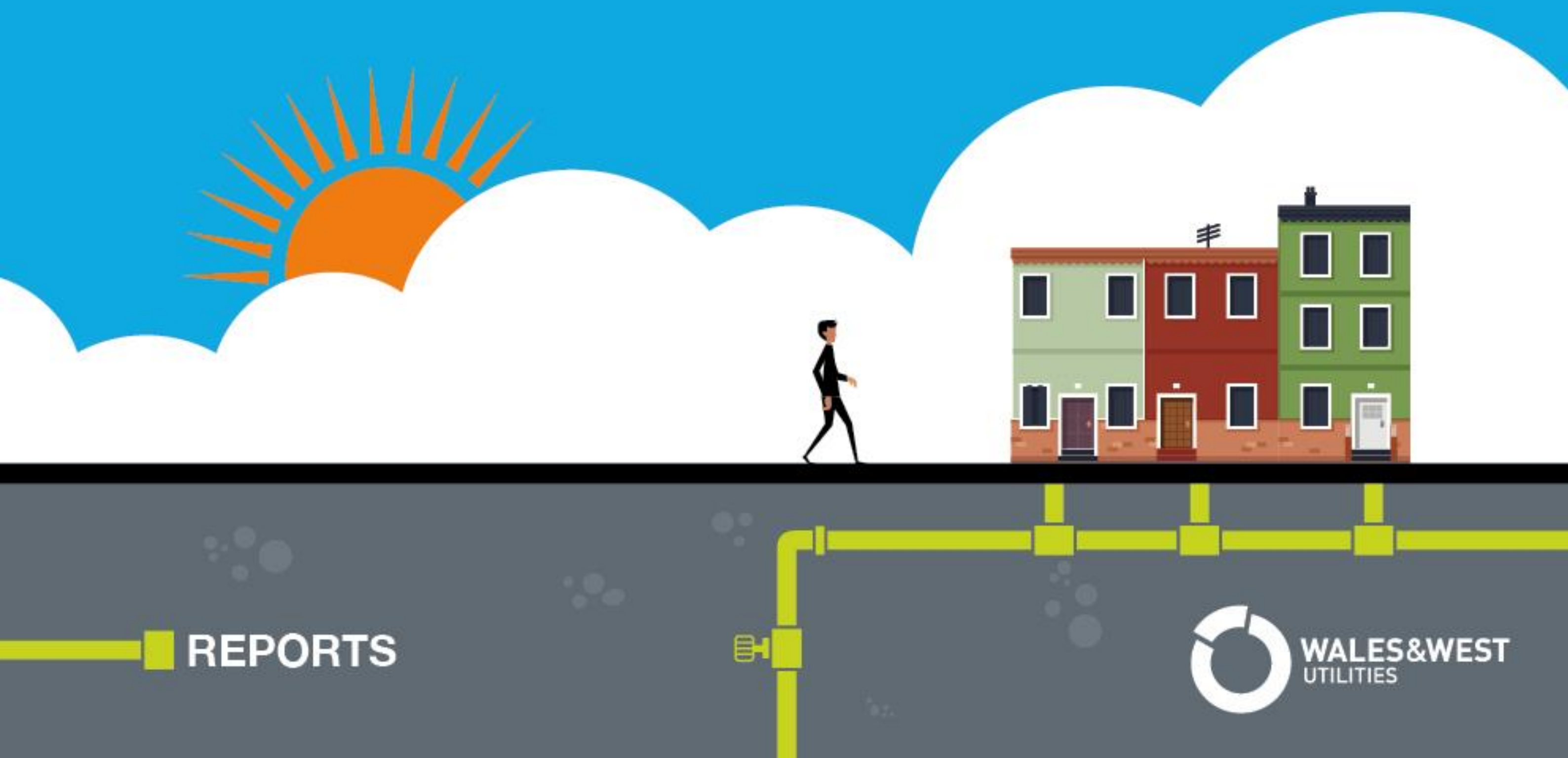
Wales & West Utilities

2017 Long Term Development Statement



1. Contents

Foreword

Chris Clarke - WWU
Director of Asset Management,
Health, Safety & Environment

The 2017 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 2017 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, system reinforcement projects and associated investment. It also looks forward and considers the impact of heat, power and transport decarbonisation on the WWU system

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Disclaimer

This Long Term Development Statement is produced for the purpose of and in accordance with Wales & West Utilities' obligations under the Standard Special Condition D3 of the Gas Transporters Licence and Section O 4.1 of the Uniform Network Code in reliance on information provided pursuant to Section O of the Uniform Network Code. Section O 1.3 applies to any estimate, forecast or other information contained in this Statement. Wales & West Utilities' Long Term Development Statement is not intended to have any legal force or to imply any legal obligations as regards capacity planning, future investment and the resulting capacity.

Executive Summary

The purpose of this document is to outline our assessment of the future use of our gas distribution network and highlight any investment requirements. The assessment is based on our annual and peak supply and demand forecasts for gas usage in Wales and the South West of England.

Data and analysis is provided for the three local distribution zones (LDZs) that constitute the Wales & West Distribution Network (WWU). The three LDZs are:

- South West
- Wales South
- Wales North

The Wales & West gas distribution network is supplied by seventeen National Transmission System (NTS) Offtakes and seventeen biomethane supplies.

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 local knowledge.

WWU are currently developing a new Long Term Forecasting Model which will drive future investment. This will be the last year that the Long Term Development Statement will be based on the existing methodology.

1.2 Use of Our Network

Many of the gas industry long term forecasting processes and models have been developed using historic gas usage patterns and relationships between annual and peak demands. Key inputs have been around the anticipated weather patterns for heat load and econometric and fuel price data for forecasting industrial growth or decline. Little consideration was given to interactions between gas and electricity demand requirements and even less to how customer energy usage patterns within day may be optimised based on available gas and power tariffs.

Following involvement and shared learning from a number of industry innovation projects in 2016, we decided in that year to develop 2 models to help us understand firstly, how an integrated power and gas energy network may operate in the future via our “2050 Energy Pathfinder” model, and secondly what capability our networks would need to deliver this via our “Investment Model”.

1.3 Demand and Supply Outlook

Our current demand forecasts show a small variation from the forecasts in 2016. WWU’s position on demand remains similar to last year with just a slight reduction in both Peak and Annual demand. The 2017 Forecasted annual demands show a slight fluctuation over the years ending with a small decrease by 2026. Despite the forecasted decrease in annual demand, peak demand is considered to remain relatively flat for the 10 year horizon and remains at a similar level to that predicted last year.

It must be noted that the current supply/demand outlook excludes the awaited policy on heat and the impact of the “Clean Growth Strategy”. These could have a influence on the methodology used in next years’ long term forecasts.

1.4 Investment Implications

Even when we experience small overall increases in demand, this does not necessarily mean investment in the network is required. Conversely, when we experience small reductions in overall forecast demand we can often see localised growth in some areas across the network and there is an annual below 7 bar investment plan to accommodate this.

We are still seeing high levels of enquiries for power generation which is providing a quick response alternative to renewable energy sources. Since last year’s publication, we have connected a further 11 sites which brings our total number of power stations to 30 which includes 7 legacy sites made up of older peaking generation fleet and larger plants. An additional 10 sites have accepted and are due to connect over the next 12 months, with over 200 additional enquiries in since April this year; this connected number is expected to grow.

If we had 100 of these sites connected and using an average daily load and profile then this would mean an additional 4.7 million cubic meters per day (mcm/d) on our peak day demand which is roughly 10% of total network demand and would trigger the need for more significant reinforcement post 2020 and into GD2.

The immediate impact that these sites are having is on our storage rather than peak demand due to the way in which they take gas to cover the breakfast and tea time peaks. We are in storage deficit at some of our Offtakes and because of this; we have identified placeholders of over £1m in our 8 year budget plan for this regulatory period to increase our line pack storage (costs associated with operating differently rather than installing pipe). We've also included provisions for installing high pressure storage facilities in the next price control period and feasibility studies will be started soon.

As commercial sites move to combined heat and power (CHP) the demand for gas also increases to produce power. Our commercial sector accounts for 17% of total network demand and if this demand was to increase by 20% to account for this move then an additional 1.637 mcm/d gas demand would be required adding to our peaks and driving investment.

