executive Summary

1.1 Context

This document contains the Wales & West Utilities annual and peak demand and supply forecasts which have been developed in conjunction with National Grid UK Transmission (UKT) and WWU modelling and analysis.

Our forecasting methods are developing and although the final results of our collaborative GDN Gas Demand Forecasting project are not yet available, significant changes have already been implemented in the way we are forecasting our peak demands.

1.2 Demand and Supply Outlook

Improved forecasting techniques include new approaches for forecasting flexible gas generation using electricity market information. In addition, the severe weather in early March gave us robust evidence on which to validate previous forecasts and determine new values.

As a result of this modelling our peak demand is now forecast to increase by 5.5% in the next 10 years.

We have continued to connect Biomethane sites to our network and now provide sufficient capacity for the energy needs of 130,000 homes via our 19 connected biomethane sites. Recent work by Cadent suggests continued growth, with the UK having sufficient feedstock for over 120 TWh green gas to be injected annually by 2035.

There are challenges associated with this level of injection include moving gas through the network to centres of demand, often at higher pressure tiers as well as storing gas during periods of low demand for use when required by our customers.

We have launched our OptiNet project in collaboration with Cadent to investigate how smart pressure control, compression and storage might be used in parallel to alleviate such constraints in one area of our network.

1.3 Industry Developments

The UK is committed to legally binding environmental targets to deliver a sustainable future. We have environmental targets to achieve by 2020 and 2050. We must achieve these targets but we must also recognise the requirements to ensure security of supply within an uncertain economic climate and rising fuel poverty.

It is recognised that whole system solutions which 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. Indeed, as part of our Gas Demand Forecasting project we are already developing models that forecast the impact of electric vehicle charging on gas generation requirements.

In 2018 we have completed our Freedom project, a collaborative project with Western Power Distribution. This project has shown how use of hybrid gas and electric heating systems in homes can significantly reduce costs and carbon whilst avoiding significant and unnecessary investment on the electricity distribution networks to meet heat demand. The full report is now available on our website: Project Freedom Final Report

In order to assess more broadly the interactions between gas and electricity networks and to determine feasible solutions for decarbonisation in a real location, we have launched our Green City Vision project. This project in collaboration with UKPN and SSEN and our partners Progressive Energy, will engage with local stakeholders to develop decarbonisation scenarios which will then be further developed through use of our Pathfinder 2050 model.

1.4 Investment Implications

Our stakeholders have told us that maintaining a safe, reliable gas supply is considered to be their number one priority. We are adopting new techniques to ensure efficient investment in network health through use of monetised risk models and are feeding this into our Business Plans.

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.

In 2018 we have also participated in Project H21 and have undertaken analysis on the likely methods of converting Bristol and Cardiff to 100% Hydrogen in the longer term. We will assess the outcomes of this analysis to determine whether we would recommend any revisions to our repex programme in these areas in the shorter term which may deliver significant cost benefits in the longer term.

1.5 Innovation

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 new innovation champions to promote, roll out, communicate and support people as they respond to the changes.

Guided by the publication of the first 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.

2. The UK Gas Network

David Smith – Energy Networks Association

The UK gas network is one of the best developed in the world, providing safe, secure, affordable energy to homes and businesses across the country. It is continuing to grow: every year around 60,000 new customers connect directly to the Gas Distribution Networks, and many tens of thousands more connect through Independent Gas Transporters. In 2016-17 over 12,000 of these connections were provided to households at risk of fuel poverty to reduce their energy costs.

The gas networks are at the centre of our energy system. As well as providing 85% of UK households with their primary source of heating, it generates 40% of our power. Gas is inherently storable: it meets sharp increases in heat demand (such as on 1 March 2018), and provides the flexible generation which balances intermittent renewables on the electricity system. The crucial role of gas across the energy systems is increasingly recognised and understood, as recent publications such as the DNVGL "Forecast of the Energy Transition to 2050" have shown.

As our energy system evolves to meet the challenge of decarbonisation, the gas networks are responding and developing their vision for the low-carbon future. In the short term, biomethane connections are increasing the volume of 'green gas' in the network. This increase in connections to lower pressure tiers is starting to change the way distribution networks are operated, and may require further changes in future to move gas around the system and allow biomethane producers to inject their gas even during times of low demand.

The decarbonisation of electricity generation has also had significant impacts, with increasing demand for flexible generation plants connected to the distribution network: 55 such sites are now in connected to the GB Gas Distribution Networks, and dozens more are in build or have accepted connection agreements. Growing use of electric vehicle recharging may exacerbate this impact further. Other new demands such as CHP engines for energy users such as hospitals and district heating schemes are also providing new peak requirements and – in some cases – additional overall demand.

The longer term government policy direction for decarbonisation remains unclear, particularly in areas such as heat and heavy industry. However, for the reasons set out above the medium term demands for gas will remain significant given the role it plays across the energy system, and the continued drive for 'low regrets' steps towards decarbonisation such as ongoing Renewable Heat Incentive funding for new biomethane production plants.

The evidence for the longer term role that gas can play in a decarbonised system is becoming clearer, partly through some of the network innovation projects referenced below. Compared to alternative ways of reducing greenhouse gas emissions, for example, attempting to completely electrify heat and transport, evolving our gas supply chain towards a low carbon future is more affordable and secure, and will help deliver our emission goals with less disruption. Investing in the continued development of our gas network also makes a wide economic contribution to the country while its innovations and capacity play a crucial role in the UK's integrated energy system.

Between now and 2032, the Gas Distribution Networks are continuing to invest in the Iron Mains Risk Reduction Programme. This work is mandated by HSE to improve safety, while reducing direct emissions of methane, a potent greenhouse gas. By the end of the programme, the distribution networks will be substantially constituted of polyethylene (PE) pipes, which are capable of carrying a wider range of gasses including low-carbon hydrogen. As these pipes also require significantly lower maintenance than existing materials, they will deliver a low cost, low carbon network which can continue to play a central role in our energy system.

3. Industry Developments

3.1 Key Messages

- We've built a unique simulator that models future energy supply and demand – and its conclusions are clear. To make sure we have a secure supply of affordable and sustainable energy for future generations, we must continue to invest in and use the gas network.
- 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.
- The gas network can underpin the decarbonisation of electricity, acting as an energy battery' and supporting renewable electricity generation to help keep the lights on.
- Smart controlled hybrid heating, where a gas boiler and an electricity powered air source heat pump work together, could be the breakthrough we've been looking for in the decarbonisation of heat.

3.2 Introduction

The UK is committed to legally binding environmental targets to deliver a sustainable future. We have environmental targets to achieve by 2020 and 2050. We must achieve these targets but we must also recognise the requirements to ensure security of supply within an uncertain economic climate and rising fuel poverty.

There have been a number of key industry developments to note since the 2017 update:

- The Welsh Government has now passed legislation that commits it to the same environmental targets as the UK
    - The Welsh Government has also recently consulted on its plans to 2030 and we have responded to that consultation and continue to work with Welsh and UK governments on their forward looking plans
- Following the establishment of a UK National Infrastructure Commission (NIC), the Commission published its first national assessment during July 2018

- The assessment highlighted the developments in renewable electricity but also outlined the challenges and further work required to decarbonise heat and transport. The assessment can be found at the following link: https://www.nic.org.uk/publications/national-infrastructure-assessment-2018/
- We also know that two follow up reports will be delivered by the NIC with regard to energy system resilience and the regulatory environment

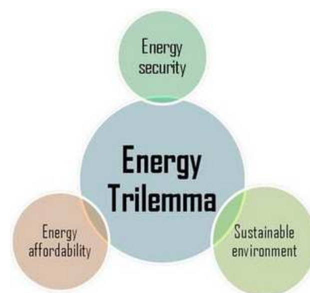
- Ofgem has consulted on the updated RIIO framework that will take effect from April 2021. The decision document can be found using the following link: https://www.ofgem.gov.uk/publications-and-updates/riio-2-framework-decision

    - Whilst the final RIIO 2 final proposals will not be delivered until December 2020, a number of framework updates have an immediate impact on our preparations for the RIIO 2 price control period and our business plan:
    - The default length of the price control period will revert back from 8 years to 5 years
    - There will be a greater focus on "Whole Systems approaches" and how networks are utilised
    - Ofgem is looking to give consumers a stronger voice, building on the existing enhancements that RIIO 1 has delivered. All networks must have a customer engagement group and Ofgem will set up a central RIIO 2 challenge group. Our Consumer engagement group was established in August 2018 and we await notification from Ofgem on the composition of the RIIO 2 challenge group
    - The RIIO 2 Sector specific proposals that will be published in December 2018 and will propose a number of updates to Outputs, incentives and updated innovation mechanisms to build on the exiting innovation mechanisms contained within the RIIO 1 package
    - Ofgem has signalled its intent to simplify price controls where it can.

- In November 2017, Ofgem approved the collaborative H21 National Innovation Competition bid. We are a funding partner along with the other gas networks. The long term Project aims to demonstrate that it is safe to transport 100% hydrogen in the gas distribution networks. The evidence produced could be used to support the case to decarbonise heat by converting the GB gas networks from natural gas to hydrogen.

- Uniform Network code (UNC) updates. The National Transmission system and the industry UNC panel will be implementing changes to the model that underpins National Transmission exit charges to Networks (UNC Modifcation 621). These changes come into effect on Oct 2019. Ofgem is the ultimate decision maker and a number of alternative proposals are under consideration by Ofgem. A decision is expected during March 2019. The outcome will be changes to the NTS exit capacity charges across Great Britain.

Our network planning and work to develop industry arrangements must therefore incorporate these important developments. More information on these key developments, can be found on the Wales & West Utilities, National infrastructure Commission, Welsh Government and Ofgem websites.



3.3 Gas as an Essential Component of Future Energy Policy

When contemplating the future of energy we have to take into account the "Energy Trilemma". The energy trilemma is the issue of how best to reach demanding low carbon targets when energy from renewable sources is either unavailable or unreliable and without requiring huge hikes in consumer and industrial energy bills.

We gained significant consumer insights from the ground breaking Wales & West Utilities Bridgend study into willingness and ability to pay. Noting the industry changes outlined above, we have now significantly developed our "whole systems" understanding and focussed on modelling at the "whole systems level" and explored the potential benefits and impacts of "Hybrid heating". More details on our two cutting edge innovations "Pathfinder 2050" and "Project Freedom" can be found on our updated future of energy section of our website. https://www.wwutilities.co.uk/about-us/our-company/future-of-energy/

3.3.1 Medium Term Outlook

In the 2020s there is an indication that increasing use of gas CHP to create heat networks will increase demand on the local gas systems. This is due to the transfer of electricity generation from national power plants to more locally produced electricity. In addition the increase of intermittent renewable generation on the electricity system is leading to more variable flows at gas fired power stations embedded within the LDZ, thus increasing capacity requirements.

3.3.2 Distribution Network Entry and Storage

WWU recognise and support the increasing interest in DN entry and storage including gas from LNG, anaerobic digesters and coal bed methane and we are currently reviewing a number of enquiries for new connections in 2018. 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 the WWU 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 CV and the capacity available on the system.

Further details on current gas quality specifications can be found in appendix A5.3.1 and further information on our connections process for DN Entry is available at the following location Distributed Gas Connections Guide

3.4 Summary

The energy system is changing and the key developments over the last 12 months highlight the requirement for us to continually engage and evolve.

With more than 80% of heat and power demand at peak times met by the gas network, we're planning for the future - to make sure we can continue to deliver reliable energy at affordable costs for customers, whilst helping the UK meet our decarbonisation targets.

1. We've built a unique simulator that models future energy supply and demand – and its conclusions are clear. To make sure we have a secure supply of affordable and sustainable energy for future generations, we must continue to invest in and use the gas network.

2. 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. The gas network can underpin the decarbonisation of electricity, acting as an energy battery' and supporting renewable electricity generation to help keep the lights on.

4. Smart controlled hybrid heating, where a gas boiler and an electricity powered air source heat pump work together, could be the breakthrough we've been looking for in the decarbonisation of heat.

So whether you want to inject gas into our network, want to understand how we are preparing for the energy future or just want to engage with our future of energy team, just head to our Future of Energy website: https://www.wwutilities.co.uk/about-us/our-company/future-of-energy/

4. Demand

4.1 Key Messages

- Peak demands are forecast to increase over the next few years
- We anticipate significant new connections associated with flexible generation
- New residential connections are forecast to outweigh efficiency reductions in all LDZs at peak
- Additional NTS capacity has been booked to meet revised forecasts
- Additional investment in storage and smart network control may be required in the longer term to support ramp-up-rates and intermittency of flexible generation and gas vehicle customers
- We are leading a number of innovation projects to better forecast our customers' changing requirements and develop more optimal ways of configuring our networks to meet them
- Our industry-leading Pathfinder Model is enabling modelling different energy models in practice enabling us to design optimal options to decarbonise the future

4.2 Forecasting Approach

In last year's 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, and how we were developing our long term forecasting and modelling capability to ensure we continue to develop reliable and efficient networks. The two key models 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 network investment required to support them.

This year we have continued to develop our thinking in a number of ways:

4.2.1 Innovation Projects:

We are working on a number of innovation projects which are helping provide further clarity on how our future customers are likely to want to use our network for gas usage or gas injection, as well as developing new and innovative ways of optimising our network to deal with this wider range of requirements.

Many of our projects are carried out with other gas and electricity network partners and further detail on our relevant projects are provided in Chapter 7 – Innovation.

4.2.2 Stakeholder Engagement:

We have increased our levels of engagement with a wider range of stakeholders from both within and outside the industry this year.

As part of our engagement programme we held a Distributed Power Generation conference in June 2018 to engage with customers, other networks and wider industry about their views on what capacity gas networks need to provide going forward and to share best practice on current approaches. We received clear feedback that we should prepare for continued growth in this area. The full report will be made available on our website once completed.

Recommendations from our Regional Community Workshops in 2018 included feedback that we should:

- Consider increasing the gas network, taking gas to non-gas areas to benefit future generations, working with local authorities and partners
- Develop relationships with community energy projects and local authority energy managers to support on future energy needs

These recommendations will feed into our Business Plans.

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 on how current forecasts relate to those previously published

Further information, including the detailed numerical tables is provided in Appendix 2

Our gas demand forecast levels in the current price control period from 2013 to 2021 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) demand is expected to increase by 5.5% in the next 10 years
- Annual demand is expected to show a slight fluctuation with a reduction of 1 % over the 10 year horizon.

During the next ten years, our view is that peak day demand in our network will increase from 2018/19 out to 2027/28 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 forecasts referred to within this document take account of national data and assumptions from a number of sources including National Grid's FES scenarios and our own forecasting models. In addition this year we have been leading a collaborative GDN project on demand forecasting with Delta-EE which recognises .a number of new load types and behaviours our networks will need to support in the future. Although the project was not fully completed in time for us to use for this year's forecasting process, some of the general learning was available and has been taken into account, further information on this project is available in Section 7.3.2

For more information on legacy Gas Demand Forecasting Methodology please contact the Joint Office, link to website (Joint Office).

For further information on Delta-EE's work on Long Term Demand Forecasting for Peak Days please see (ENA Smarter Networks Portal) and Section 7.3.2

4.3.1 Composite Weather Variables

Due to the temperature sensitivity of the domestic load band, LDZ forecasts of annual demand are based upon an assumed average weather condition. The demand models adjust from actual to average weather conditions using 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.

The Uniform Network Code obliges us to review, at least every 5 years, the definition and seasonal normal basis of all CWVs.

From 1st 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.

For more detail on the change to the EP2 method and its effects on the demand forecasting process please refer to Appendix 1

4.3.2 Capacity Management

We annually assess the level of capacity required to operate the Network in a safe and secure manner and to comply with the obligation to meet 1 in 20 demand conditions and there are a variety of ways that capacity requirements can be managed. In the event of a capacity constraint occurring on our network our main options are i) Network investment as explained in Chapter 6 or ii) interruption of key sites through bilateral interruption contracts with customers. In the event of interruption not being available there also may be a requirement to increase our bookings of capacity from the National Transmission System.

Given the signals of peak demand increases in this year's process we took the decision to participate in the annual auction for interruption processed by xoserve on behalf of the gas networks. We invited offers for any level of interruption, for any number of days and in any location. There were no offers from any of our customers and there are no longer any interruptible customers connected to WWU's network.

This has meant increases in our bookings for capacity from the National Transmission System going forward.

4.3.3 Local Distribution Zone Peak Forecasts

This section provides the latest gas demand forecasts through to 2027/28. A more detailed view can be found in Appendix 2 which includes forecasts by load band for both peak and annual demand on a year-by-year basis.

We noted last year that early indications from the forecasting models we were developing to better predict changes to customer behaviour, showed that peak demands may increase when the process was completed this year. This has been the case in Wales North and South West with immediate increases to peak day being forecast. In Wales South we have reduced the peak day forecasts for this year based on our experience during the severe weather in February and March 2018, but these are projected to increase again by 2027/28.

Most of our current investment decisions are based on days when our network is under the most stress i.e. on a peak day. It's 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 has been the case in the past.

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

4.3.4 Peak Day Forecasting Process

Our process for peak day projections in this year's process included demand information not used in previous processes:

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 are influenced by daily gas pricing. In our analysis we can clearly see the pricing impact which 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. The on-going requirement for us to connect flexible generation onto our network has made it necessary for us to improve our understanding of electricity networks and improve our use of publically available data. In this year's process we have mapped information from the National Grid Market Electricity Capacity Register against sites which are either connected or have enquiries in process on our network. This has allowed us to determine via a robust process which enquiries to include in our projections. It has also provided information about sites we were not yet aware of who may approach us for capacity.

4.3.5 Peak Day Forecasting Results

The 2018 peak demand forecast for the Network is 498 GWh/d and we project that this will increase to 525 GWh/d by 2027/28. This represents a 5.5 % increase.

The increase is attributed to the continued growth domestics and of power generation seen on our network since 2013; we have included loads which have accepted connection offers from us in 2018/19, sites who have capacity via the electricity capacity register in 2019/20 (T-1) and sites who have capacity via the electricity capacity register in 2022/23 (T-4).

For years after 2023 we have assumed similar levels of flexible generation growth in South West and Wales North. However, constraints on the Western Power Distribution network mean that we have not included new power generation in Wales South until 2026.