This drive towards fast acting renewable backup coupled with a move towards CHP in the commercial sector means we could well see an upsurge in gas demand. This raises some big questions: Will backup generation equal renewable gas by 2025? Will these power generation enquiries start to die down for WWU with planning being made more difficult for > 10MW sites in Wales and Hinckley Point C operating?

There is still uncertainty about what gas demand will look like but confidence is growing that gas network will provide a crucial part of an integrated credible future energy scenario, supported by results from WWU projects; Bridgend Study & Cornwall Energy Island. Support for this view is spreading amongst DNs, industry and government.

The key point is that this area is not impacting peak demand at the moment but a flag is needed for potential reinforcement in 2020's for increases in peak demand and storage.
Even though we are not currently investing in the network, we are still investing in resources and process developments to manage these enquiries and new loads.

1.5 Innovation & Projects

WWU have produced an innovation management toolkit, adapted from Change Management Expert John Kotter's processes to fit our needs. This uses a range of tools and techniques that produce clear project strategies and plans, engages stakeholders in our vision, encourages project success and supports the roll-out of equipment, products, research findings and procedures. It will help us to manage projects effectively to give them the best chance of success.

During 2016/17 we have continued to evolve our innovation portfolio while investing a further £1.8m on innovation activities using NIA funding that will help us to harness knowledge, expertise and potential to meet the challenges of the future.

During the year, a total of 148 new innovation project ideas were submitted to our team for review and evaluation. These ideas became 15 new projects using NIA funding as well as 14 projects which were supported by other means including self-funding to demonstrate the new equipment, materials and technologies in a real world environment. This demonstration is vital if benefits of innovation are to be realised.

WWU are currently working on a new investment model (as discussed in Section 3) and 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:

- Freedom; a unique £5.2m demonstration project being pursued in collaboration with electricity network Western Power Distribution, that bring efficient integration into the home by installing a hybrid heating system and contributing to carbon reduction targets. (See Section 8.1)
- Development of a flexible energy simulator; a simple, flexible energy simulator that can be used to assess different energy supply scenarios, supporting evidence-based public policy and future investment policy for energy networks and other utilities. (see Section 8.2)

1.6 Next Steps

This Long Term Development Statement will be published on the WWU website (WWU - Long Term Development Statement). WWU actively solicit views and comments from interested parties.

2 Document Scope

Demanding SAFETY ALWAYS

We keep raising the bar on safety, continually looking for ways to improve standards for our customers and colleagues.

2.1 Structure of the Document

The main body of this Statement (Chapters 3 to 6) sets out the key drivers and uncertainties affecting demand, supply and the provision of capacity on our pipeline system.

- Chapter 3 Discusses how the use of our network is changing and how we are developing our processes in response
- Chapter 4 Provides an overview of our latest demand forecasts
- Chapter 5 Gives a synopsis of our supply forecasts
- Chapter 6 Summarises our development plans on the Local Transmission System (LTS).
- Chapter 7 Discusses the role innovation plays within our company
- Chapter 8 Looks at some specific innovation projects that WWU are leading on

Appendix 1 Details the methodologies that are currently being used to produce our demand forecasts. Appendix 2 & 3 Give greater detail of our gas demand forecasts and the actual demands seen during the previous year. The remaining appendices provide details on system maps, connection specifications and commercial incentives.

A glossary and conversion matrix is included at the end of the document.

Designing OUR FUTURE

We invest in our people so that we all have the skills, confidence and innovative thinking to build our business long into the future. We want to be a company people aspire to work for.

3 Use of Our Network

Bethan Winter – System Operation Manager

Our customers' requirements and use of our network is changing significantly as we see the growth of renewable energy supplies in the UK.

In recent years we have seen a huge increase in enquiries for and connection of Peak Generation Plants, which ensure security of supply on the Power Networks by providing flexible generation for use when intermittent renewables are not available. 22 new sites of this type have connected to our Network during this RIIO period, and with the anticipated ongoing growth of intermittent generation and decline of coal and nuclear generation capacity, this is a pattern we expect to continue. In the same period we have connected 17 biomethane plants which are delivering carbon neutral gas onto our network, allowing our customers in those local areas to use green energy without any requirement for investment in new appliances.

Other anticipated changes are the growth of green transport, which if gas fuelled will have a direct impact on our network, and if electric fuelled may still result in an increase in gas usage for the peaking power generation sites which will inevitably be required to provide the power for them at times when intermittent sources are not available.

Finally, we anticipate the use of gas to grow in areas such as Heat Network boilers, Combined Heat and Power, and Hybrid heating systems, particularly where new electricity balancing markets encourage customers to maximise use of power when intermittent renewable generation is available but to switch to alternative fuels, such as gas at times when it's not.

Many of the gas industry long term forecasting processes and models have been developed using historic gas usage patterns and relationships between annual and peak demands. Key inputs have been around the anticipated weather patterns for heat load and econometric and fuel price data for forecasting industrial growth or decline. Little consideration was given to interactions between gas and electricity demand requirements and even less to how customer energy usage patterns within day may be optimised based on available gas and power tariffs. Following involvement and shared learning from a number of industry innovation projects in 2016, we decided in that year to develop 2 models to help us understand firstly, how an integrated power and gas energy network may operate in the future via our "2050 Energy

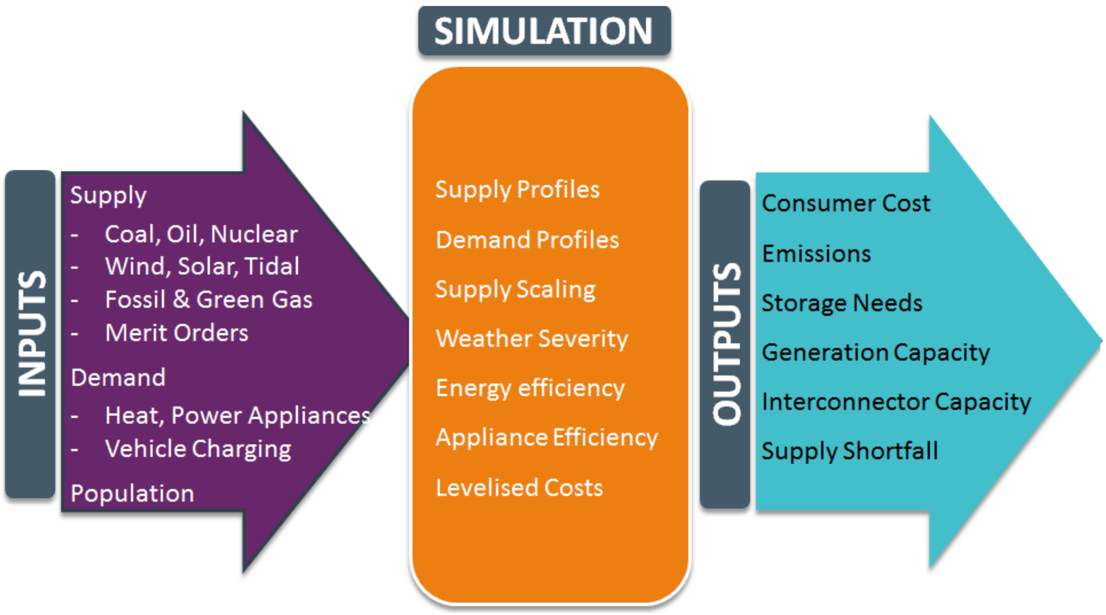
Pathfinder" model, and secondly what capability our networks would need to deliver this via our "Investment Model".

3.1 2050 Energy Pathfinder Model

The 2050 Energy Pathfinder Model has been built to assess how different future energy mixes would work in practice. It enables any energy scenario, current or future, to be modelled for a town, city, county or country and the results show the costs, carbon impact and any shortfall / surplus in heat and power supply. The simulator can be used to find better solutions across all energy types in a more integrated way. A pictorial summary is provided below.

The outputs of the model help us determine which are the most credible scenarios as well as providing forecasts of hourly gas usage which we can then use in our investment model to determine how we would need to develop our network to deliver this. This is particularly useful to help us understand the likely behaviours of new customer types such as those with hybrid heating which may switch from gas to power source, and for flexible power generation.

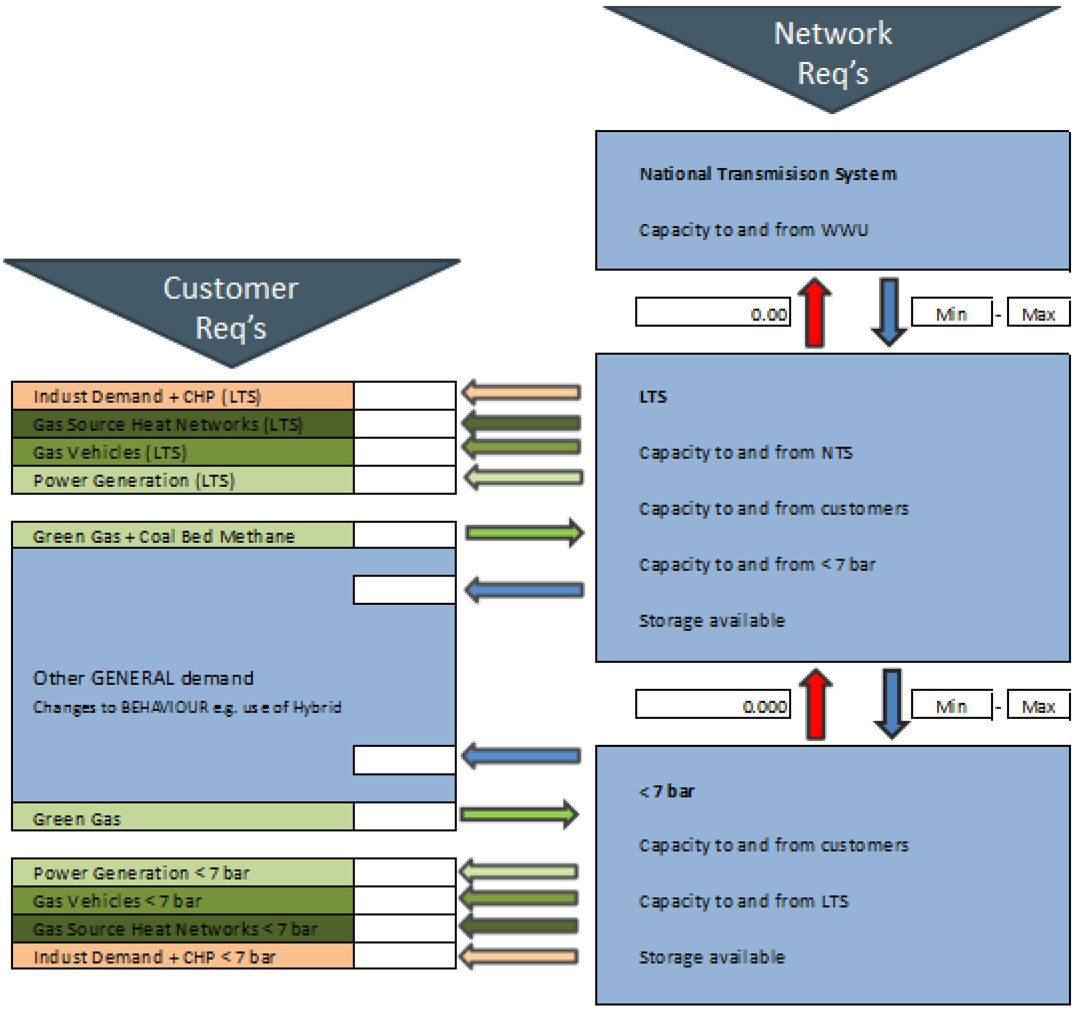
Note: we are also testing the operation of hybrid heating systems as part of Project Freedom in South Wales this winter which will provide further evidence and validation of these modelled outputs. See Section 8.1



3.2 Investment Model

Once we have used our 2050 Energy Pathfinder Model to gain insight into likely customer behaviours and scenarios, this information is then used as inputs in our investment model. This model splits the network into the Above 7 bar network: the strategic, controllable part of the network where gas storage is available as linepack, and the Below 7 bar network: which is currently a more passive system with very little storage.

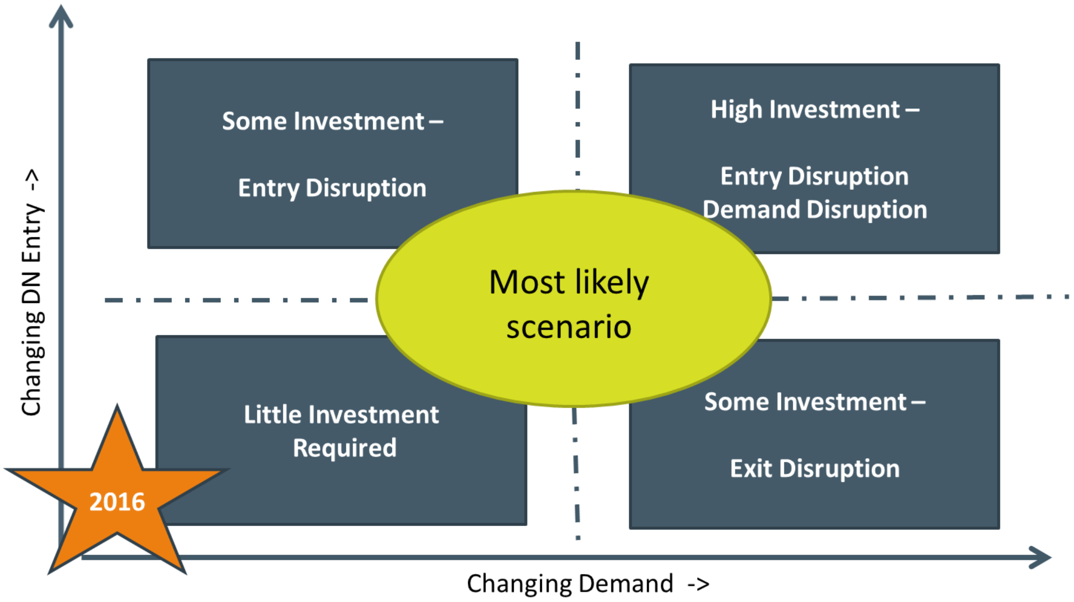
The model takes account of customer requirements, shown on the left of the picture below as well as the interaction with the National Transmission System shown at the top right hand side. The model can be run at an LDZ or Network Level and for any year between now and 2050.



Outputs for each scenario include new capacity requirements including storage, and in the event that embedded gas entry outweighs gas demand in an area, the volume of gas that would need to be compressed back up the system. It will also help us understand whether investment is needed on the below 7 bar part of the network to include smart control to release further capacity.

The model has been externally validated and whilst further work is required to improve our forecasts of the rate of update of some of the customer types on the left, it is already providing useful insight into our future requirements.

Results are presented in 5 scenarios as per the Boston Square below to include, low, medium and high peak demands against low, medium and high scenarios for distributed gas entry.



Although work to date has been carried out within WWU, we are now engaging with the other Gas Networks and it is likely that this work will be shared and further work to forecast the rate of uptake of customer types will be carried out on a collaborative basis.

Designing OUR FUTURE

We invest in our people so that we all have the skills, confidence and innovative thinking to build our business long into the future. We want to be a company people aspire to work for.

4 Demand

Gregory Hill – LTS Network Planner

4.1 Summary

This chapter 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. It also includes the headline outcomes as well as a discussion on our current forecasts and their comparison with the 2016 forecasts (see Section 4.3).

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

4.2 Demand Forecast overview

Our gas demand forecast levels in the current price control period from 2013 to 2021 is 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 underpinned by previous detailed analysis commissioned by WWU and other GDNs

In overview, the key headlines are:

- Annual demand is expected to show a slight fluctuation ending with a small decrease of 6.39% over the 10 year horizon.

- During the next ten years, our current view is that peak day demand in our network will remain flat from 2017/18 out to 2026/27 for all LDZs with just a slight reduction in the first year in comparison to the 2016 forecasts. This does not lead to any investment requirements.

- WWU are currently working on a new investment model to forecast future demand. This will be used next year and we anticipate that the methodology, based on new research into future demand, will result in changes going forward and network investment being required.

- Response to the opportunities available in the new electricity market has caused a change in customer requirements and / or behaviour. Significant increases in power generation enquiries for sites operating as part of the short term operating reserve (STOR) market have impacted on our requirement for storage. Increases in biomethane connections and enquiries also impact on planning processes and "Within Day" operations as we now have to keep capacity available for when these sites operate.