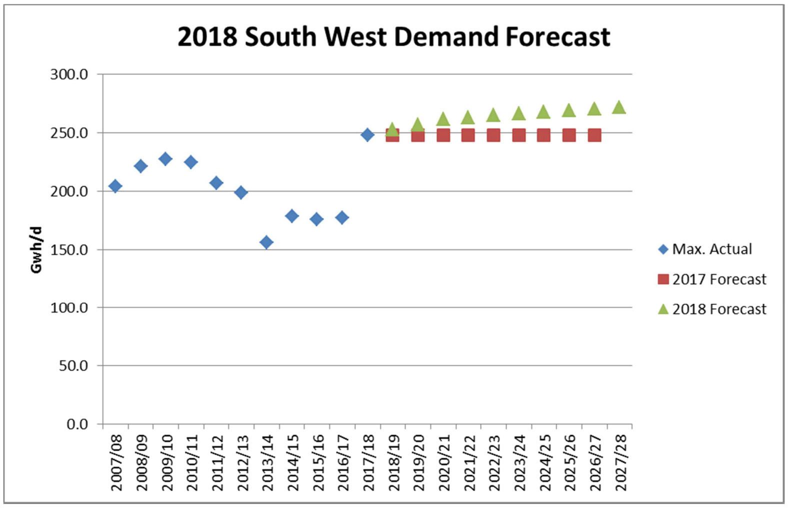
Further information on the Western Power constraint is available in Appendix 2

South West:

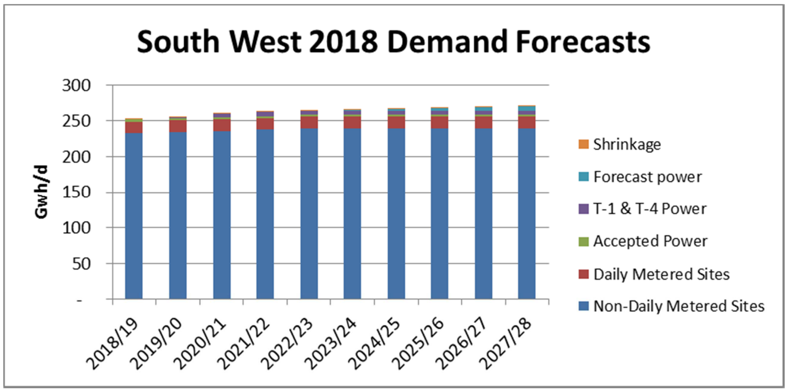
The 2018 peak demand forecast for the South West is 252.7 GWh/d and this is projected to increase to 271.8 GWh/d by 2027/28. This represents a 7.6 %. The increase is due to domestic and power generation growth which has not been offset by reductions in other load bands as shown in the graph below.

The maximum demand for 2017/18 was 247.98 Gwh/d which was experienced on 1st March 2018. This has been a record maximum demand seen for this LDZ.

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



Graph 2: 2018 Demand forecast by load type

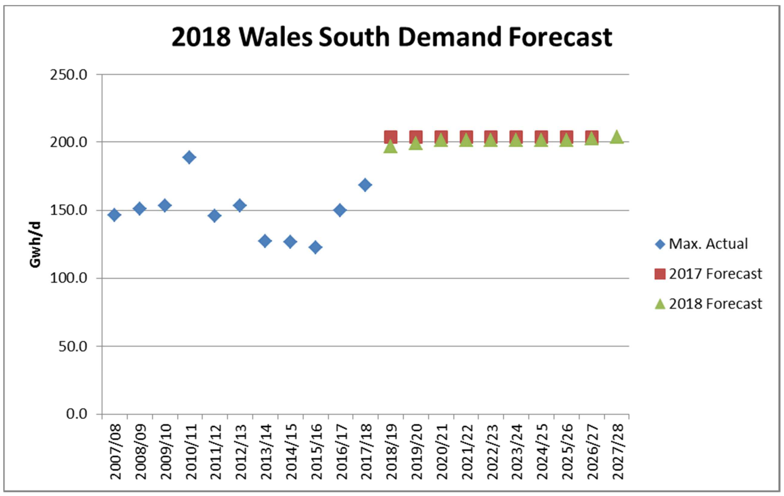


Wales South:

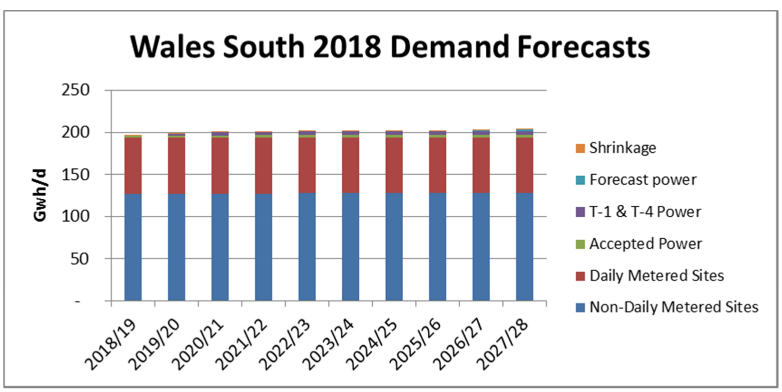
The 2018 peak demand forecast for the Wales South is 196.8 GWh/d which is a reduction from last year's forecast and is the result of a review of our forecasts following the severe weather in Feb / March 2018. This is projected to increase to 204 GWh/d by 2027/28 which represents a 3.65 % increase.

The maximum demand for 2017/18 was 168.5 GWh/d was experienced on 1st March 2018. On this day, some key sites were not running due to the high gas prices caused by the potential for a supply deficit.

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



Graph 4: 2018 Demand forecast by load type

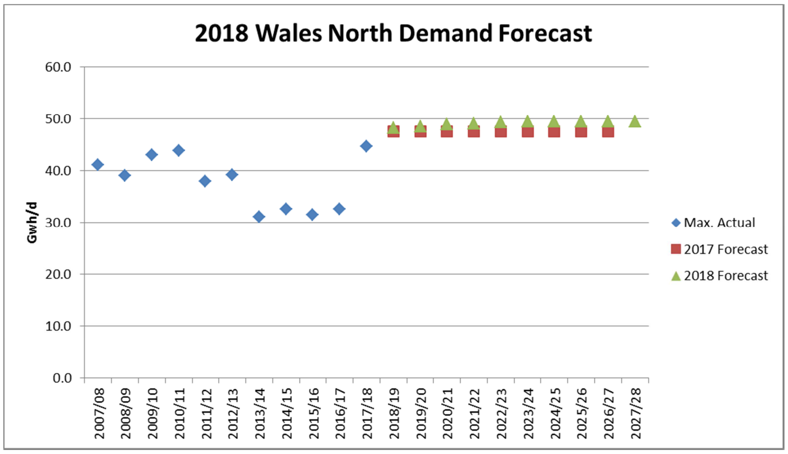


Wales North:

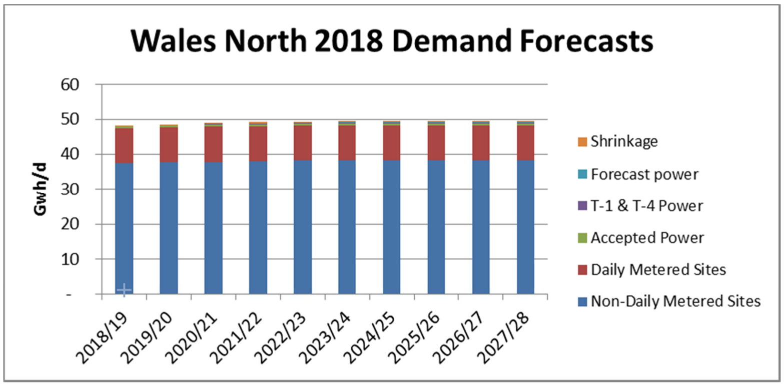
The 2018 peak demand forecast for the Wales North is 48.3 GWh/d and this is projected to increase to 49.5 GWh/d by 2027/28. This represents a 2.4 % change. The increase is due to domestic and power generation.

The maximum demand for 2017/18 was 44.7 Gwh/d which was experienced on 1st March 2018.

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



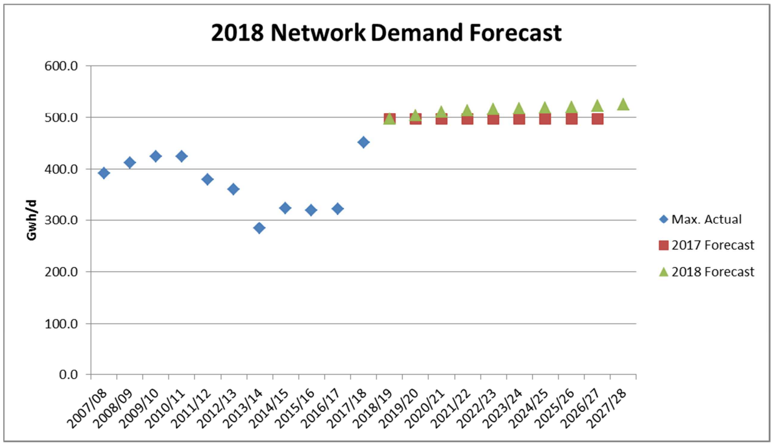
Graph 6: 2018 Demand forecast by load type



WWU Network:

The graph below shows the data for the network considered as a whole for all three of our LDZs.

Graph 7: Whole Network



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 and have taken account of available information from public sources and stakeholder engagement to assess the impact of flexible generation at specific locations in our network.

Through research that is underway this year we aim to provide further certainty for other loads on our networks as follows:

Delta EE – Gas Demand Forecasting Phase 2

WWU are leading this collaborative project with all GDNs which is providing information in a number of areas to provide certainty on future investment needs. Key areas of research which will impact our next series of forecasts are listed below. The learning from this project will inform our shorter term forecasts with sensitivities considered for the longer term:

- Consolidation of domestic measures
- Locational impacts of demand

- Electric and Gas Vehicles note: electric charging will impact gas generation requirements
- Combined impact of Electric Vehicles and Heat Pumps
- Review of annual to peak relationship
- Future generation mix scenarios
- What if' analysis on policy
- Commercial / industrial analysis
- Emerging technologies and business models

Further information is available in Chapter 7 and once the project is completed we will provide additional information on the Future of Energy section of our website.

Green City Vision

WWU is leading this collaborative project with SSEN, UKPN and our partners Progressive Energy. In this project we will work with other stakeholder to develop a 2050 low carbon scenario for Swindon taking into account the impacts on carbon reduction and costs. Our pathfinder model will be used to assess any scenario and its impact on hourly flows through the network in order that capacity requirements can be fully understood and assessed.

The learning from this project should inform our longer term forecasts.