- The forecasts referred to within this document take account of national data and assumptions sourced from NG. A range of forecast scenarios are produced and we consider this information in conjunction with local knowledge and analysis to develop the final forecasts used to plan the network. In 2014, we commissioned energy consultants Delta-EE to carry out a review on peaks in the domestic load band. The Delta-EE models were updated with the latest economic and demand data in 2017 and we have used the results from this revalidated model to develop the forecasts for the 2017 view of peak demand.

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 Appendix A1.2

4.2.1 Demand and Weather Modelling

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 3 - section A3.1 of this document.

4.2.2 Interruptible Capacity

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. In previous years Interruptible capacity has been put out to tender in all areas, however no interest has been shown in this by customers within the WWU network. There are no longer any interruptible customers connected to WWU's network.

4.2.3 Forecast Demand charts

This section provides an overview of the latest gas demand forecasts through to 2026/27. A more detailed view can be found in Appendix 2, which includes forecasts for both peak and annual demand on a year-by-year basis.

Early indications form the forecasting models we are developing to better predict changes to customer behaviour are that demands may increase when the process is completed next year. However, as this may result in investment requirements we have not moved to these forecasts in this year's process pending further work.

Figure 4.1 Historical and Forecast Peak Day Gas Demand for WWU

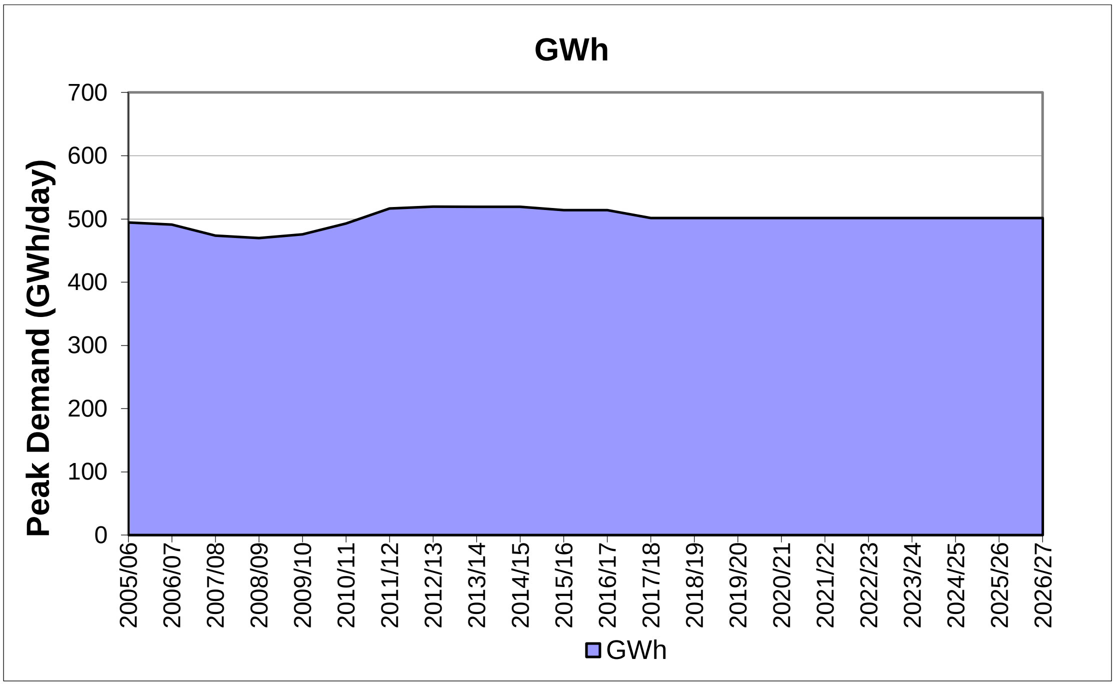
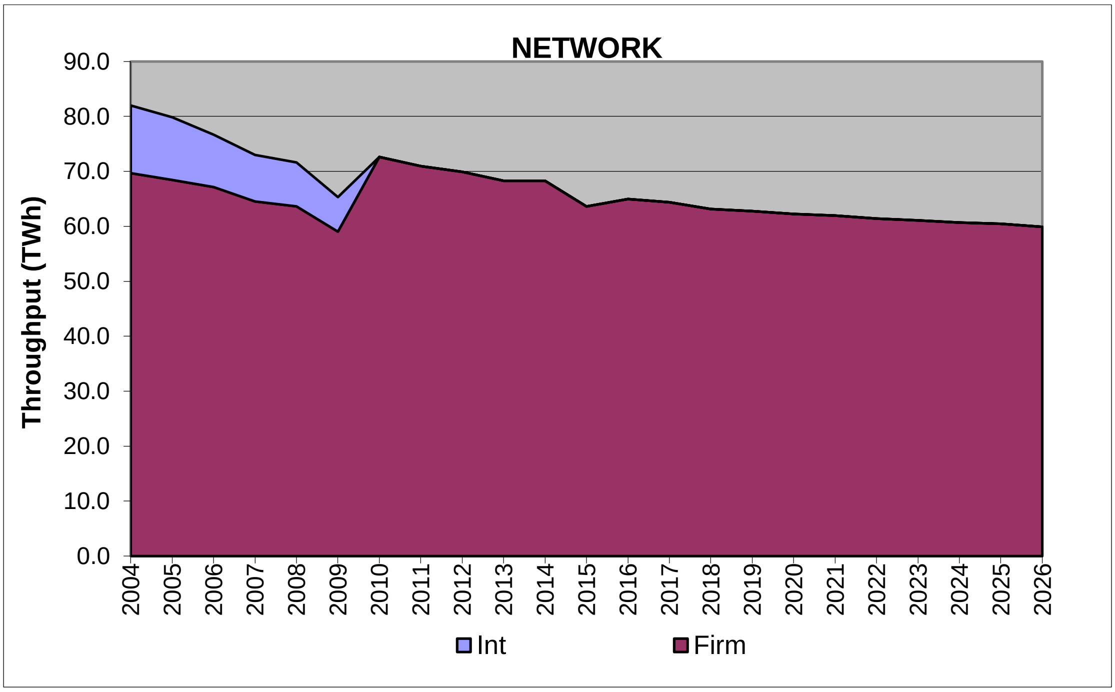


Figure 4.1 represents the view, that demand will remain reasonably steady when considered alongside reasonably constant annual demands. This results in a flat forecast from 2017/18 onwards.

Figure 4.2 Total Historical and Forecast Annual Gas Demand for WWU



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.

Figure 4.3 Historical and Forecast Annual Gas Demand for South West LDZ

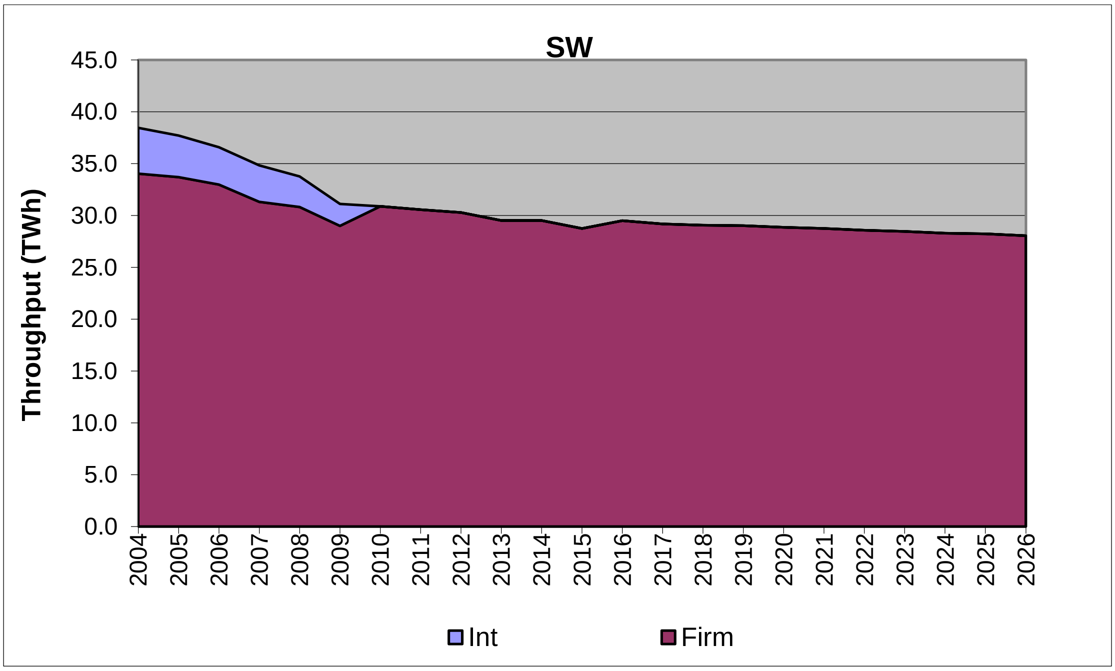


Figure 4.4 Historical and Forecast Annual Gas Demand for Wales South LDZ

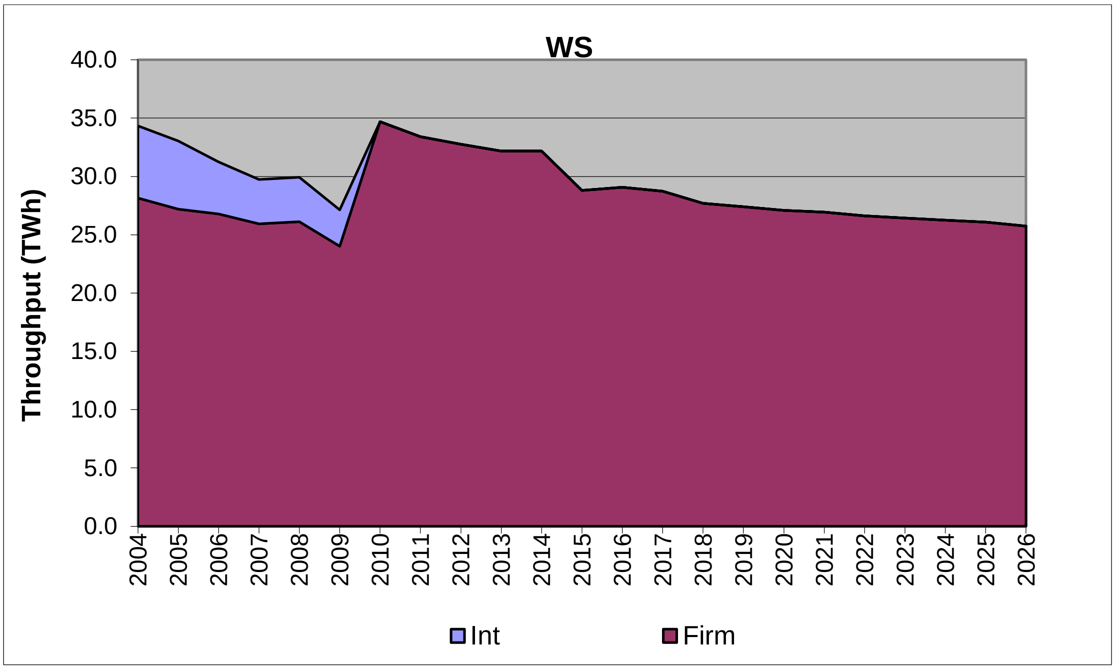


Figure 4.5 Historical and Forecast Annual Gas Demand for Wales North LDZ

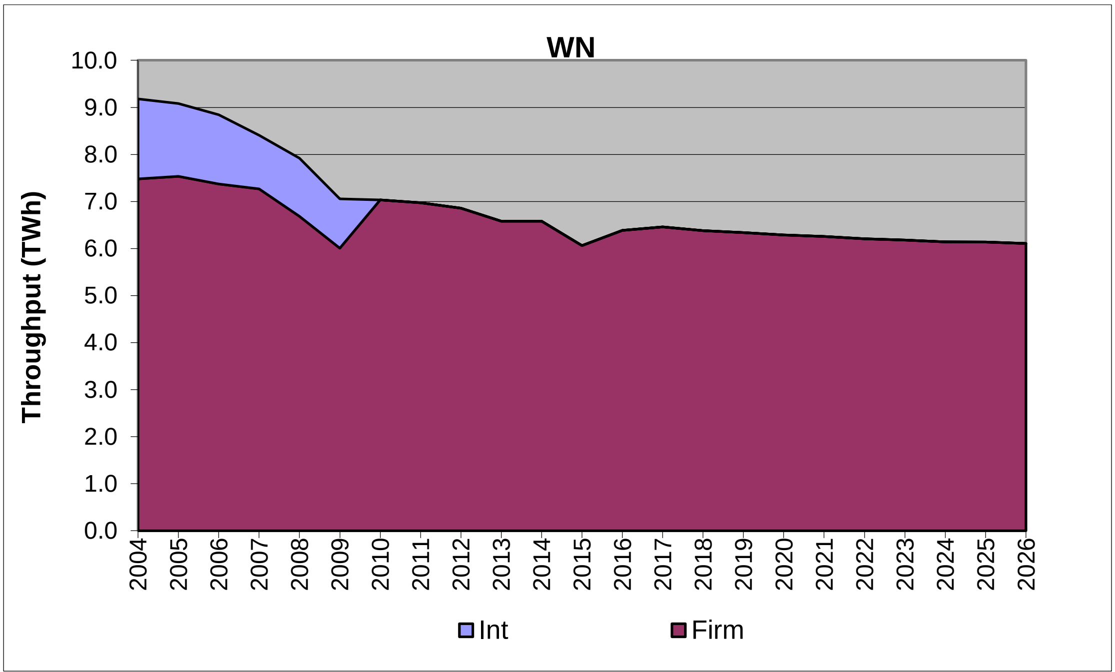
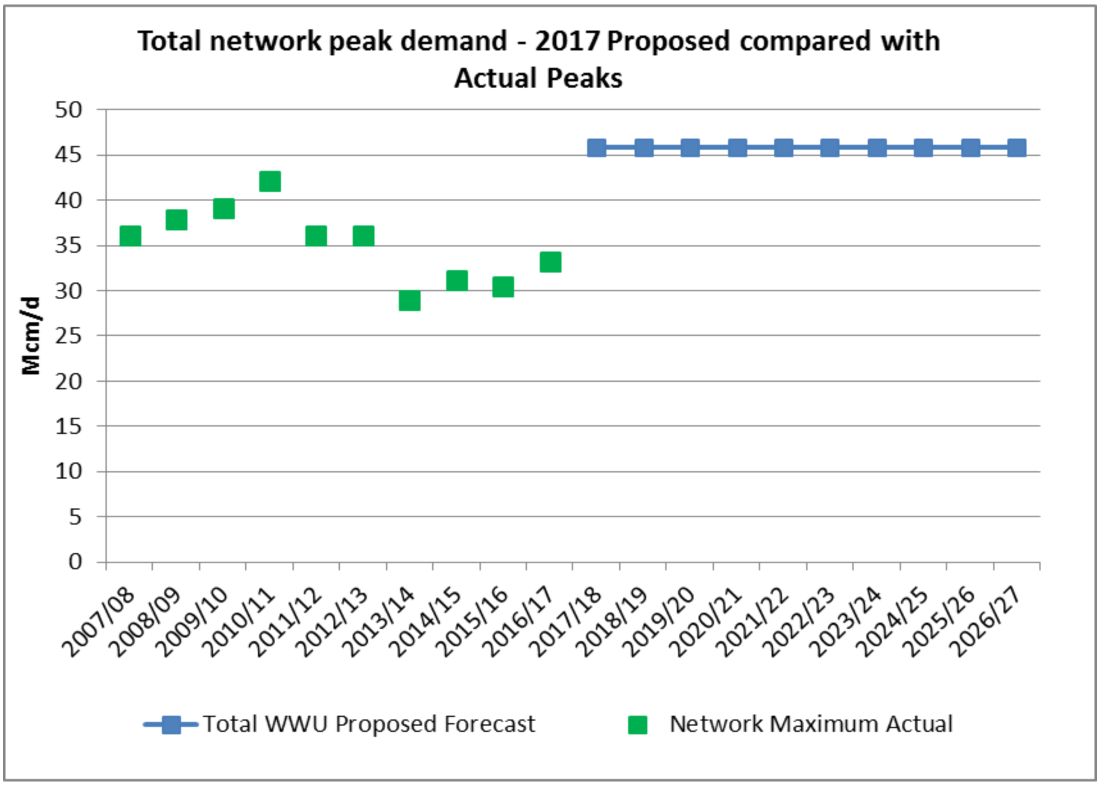


Figure 4.6: Forecast Peak Day Demand – 2017 Proposed compared to Actual (non-weather corrected) Maximum Demand



Information on the demand forecasting process is available in Appendix 1.