Further information is available in Chapter 77.3.2

Regional FES

Our regional FES project is a WWU project being undertaken with Regen. This project will take learning from the Gas demand forecasting project above and use that along with regional strategies and information from stakeholders e.g. local authorities, to develop granular forecasts at a sub-LDZ level for the first time.

The learning from this project should inform both long and short term forecasts at a local level.

Further information is available in Chapter 7.3.2

4.3.7 Annual Gas Demand

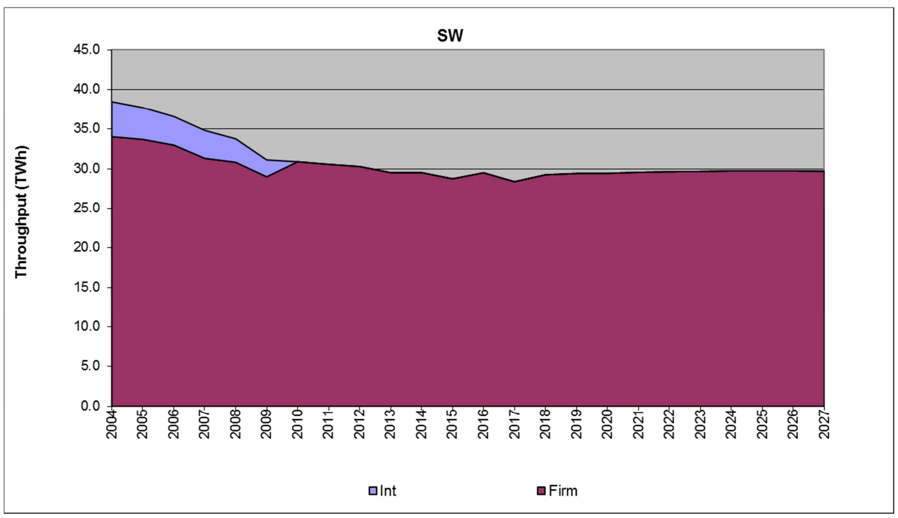
There are a number of processes which rely on annual gas demand which detail the total quantity of gas we expect to transport through our network in any given year. Going forward these will be increasingly important for determining the carbon emissions associated with use of fossil gas and any reduction in this associated with 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 through the year, as this may result in a requirement for seasonal storage which is currently not available in our network.

Whilst our analysis of peak demand shows increases in the short term, we agree with the more general view that annual gas demand may reduce. This reduction would be as 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.

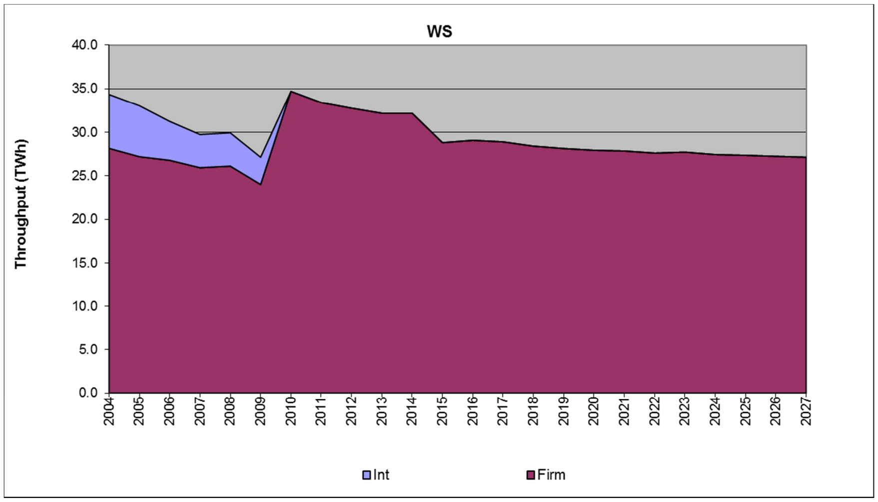
In South West and North Wales LDZs the majority of the demand is from domestic energy users, whereas in Wales South the demand is more evenly spread between domestic and large industrial users. Throughput in WN is significantly less than in SW and WS.

South West

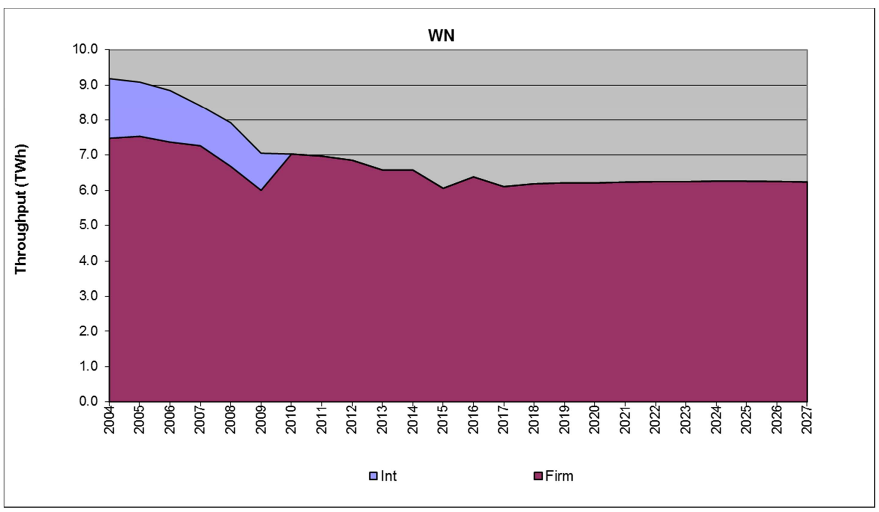
Graph 7: Historical and Forecast Annual Gas Demand for South West LDZ



Graph 8: Historical and Forecast Annual Gas Demand for Wales South LDZ



Graph 9: Historical and Forecast Annual Gas Demand for Wales North LDZ



5. Supply

5.1 Key Messages

- We have already connected 19 biomethane sites to our network which have capacity to meet the needs of over 130,000 customer homes
- 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 2019
- We are supporting significant industry work to update industry standards around gas quality so that networks are able to transport a wider range of gases safely to 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 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 will be 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 therefore WWU 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 storage within those networks is used to retain it until it is required at specific times of that day by our demand customers. In the Wales and West networks we store gas within the network of pipes in the form of "linepack" and also in High Pressure Storage Vessels. In total we have 52.5 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 both achieve climate change targets (reducing reliance on fossil fuels) and improve security of supply.

During our consultation processes in 2018 we have received the following feedback from stakeholders:

- There was support for initiatives to encourage more green gas to enter the network, especially that which is domestically produced, as it would reduce our reliance on imported gas (Critical Friends Panel – September 2018).
- Investment in innovative and greener technology is the second most important priority or customers (Impact Utilities – September 2018)
- 63% voted 'Investment in new and greener technologies' as very important. (Impact Utilities – September 2018)
- There was unanimous support for WWU to increase its investment in lower carbon energy in order to power 642,000 homes by green gas by 2026. (Mindset Research – August 2018).

Projected annual green gas production volumes vary between different national energy scenarios, depending on the policy measures which are assumed to be in place. Scenarios for 2030 vary from a "failure" or no increase scenario, to the highest prediction of 120 TWh per year which is equivalent to over a thousand "Biomethane to Grid" plants across the UK.

We expect our Gas Demand Forecasting Phase 2 and Green City Vision projects (referenced in Chapter 7) to provide evidence that significant amounts of green gas injection will be required in order for the UK to meet its carbon reduction targets in the heat and transport sectors. This is supported by external publications including BEIS and National Grid scenarios.

5.3.2 Coal Bed Methane

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

5.3.3 Hydrogen

In 2018 we have undertaken analysis on the likely methods of converting Bristol and Cardiff to 100% Hydrogen in the longer term. We will assess the outcomes of this analysis to determine whether we would recommend any revisions to our repex programme in these areas in the shorter term which may deliver significant cost benefits in the longer term for example, by installing additional strategic valves which could be used to sectorise those cities as part of any transition. The wider project is due to complete July 2019. We are however, using our analysis to understand the impact within these networks as part of our thinking for GD2 and GD3.

Further information is available in Chapter 7.3.2

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 it will be necessary for us 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. In order 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.

In 2018 we are leading an innovation project 'OptiNet' with Cadent and our partners Passiv to look at innovative ways of making capacity available in a part of our network which is currently unable to accept enquiries we have received for green gas injection. Further information is available in Chapter 7

We recognise that new commercial and regulatory frameworks will be required to ensure associated costs are dealt with appropriately and are engaging with stakeholders for their views on how these should be managed.

5.5 NTS Supplies

In order to ensure 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. Whilst 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 of off-setting our NTS capacity.

Included in our 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 4 years under User Commitment arrangements. This can result in use having more capacity than we need either in specific locations or in some cases at an LDZ or Network level.

In 2017 we raised this issue in our response to the NTS' Exit Capacity Release Methodology consultation: WWU Response and this year we have raised UNC Modification 671 to propose arrangements are changed.

NTS Pricing Arrangements are also under discussion and further information is available in Chapter 3 – Industry Developments.