4.3 Forecast Comparisons

The following chart shows the comparison of the 2016 and 2017 Forecasted Peak Day.

Figure 4.7: Peak Demand Forecasts for WWU

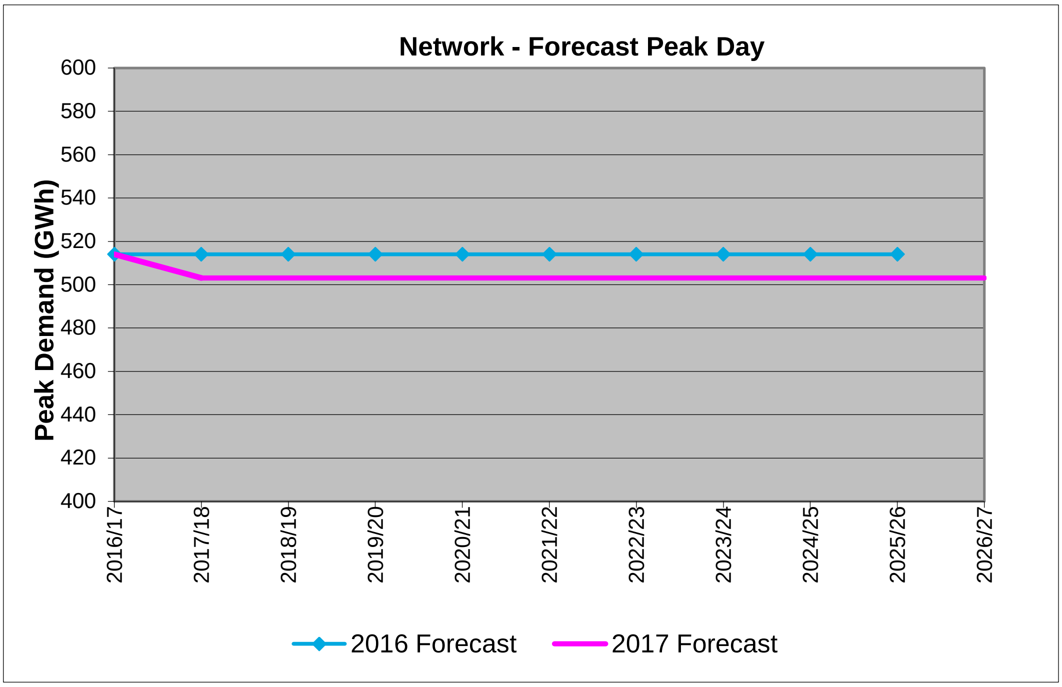


Figure 4.8: Peak Demand Forecasts for South West LDZ

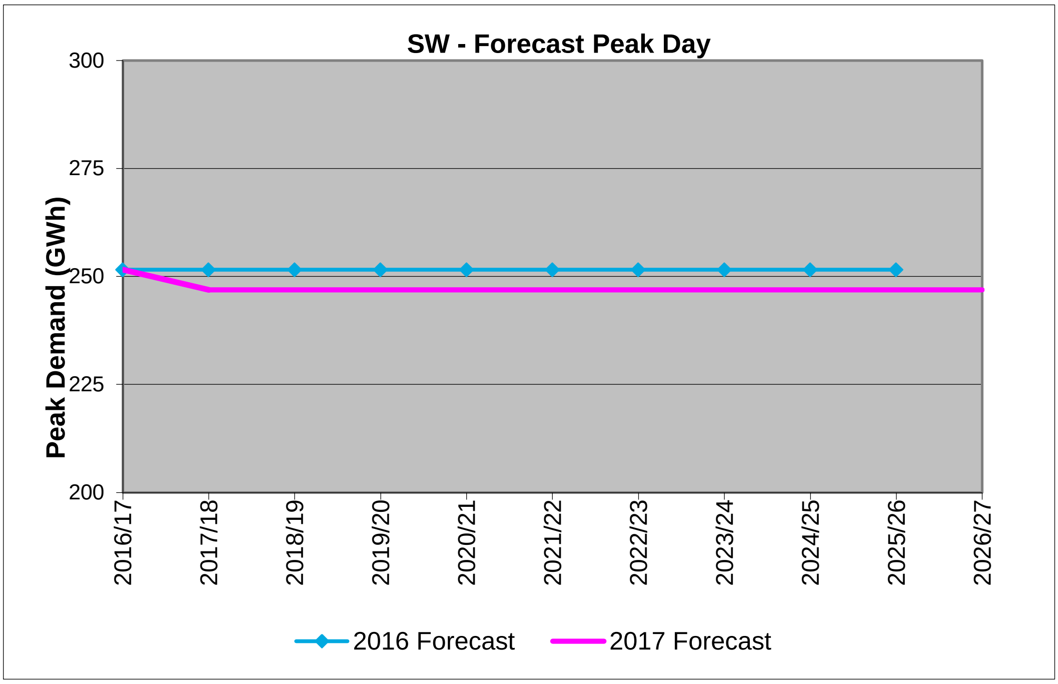


Figure 4.9: Peak Demand Forecasts for Wales South LDZ

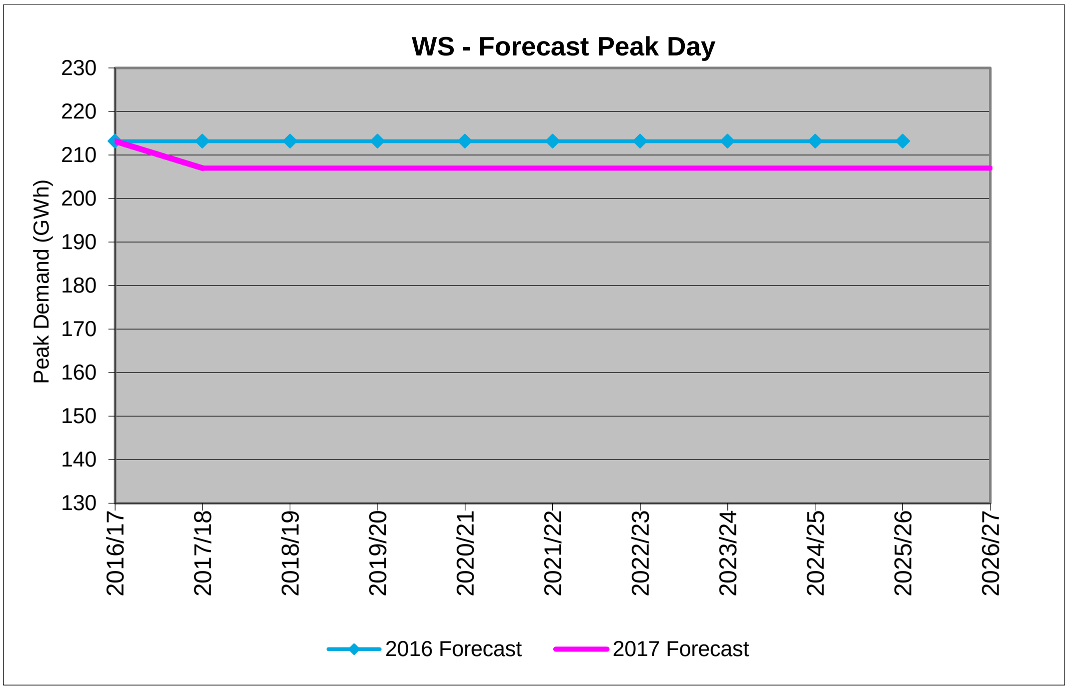
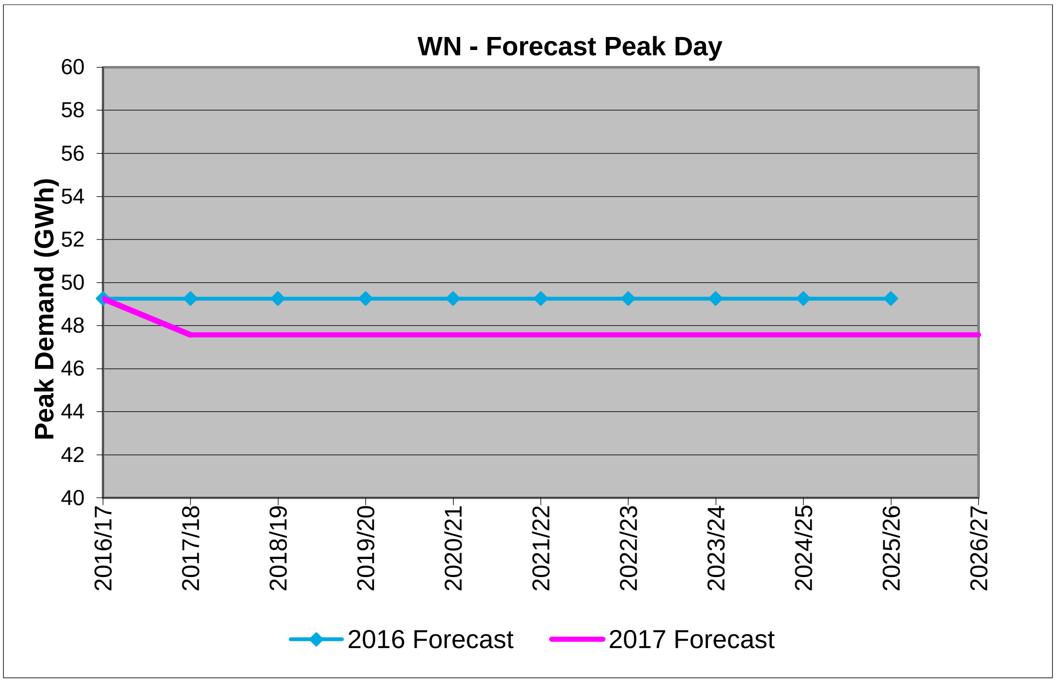


Figure 4.10: Peak Demand Forecasts for Wales North LDZ



*Please note that the Peak Day Forecasted volumes, shown in energy in the above graph for WN, have changed since last year's forecast but our OCS bookings remain the same due to user commitment.

Doing all we can to PROVIDE A RELIABLE GAS SUPPLY & PROMOTE SUSTAINABILITY

We are committed to providing a reliable gas supply for our customers whilst protecting and helping the environment for today and for the future.

5 Supply

5.2 Overview

We develop the local transmission and distribution systems to meet the requirements of the demand forecasts. In turn, National Grid Transmission (NGT) will develop the national system 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 17 biomethane supplies. However, as these feeds are subject to the customers' requirements, we do not assume they will be flowing at peak and therefore we book sufficient NTS capacity to meet peak day demand requirements. The gas enters the LTS and is stored within the network of pipes in the form of "linepack" and also in High Pressure Storage Vessels.

5.3 Network Facilities

5.3.1 Bio Methane Sites

WWU currently have 17 biomethane plants connected to the network; however studies have shown that DN Entry could increase significantly out to 2030. If this is the case, significant network redesign may be needed to facilitate and support these connections. This redesign may include requirements for storage, compression and smarter control of our low pressure systems.

Projected annual biomethane production profiles 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* which is equivalent to over a thousand "Biomethane to Grid" plants with a production rate of 5417 kWh per hour.

*The Forecast of 120TWh includes assumes production from industrial scale bio-SNG plants

5.4 Network Supplies

The three LDZs in the Distribution Network (DN) are supplied by National Grid (NG) NTS through seventeen Offtakes, with the SW LDZ being divided into three distinct sub-systems. Figure 4.2 provides details of the current and future capacity and flows through our NTS Offtake sites. The forecast flows are intended to meet the forecast demand requirements detailed in Chapter 3. Appendix 3 provides details of the annual flows during the 2016 calendar year.

Figure 5.1 WWU Offtakes

Subsystem Name	Offtake Location			Capacity
		kscm/h	mcm/d	
	LDZ:- SW			
Northern	Wiltshire (1)	122	2.93	2.5
	Gloucestershire (1)	116	2.78	1.9
	Bristol (1)	243	5.83	4.5
Central	Bristol (2)	150	3.60	2.1
	Somerset	175	4.20	2.6
Southern	Exeter (1)	63	1.50	1.3
	Plymouth	300	7.20	3.7
Other	Exeter (2)	122	2.92	1.7
	Gloucestershire (2)	45	1.08	0.7
Pressure Controlled	Devon	40	0.96	0.4
	Herefordshire	25	0.60	0.4
	Wiltshire (2)	21	0.51	0.2
	Worcestershire	38	0.91	0.5
	LDZ:- WS			
South Wales	Cardiff	449	10.78	8.4
	Swansea	235	5.64	3.7
	Newport	316	7.58	6.9
	LDZ:- WN			
North Wales	Wrexham	250	6.00	4.5

Gas supplies, and the supply to our GDN through these Offtakes, are generally affected by the changes in gas production. We have seen a decline of gas production from the UK

Continental Shelf Supplies (UKCS) and in order to compensate for the decline, NG has developed the NTS to support a number of projects to enhance interaction with mainland Europe and the Liquefied Natural Gas (LNG) markets. These include, for example: the Langeled Pipeline linking the offshore Norwegian gas network and the Ormen Lange gas field to the NTS, increased facilities for LNG imports into the Isle of Grain terminal, and a pipeline to connect the LNG facilities at Milford Haven, Wales to the NTS. The Dragon LNG facility and the South Hook terminal at Milford Haven are also fully operational.

5.5 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 2017. 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

In addition to the gas supplied from the NTS, a small volume of gas is available from 17 biomethane sites. This is a developing area and supplies are not currently sufficiently secure to be relied on to meet our peak demand and there is no obligation for these sites to commit to flat capacity bookings. As such these volumes are not considered when we consider our flat capacity booking requirements with the NTS.

5.6 Security of Supply

We invest to ensure that the security of the Network's supply is maintained in line with the obligations detailed in our Licence to Operate. Our investment programme, discussed in section 6 of this document details a number of projects that have been identified to ensure that the security of supply is not compromised.

6 Investment in the Distribution Network

6.1 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 DN 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. At the highest level these are:

- Identification of performance requirements of physical assets using stakeholder analysis (including growth)
- Identify any risks that assets will cease to meet the required performance
- Put actions in place to address any change in requirements or close identified gaps.

6.2 Local Transmission System Development Plan

The LTS is designed for transmission and storage on the basis of ensuring security of supply at 1 in 20 peak day conditions. The system is developed, based on supply and demand forecasts, to ensure that this capability is maintained.

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.

We have developed a suite of monetised risk models which are based on the basic principles of CBRM but take asset risk modelling to another degree of sophistication. We have also purchased a software product (AIM) which utilises these models and supports the development of optimised programmes of work. We have just completed User Acceptance Testing (UAT) and will be using these models and the AIM tool in the planning process for the remainder of RIIO-GD1 and also to understand investment requirements for RIIO-GD2.

6.3 Below 7 Bar System

The below 7 Bar distribution system is constrained to operate between levels of pressure defined by statute, regulation and safe working practices. It is designed and managed to meet a peak six-minute demand level, which is the maximum demand level (averaged over a six minute period) that can be experienced in a network under cold winter conditions.

Due to the increase in biomethane and below 7 Bar connected power generation "peaking" plants, we have started analysing the impact of these loads by creating below 7bar models that are analysed transiently.

We will continue to invest in capital 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 the coming years further non-demand driven investment may be required as we start to investigate other requirements such as hydrogen injection, blending services and compression.

Following a review for the requirement of local gas storage provided by Low Pressure Gas Holders to satisfy daily peaks in demand, all of our holders have been retired from service.

Our programme of holder demolition funded in RIIO-GD1 is near completion, and the remaining holder demolition will be funded in the next price control period. In some instances the works include environmental remediation and disposal of land.

6.4 Intervention Planning

We own, operate and maintain almost 4,000 above ground installations, over 35,000 kilometres of pipeline and supply over 2.5 million customers. Our asset policy is to balance the needs of supplying our customers and ensuring both public and employee safety are not compromised whilst minimising environmental impact and public nuisance.

The technical asset life varies across the whole range of our asset base. These are only a guide with the key drivers being: Condition, Serviceability, Security, Obsolescence, Legislation and Safety.

6.5 Project List

The table in Figure 5.3 details the projects planned for our network for the current price control period.