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

	Offtake Location	Capacity		2018/19 NTS Capacity Bookings kWh/d
	LDZ:- SW	kWh/h	kWh/d	
Northern	Wiltshire (1)	1,332,368	31,976,821	27,391,725
	Gloucestershire (1)	1,264,156	30,339,738	21,293,234
	Bristol (1)	2,652,075	63,649,800	50,365,514
Central	Bristol (2)	1,637,083	39,290,000	23,885,892
	Somerset	2,046,354	49,112,500	31,408,565
Southern	Exeter (1)	682,118	16,370,833	14,000,883
	Plymouth	3,274,167	78,580,000	40,420,636
Other	Exeter (2)	1,327,893	31,869,429	19,128,874
	Gloucestershire (2)	491,125	11,787,000	7,417,140
Pressure Controlled	Devon	381,986	9,167,667	5,150,000
	Herefordshire	272,847	6,548,333	4,023,357
	Wiltshire (2)	232,357	5,576,561	2,299,463
	Worcestershire	413,855	9,932,512	6,441,859

	Offtake Location			2018/19 NTS Capacity Bookings kWh/d
	LDZ:- WS	kWh/h	kWh/d	
South Wales	Cardiff	4,890,358	117,368,600	91,369,207
	Swansea	2,559,542	61,429,000	40,231,974
	Newport	3,441,767	82,558,833	75,404,154

	Offtake Location			2018/19 NTS Capacity Bookings kWh/d
	LDZ:- WN	kWh/h	kWh/d	
North Wales	Wrexham	2,749,306	65,983,333	49,258,990

6. Investment in the Distribution Network

6.1 Key Messages

- Our stakeholders have told us that Maintaining a safe, reliable gas supply is considered to be the number one 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 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 LTS and below 7 Bar DN 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 2018 our stakeholders have told us that:

- Maintaining a safe, reliable gas supply is considered to be the number one priority (and in general, respondents tended to focus on the particular importance of safety in relation to gas). (Mindset Research – August 2018)
- Reliability is the most important priority to ensure there is a continuous gas supply and ensuring that interruptions are minimised. (Impact Utilities – September 2018)
- All stakeholders were of the view that WWU's target to repair and maintain its assets, re-connecting consumers' gas supply within 24 hours 90% of time was appropriate (Critical Friends Panel – September 2018).
- There was support for initiatives to encourage more green gas to enter the network, especially that which is domestically produced, as it would reduce our reliance on imported gas (Critical Friends Panel – September 2018).

6.3 Network Management

In order 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 utilised Condition Based Risk Management (CBRM) models to date. These decision support tools assist us with planning, justifying and targeting future investment to maintain the current high level of safety and reliability of the gas supply network and cover pressure reduction installations (PRIs) and pipelines. The methodologies established have gone on to be developed further across the industry in the Network Output Measures (NOM) methodology work. WWU is investing further in this area to optimise efficient delivery of a risk based approach to asset management across all major asset groups.

For pipelines, we have implemented an "As Low As Reasonably Practicable" (ALARP) methodology in assessing options available to us to identify the most cost effective method of minimising societal risk , specifically targeting high consequence areas.
To manage pipelines in this way requires high quality data and analytics. To support this we have digitised our entire high pressure pipe network (2,364km) into short sections to better assess consequence of failure. Previously we had 199 pipeline routes. This has now become 10,785 pipeline sections. This took a team of 4 staff 18 months to deliver and has resulted in a very detailed assessment of risk dependent on the people, property and infrastructure in the vicinity of each pipeline section.
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 Chapter 7 – Innovation.

6.5 Hydrogen Impacts on our Repex Programme

In 2018 we have participated in Project H21 - strategic modelling, major urban centres and have undertaken analysis on the likely methods of converting Bristol and Cardiff to 100% Hydrogen in the longer term. We will assess the outcomes of this analysis to determine whether we would recommend any revisions to our repex programme in these areas in the shorter term which may deliver significant cost benefits in the longer term for example, by installing additional strategic valves which could be used to sectorise those cities as part of any transition. The wider project is due to complete July 2019. We are however, using our analysis to understand the impact within these networks as part of our thinking for GD2 and GD3.

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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

David Smith – Energy Networks Association

Since the start of the current gas network price controls in 2013, the networks have delivered over 400 innovation projects. Innovation projects allow network operators to better understand how to integrate new technologies into our energy networks, help them identify new opportunities for their use and speed up their wider adoption. They also reflect our commitment to build an efficient, smarter, cleaner energy system fit for Britain's homes and businesses.

In March 2018, ENA published the first Gas Networks Innovation Strategy (GNIS). This summarised progress in network innovation to date, and set out our priorities for the future under seven key innovation themes:

- Future of gas
- Safety and emergency
- Reliability and maintenance
- Repair
- Distribution mains replacement
- Environment and low carbon
- Security

In each of these areas, the document sets out strategic aims for the future, explaining how we will use innovation to help us deliver the low cost, low carbon network of the future.

We work closely with colleagues from the Electricity Networks and the wider energy industry to deliver innovation. The GNIS was published alongside an equivalent Electricity Network Innovation Strategy, and we worked closely with the electricity networks to map common priorities. We work hard to disseminate learning from projects across the industry, via the Smarter Networks portal and events such as the Low Carbon Network Innovation (LCNI) conference.

As the Strategies set out, we encourage third parties to participate in our innovation projects and present new ideas to network operators. In 2018 we launched a joint call for ideas for the Network Innovation Competition across all gas and electricity networks, and created a "Dragons' Den" style event at LCNI to encourage cross-vector ideas with the potential to become new Network Innovation Allowance projects.

7.3 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.

7.3.1 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 67 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:

- Setting out to develop a network approved steel cutting tool that allows rapid access to inserted PE pipe in our mains. This advanced equipment is now commercially available and saves us time and money and reduces disruption for customers as a result of our work.
- A cross-sector, pioneering project to establish a standard, network-wide framework from drone use that could revolutionise the way we monitor and maintain our assets. The 'Above and Beyond' project is looking at how drones could transform the way energy networks perform vital inspections and aims to shape the future for drone applications. Innovation for Customers Tomorrow

7.3.2 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're 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 more than 60% of our NIA funding has been committed to innovating for the customers of tomorrow.

A vision of the future is emerging. Our research has told us that the full electrification of heat comes at an excessive cost. We are committed to, alongside partners, 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 includes:

Gas Demand Forecasting Phase 2

Scenarios being developed highlight significant uncertainty in the quantity and types of energy likely to be used in the future.

But a consistent message is that future gas demand will be increasingly difficult to predict and will require gas networks to provide more flexibility in response to more variable customer demands.

We have recently developed an in-house investment decision support tool that allows us to assess the impact of changing customer requirements on our network, when considering maximum load, minimum load and likely hourly profiles. Good input data on the long term volume and characteristics of different load types, which are required for the model have been difficult to obtain, especially at a local level.

This project, in collaboration with all gas networks, will help us better predict future requirements to facilitate energy system transition and provide the necessary inputs for our model. This work will support the UK's strategic aim to allow use of smart technologies to help decarbonise energy over the next 40 years. We plan to use the outputs of this project to help us produce robust and validated models and tools to make the best investment decisions.

Freedom – Flexible Residential Energy Efficiency Demand Optimisation and Management

Freedom is an industry first cross-sector collaboration project involving the installation of hybrid heating systems in 75 residential properties in Bridgend, South Wales.

Working alongside Western Power Distribution and Passiv Systems the project simulates a roll out of hybrid heating systems in a demand side response market to demonstrate and articulate the potential consumer cost, carbon emissions and energy system security benefits from the large scale deployment.

It will give a first insight into balancing the interests of the consumer, supplier and network operations. A hybrid heating system combines an electricity powered air source heat pump with a conventional gas boiler. A smart control panel enables switching between the two heat sources driven by the cost – supporting the decarbonisation of heat in an affordable way, with limited cost to the customer and limited behaviour change needed.

H21

Ambitious plans to convert the UK gas network to transport hydrogen are into their latest phase with a

£10.3m project supported by £8.9 million funding award from regulator Ofgem.

The H21 programme, which is a collaboration between the UK's four gas networks, received the support through the annual Network Innovation Competition. This project is studying the technical feasibility of converting existing gas assets to transport hydrogen.

Although the initial H21 Leeds City Gate project focussed on the practicalities of the innovation based on a blueprint for Leeds, the team estimates that a country-wide conversion to hydrogen, which produces no carbon emissions when used, could cut emissions from heat by at least 73%.

Igem Gas Quality Standard Working Group and Gas Quality Impacts on Industrial and Commercial applications

The gas we use today is changing. Less than 50% of the gas in our network is now provided by North Sea gas production. Consequently, our import infrastructure has increased five-fold over the past decade and there has been a significant move to include imported natural gas (both pipeline and liquefied natural gas or LNG) and alternative sources of gas, such as and bio gas.

Gas entering the UK transmission and distribution grid has to meet certain specifications under Gas Safety (Management) Regulations 1996 (GS(M)R). Under these regulations, a variety of different parameters and limits are used to describe what may be generally referred to as "gas quality". These GS(M)R limits have been established over many years in order to ensure that gas combustion in all types of domestic appliance, and in commercial and industrial applications, is safe and efficient.

Gas Quality is changing, and in order to facilitate transition to a lower carbon economy, regulation must change too. We are exploring a number of innovative projects designed to support and meet our future energy needs:

The Gas Quality Standard Working Group was established early 2016 following discussions with BEIS, OFGEM & HSE, and will review and produce an IGEM standard covering UK gas quality specification, today.

We are also exploring the real impact of gas quality on Industrial & Commercial customers, and have commissioned research to understand the effects of a wider Wobbe Index could have for these applications.

Impact of Biomethane on gas networks

This research project was initiated by gas networks to share knowledge about biomethane quality and its impact on the gas network and users – including customers using gas as a vehicle fuel.

The study of biomethane is important to help us address challenges facing the biomethane production industry. Biomethane and other types of green gas will play a major role in the decarbonisation of gas and the delivery of an energy future that is affordable, secure and low carbon.

The output from this project has defined how the knowledge gaps on the impact of biomethane on gas networks should be addressed and what studies are required to fill the gaps.

Pathfinder and Green City Vision

We're analysing Swindon to design a 2050 energy solution that's affordable, secure and green.

With more than 80% of heat and power at peak times met by the gas network, we're planning for the future. We will continue to deliver reliable energy at affordable costs for customers, whilst helping the UK meet decarbonisation targets.

Green City Vision is a unique collaborative study, which is using Wales & West Utilities' 2050 Energy Pathfinder model to assess low-cost, technically feasible solutions to deliver a city of the future. The project aims to simulate and design a 2050 low cost, low carbon, heat, power and transport solution, for Swindon to inform investment strategies for both gas and electricity networks

Working with two electricity distribution network operators, the project will help us understand how the gas and electricity networks will work in the future, taking into account demand for heat, power and transport throughout the year. It will consider energy supply and demand, energy and carbon costs, cross system opportunities and, importantly, the potential cost to customers

OptiNet

This project will demonstrate the benefits of an optimized network solution for the first time in the UK. It seeks to maximize the opportunity to decarbonise the gas network & support energy system transition by creating capacity for more green gas to enter our network.

OptiNet is a collaboration project that combines low carbon, smart and flexible technologies to create capacity in the network to allow additional biomethane plants to connect and flow even in the lowest demand periods. Using a unique mix of technologies we will demonstrate smart pressure control of the network, compression of gas from a medium pressure network to a higher pressure tier & research viable storage solutions.

This pioneering project will investigate several solutions and determine the viability of implementing such solutions in the field.

7.4 Our Team

7.4.1 Governance and Delivery

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.

7.4.2 Collaboration and Sharing

Collaboration is central to delivering our business innovation strategy. We are proud that two thirds of our NIA project portfolio since 2013 has been delivered in collaboration with one or more other network licensees. We are now working with more partners than ever before. Since 2013, we have formed relationships with more than 350 organisations like 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 business 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. One example where this approach has benefited a wider market is the Ductile Iron mains cutting tool (NIA_ WWU_013), which we designed and developed alongside Steve Vick International. It has not only been bought by the other UK networks, it has also reached gas networks in the United States of America and Australia.

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 at Wales & West Utilities. 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 Wales & West Utilities 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.

7.5 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 new innovation champions to promote, roll out, communicate and support people as they respond to the changes.

Guided by the publication of the first 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 (GWh per day).

LDZ	2018/19	2019/20	2020/21	2021/22	2022/23	2023/24	2024/25	2025/26	2026/27	2027/28
South West	253	256	261	263	265	265	265	265	265	265
Wales North	48	48	49	49	49	49	49	49	49	49
Wales South	197	199	201	201	202	202	202	202	202	202
Network Total	498	504	511	513	516	516	516	516	516	516

Figure A2.2 – South West LDZ Forecast Annual Demand Table – Split by Load Categories (TWh).

Calendar Year	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027
0 - 73.2 MWh	19.40	19.27	19.15	19.07	19.00	18.93	18.85	18.77	18.70	18.63
73.2 - 732 MWh	3.09	3.22	3.23	3.28	3.28	3.30	3.31	3.30	3.29	3.28
>732 MWh	3.85	3.95	4.03	4.13	4.21	4.27	4.36	4.42	4.46	4.49
NDM Consumption	26.34	26.43	26.40	26.47	26.50	26.50	26.52	26.49	26.45	26.40
DM Firm Consumption	2.91	2.98	3.03	3.09	3.14	3.18	3.23	3.27	3.29	3.31
Total LDZ Consumption	29.26	29.41	29.43	29.56	29.64	29.67	29.75	29.76	29.74	29.70
Total Shrinkage	0.27	0.27	0.27	0.27	0.27	0.27	0.28	0.28	0.28	0.28
Total Throughput	29.53	29.68	29.70	29.83	29.90	29.94	30.03	30.04	30.02	29.98
Gas Supply Year	2017/18	2018/19	2019/20	2020/21	2021/22	2022/23	2023/24	2024/25	2025/26	2026/27
Total Throughput	29.66	29.72	29.76	29.90	29.92	30.06	29.99	30.04	30.00	30.00

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

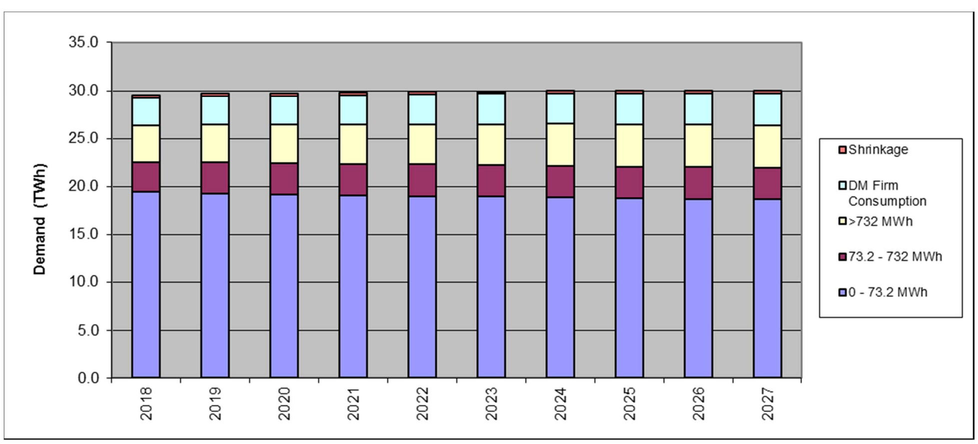
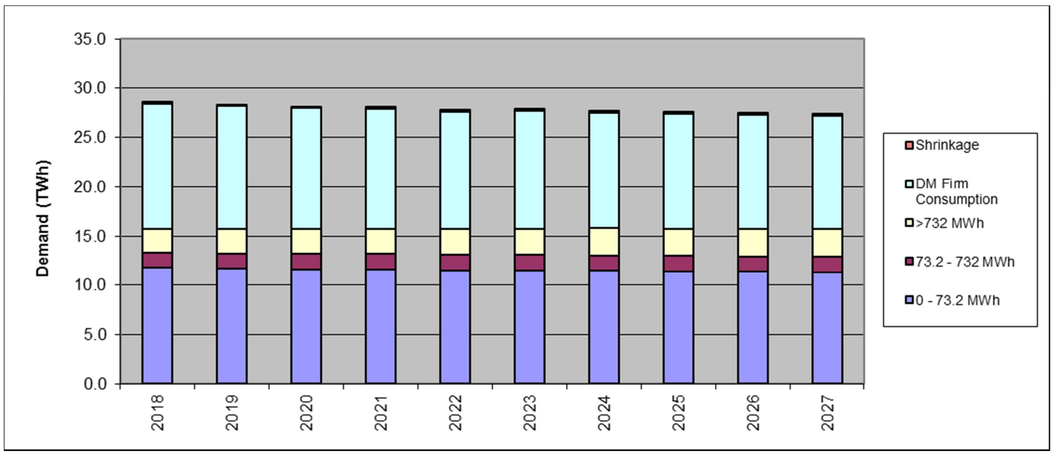


Figure A2.4 – Wales South LDZ Forecast Annual Demand Table – Split by Load Categories (TWh).

Calendar Year	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027
(a) 0 - 73.2 MWh	11.79	11.70	11.63	11.58	11.54	11.50	11.45	11.40	11.36	11.32
(b) 73.2 - 732 MWh	1.49	1.55	1.55	1.58	1.58	1.59	1.59	1.59	1.58	1.58
>732 MWh	2.42	2.48	2.53	2.59	2.65	2.68	2.74	2.77	2.80	2.82
NDM Consumption	15.69	15.73	15.71	15.75	15.76	15.76	15.78	15.76	15.74	15.71
DM Firm Consumption	12.71	12.40	12.22	12.10	11.84	11.95	11.66	11.59	11.50	11.42
Total LDZ Consumption	28.40	28.13	27.93	27.85	27.61	27.71	27.44	27.36	27.24	27.14
Total Shrinkage	0.19	0.19	0.19	0.19	0.18	0.19	0.21	0.22	0.22	0.22
Total Throughput	28.59	28.32	28.12	28.03	27.79	27.91	27.65	27.58	27.46	27.36
Gas Supply Year	2017/18	2018/19	2019/20	2020/21	2021/22	2022/23	2023/24	2024/25	2025/26	2026/27
Total Throughput	28.39	28.18	28.04	27.83	27.90	27.74	27.57	27.49	27.39	27.31

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



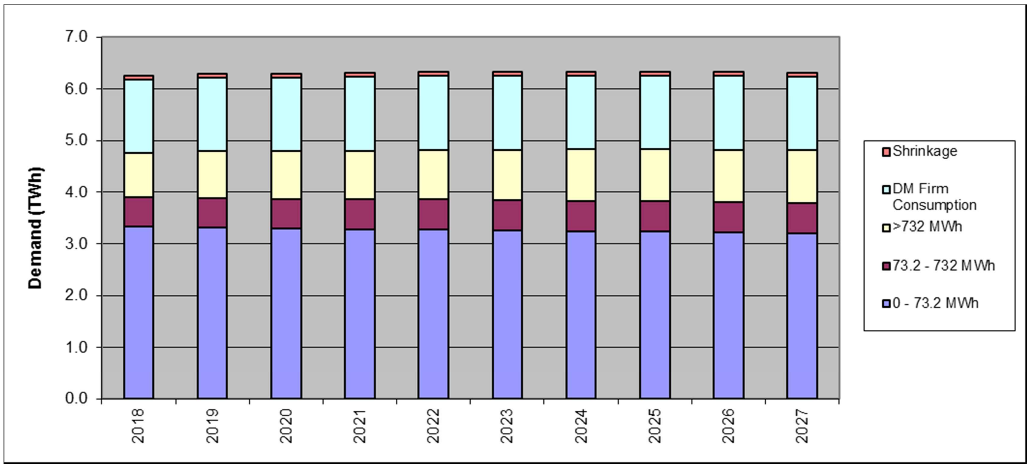
A2.2 Western Power Constraint Information

WPD-South-Wales-St
atement-of-Works-U

Figure A2.6 – Wales North LDZ Forecast Annual Demand Table – Split by Load Categories (TWh).

Calendar Year	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027
(a) 0 - 73.2 MWh	3.34	3.32	3.30	3.29	3.27	3.26	3.25	3.23	3.22	3.21
(b) 73.2 - 732 MWh	0.55	0.57	0.57	0.58	0.58	0.58	0.58	0.58	0.58	0.58
>732 MWh	0.88	0.90	0.92	0.94	0.96	0.98	1.00	1.01	1.02	1.02
NDM Consumption	4.77	4.79	4.79	4.80	4.81	4.82	4.83	4.83	4.82	4.81
DM Firm Consumption	1.42	1.43	1.43	1.43	1.44	1.43	1.44	1.44	1.44	1.43
Total LDZ Consumption	6.19	6.22	6.22	6.24	6.25	6.25	6.27	6.26	6.26	6.24
Total Shrinkage	0.07	0.07	0.07	0.07	0.07	0.08	0.08	0.08	0.08	0.08
Total Throughput	6.26	6.29	6.29	6.31	6.32	6.33	6.34	6.34	6.33	6.32
Gas Supply Year	2017/18	2018/19	2019/20	2020/21	2021/22	2022/23	2023/24	2024/25	2025/26	2026/27
Total Throughput	6.28	6.29	6.30	6.32	6.32	6.35	6.33	6.33	6.32	6.32

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



Appendix 3: Actual Flows 2017

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. In order 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.

Figure A3.1 – South West LDZ Annual Demand 2017 (TWh)

	2017 Actual Demand	Weather Corrected Demand	2017 Forecast Demand
0 – 73 MWh	18.52	18.96	18.59
73 – 732 MWh	2.88	2.94	2.73
> 732 MWh Firm	6.99	7.12	7.87
Interruptible	0.00	0.00	0.00
Total Consumption	28.38	29.02	29.20
Unidentified Gas	0.57	0.57	0.00
Shrinkage	0.21	0.21	0.27
Total Throughput	29.17	29.81	29.46

Figure A3.2 – Wales South LDZ Annual Demand 2017 (TWh)

	2017 Actual Demand	Weather Corrected Demand	2017 Forecast Demand
0 – 73 MWh	11.07	11.39	11.75
73 – 732 MWh	1.34	1.38	1.40
> 732 MWh Firm	16.49	16.58	15.58
Interruptible	0.00	0.00	0.00
Total Consumption	28.90	29.35	28.73
Unidentified Gas	0.58	0.58	0.00
Shrinkage	0.11	0.11	0.19
Total Throughput	29.58	30.04	28.92

Figure A3.3 – Wales North LDZ Annual Demand 2017 (TWh)

	2017 Actual Demand	Weather Corrected Demand	2017 Forecast Demand
0 – 73 MWh	3.21	3.28	3.38
73 – 732 MWh	0.51	0.52	0.53
> 732 MWh Firm	2.39	2.41	2.55
Interruptible	0.00	0.00	0.00
Total Consumption	6.11	6.20	6.46
Unidentified Gas	0.12	0.12	0.00
Shrinkage	0.05	0.05	0.07
Total Throughput	6.27	6.37	6.53

The weather corrected demand gives the expected level of demand for 2017 had the weather been at its seasonal normal value. As can be seen in the tables above the Actual Demand in 2017 was very similar to the Seasonal Normal in the Wales North and South West areas but higher in Wales South.

A3.2 Maximum and Peak Flows

In 2018 our most severe weather occurred in all LDZ on the 1st March and this is the date on which all LDZ saw their highest demands. The maximum firm demand for the whole network this gas year also occurred on the 1st March and was 42.57 mcm.

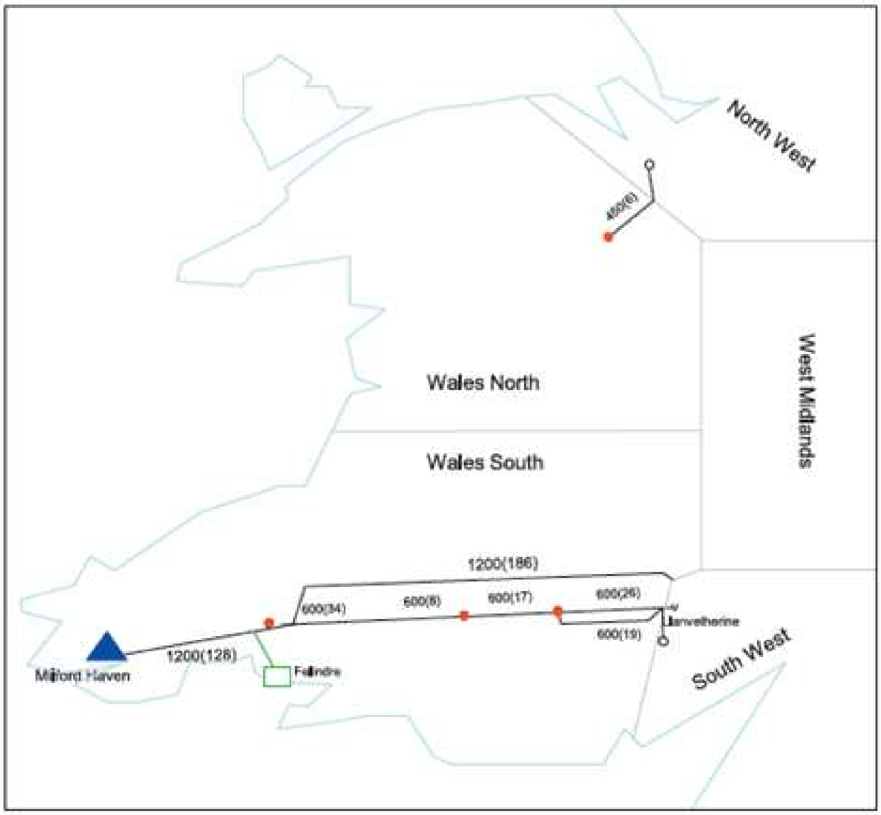
The maximum and minimum for the LDZs are shown in the following table.

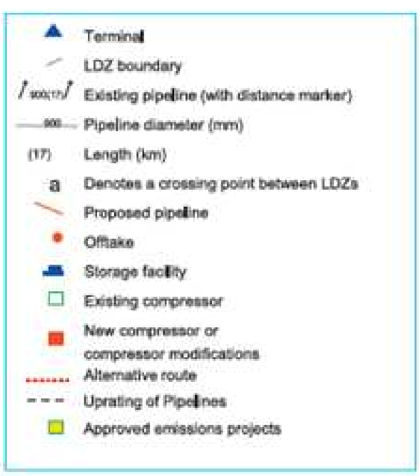
Figure A3.4 – LDZ Peak and Minimum Flows (GWh)

Max and Min Demand Days (GWh)			
LDZ	Maximum Day 01/03/2018	1 in 20 Forecast peak 2017/18	Minimum Day 04/08/2018
Wales South	168.5	203.7	22.2
LDZ	Maximum Day 01/03/2018	1 in 20 Forecast peak 2017/18	Minimum Day 04/08/2018
Wales North	44.7	47.5	7.59
LDZ	Maximum Day 01/03/2018	1 in 20 Forecast peak 2017/18	Minimum Day 08/07/2018
South West	247.98	247.6	25.2

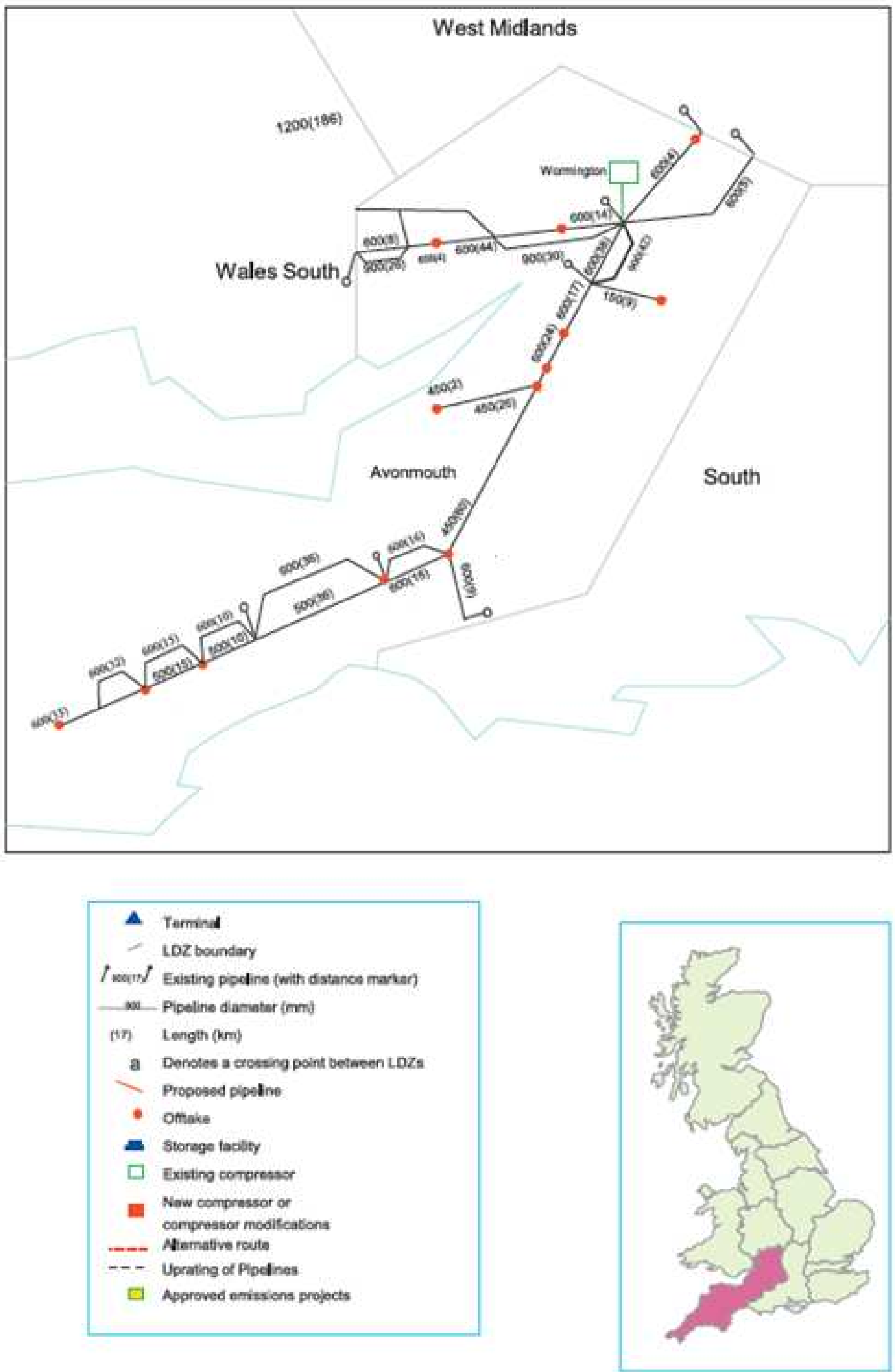
Appendix 4: The Gas Transportation System

A4.1 Wales North and Wales South (WN & WS) NTS

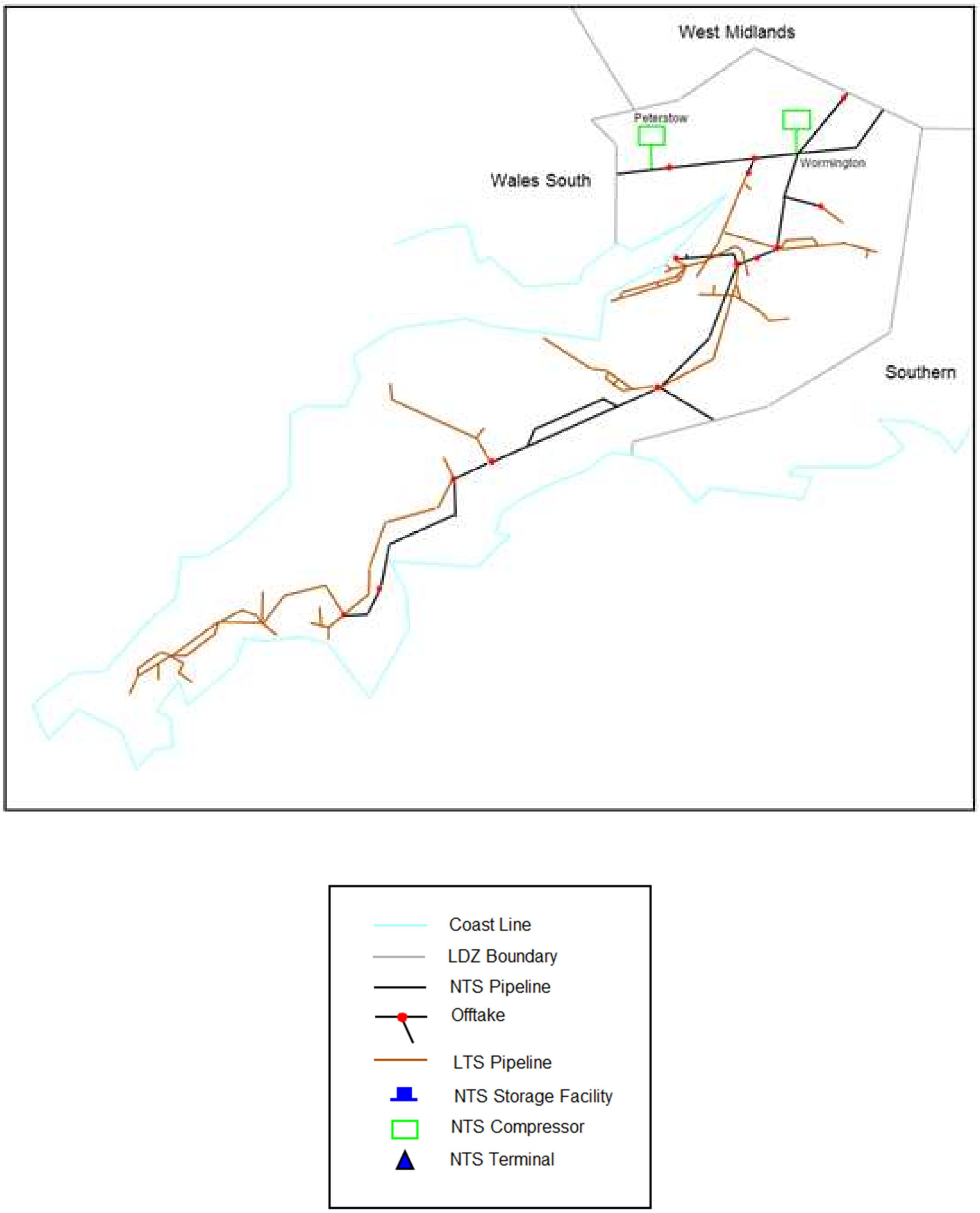




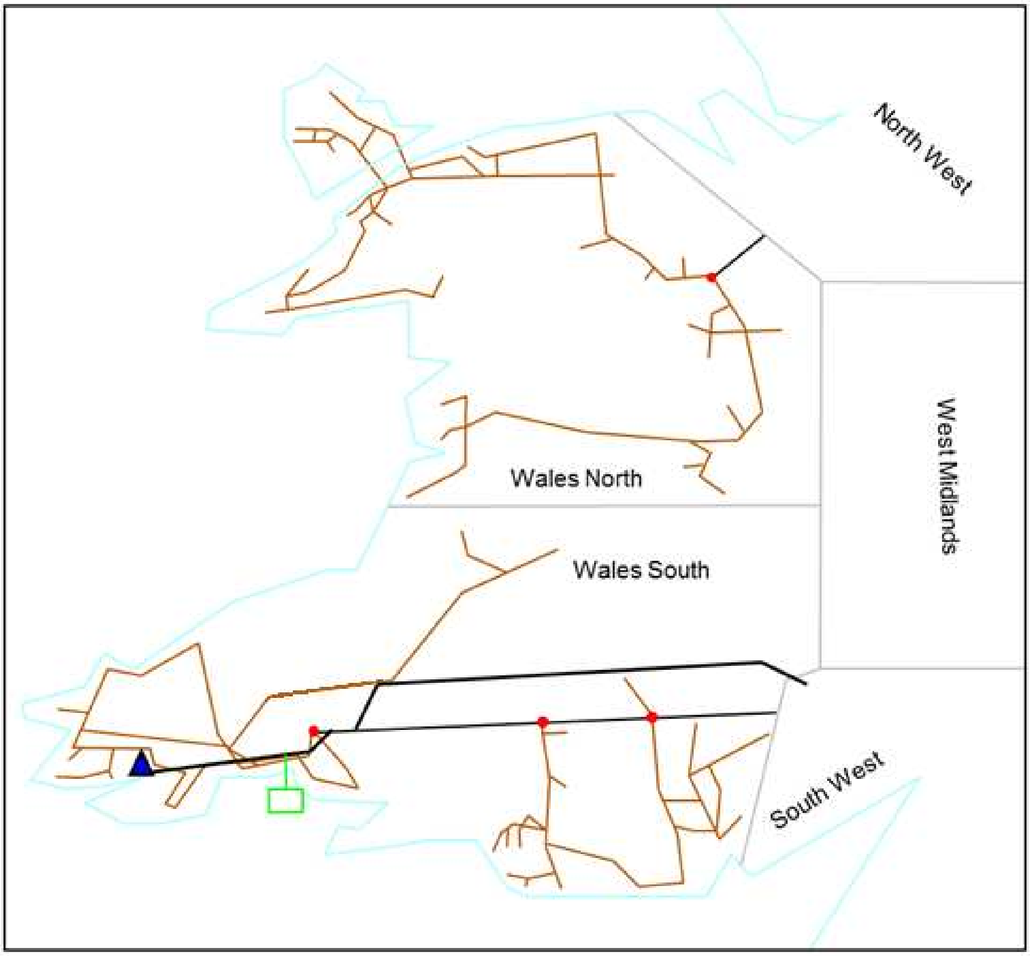
A4.2 South West (SW) NTS



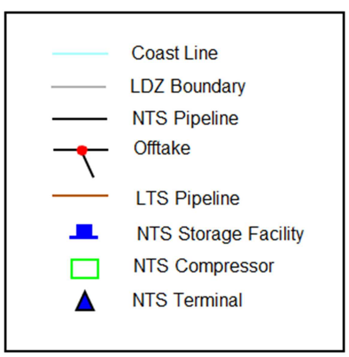
A4.3 South West (SW) LDZ - LTS



A4.4 Wales North and Wales South (WN & WS) LTS



A4.5 Code LDZ Maps



Appendix 5: Connections to WWU System

A5.1 Introduction

We offer connection services in line with our Gas Act obligations. System entry connections conditions are detailed in Section A5.3 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.

A5.2 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 as outlined in A5.4.3.

A5.3 Information for System Entry Connections

We require a Network Entry Agreement 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.

A5.3.1 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℃ at any pressure up to 85barg

6. Water Dewpoint

- Not more than -10℃ 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℃ and 38℃
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.

A5.4 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.

A5.4.1 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.

A5.4.2 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.

A5.4.3 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 6: Gas Transporter Licence

A6.1 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.

A6.2 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 7: 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 Holder

A vessel used to store gas for the purposes of providing diurnal storage.

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 8: 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