Figure 5.1 Planned Projects for 2018 – 2025

Project Type	**Workload Volume**
2018	
LTS Sleeves	4
LTS Pipeline - Condition/Remedial Work - Proactive	171
LTS Pipeline - Condition/Remedial Work - Reactive	118
HP Storage	6
LTS Diversions	3
Offtake & PRI - E & I Work - Proactive	9
Offtake & PRI - E & I Work - Reactive	2
Offtake & PRI - CPNI	3
Offtake & PRI - Security	3
Offtake & PRI - Mechanical - Proactive	114
Offtake & PRI - Mechanical - Reactive	96
System Ops Work	37
2018 to 2025	
LTS Sleeves	16
LTS Pipeline - Condition/Remedial Work - Proactive	1004
LTS Pipeline - Condition/Remedial Work - Reactive	838
HP Storage	48
LTS Diversions	38
Offtake & PRI - E & I Work - Proactive	154
Offtake & PRI - E & I Work - Reactive	16
Offtake & PRI - CPNI	3
Offtake & PRI - Security	24
Offtake & PRI - Mechanical - Proactive	957
Offtake & PRI - Mechanical - Reactive	884
System Ops Work	180

*Proactive and Reactive work includes ALL types of work even down to inspections and painting etc.

This is a reflection of the current view on demands. Should future demand statements change the outlook on general growth or new large loads connect to the network then we will make necessary investments in our assets to meet the gas demand requirement.

There is a continued intervention program for Pipelines and Pressure Reduction Station's (PRSs) in the network beyond 2017/18 which has been identified at a high level as listed above, with detailed scoping on going throughout the price control period.

7 Innovation

Designing OUR FUTURE

We invest in our people so that we all have the skills, confidence and innovative thinking to build our business long into the future. We want to be a company people aspire to work for.

Lucy Mason - WWU Innovation Manager

7.1 Innovation Summary

We put our customers first. It's a core value of our business. They rely on the safe and reliable gas supply we provide, and expect us to work hard to keep the gas flowing today and prepare our gas network to play its part in a future affordable, secure and low carbon energy system.

In 2016/17, we invested more than £1.8 million on 34 innovation projects, an increase of £0.8 million on last year. Our 2016/17 Annual Innovation Report outlines our progress on these projects – supported by Network Innovation Allowance (NIA) funding. NIA funding has delivered very real successes, and as an industry we must do all we can to continue this.

7.2 Why Innovate?

The energy sector continues to be dynamic and constantly changing. Innovation, supported by incentives, is essential to meeting the challenges of the future. Our sector is undergoing rapid and significant change and we recognise the importance of challenging ourselves and others within our sector to find better ways of doing things. It is helping us support a sustainable integrated energy solution by providing a safe and reliable gas network that delivers best value and excellent service for our customers today and in the future.

7.3 Our Successes

We were proud that two of our projects have won awards. The Flexible Energy Simulator won the IGEM Gold Medal award and the Reuse of Gasholder Sludge (NIA_WWU_016) won the Brownfield Briefing Award for the Best Use of a Combination of Remediation Techniques – for applying a range of technologies to overcome a significant technical challenge in its treatment.

During the year, we have done more to connect with the innovation community and in listening to their feedback we have refreshed our problem statements making them easier to follow. We have used our network of collaborators to reach out to more people and are building relationships to drive collaborative working.

7.4 Our 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.

7.5 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 62 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:

- Exploring the use of unmanned aerial drones; they've taken film and photography to new heights, have been heralded as the next big thing in delivery services and now drones are set to help us survey our pipelines and network faster, easier and cheaper than ever before.
- Development of a smart pressure sensor; a tool that combines with a smartphone application to provide us with a digital record telling us where and when it's been taken, and its success result. This will improve the availability and accuracy of our gas pressure test readings.

7.6 Innovation for Customers 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:

- Freedom; a unique £5.2m demonstration project being pursued in collaboration with electricity network Western Power Distribution, that bring efficient integration into the home by installing a hybrid heating system and contributing to carbon reduction targets. (See Section 8.1)
- Development of a flexible energy simulator; a simple, flexible energy simulator that can be used to assess different energy supply scenarios, supporting evidence-based public policy and future investment policy for energy networks and other utilities. (see Section 8.2)

7.7 Our Team

7.7.1 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.

In the past 12 months we have expanded what remains a small innovation team, and focused on improving our project management and implementation processes. We are committed to embedding innovation, and have updated our processes to make sure this happens. Through our experience, we have learnt that positive project outcomes are linked to the speed in which they are formed, demonstrated and assessed.

We have produced an innovation management toolkit, adapted from Change Management Expert John Kotter's processes to fit our needs. This uses a range of tools and techniques that produce clear project strategies and plans, engages stakeholders in our vision, encourages project success and supports the roll-out of equipment, products, research findings and procedures. It will help us to manage projects effectively to give them the best chance of success.

During 2016/17 we have continued to evolve our innovation portfolio while investing a further £1.8m on innovation activities using NIA funding that will help us to harness knowledge, expertise and potential to meet the challenges of the future.

During the year, a total of 148 new innovation project ideas were submitted to our team for review and evaluation. These ideas became 15 new projects using NIA funding as well as 14 projects which were supported by other means including self-funding to demonstrate the new equipment, materials and technologies in a real world environment. This demonstration is vital if benefits of innovation are to be realised.

7.8 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 250 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. An "alternative Emergency Control Valve (ECV) exchange kit" project, completed this year with Northern Gas Networks and the Energy Innovation Centre (EIC), is an operational innovation that allows us to exchange a customer's ECV without isolating their supply. This project was identified, designed and developed by a call for innovation through the EIC.

The open and transparent process generated interest and action from other manufacturers who have also produced competitive solutions to the same problem – helping us deliver value for money to our customers.

We have shared our project successes and learning experiences with other networks and industry in the UK, as well as other organisations further afield. This approach has benefited a wider market. The Ductile Iron mains cutting tool (NIA_ WWU_013), which we designed and developed alongside Steve Vick International has not only been bought by three out of the four 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.

7.9 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.

We will be shaping our forward- looking gas sector innovation strategy that embraces our innovation plans for the remainder of this price control period and beyond into the next.

8 Innovation Projects

Oliver Lancaster - WWU Project Manager

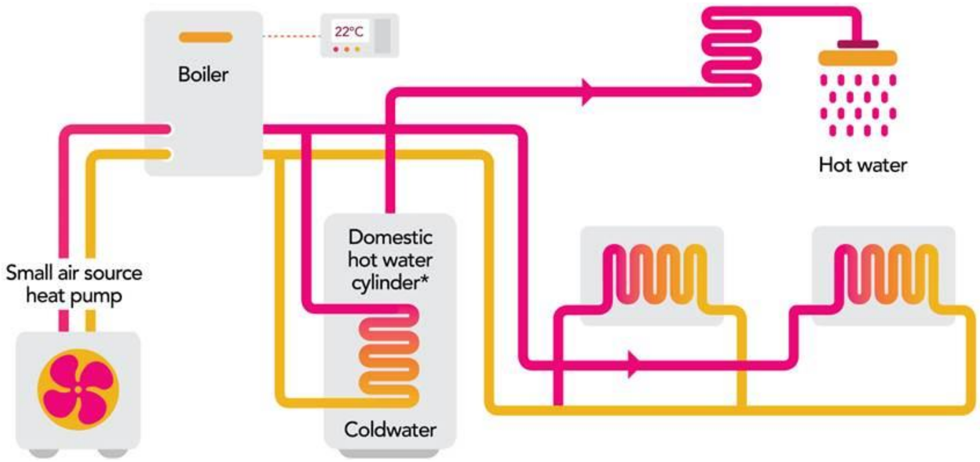
8.1 Project Freedom

The Freedom Project is the first collaborative future of energy project between electricity and gas networks. The project's principal funders are Western Power Distribution, the electricity distribution network operator and Wales & West Utilities, the gas distribution network operator. Alongside the two main funding parties, the other main contributor and part-funder within a tripartite contract is PassivSystems, who are leading the day-to-day project management, development of control algorithms, designing the architecture of the smart switching system, overseeing the recruitment of homes and the procurement and installation of hybrid heating systems. The other project partners collaborating and contributing significantly on research and deliverables for the Freedom Project include Imperial College, Delta EE and City University.

Freedom is a £5.2m innovation project involving the installation of 75 hybrid heating systems in residential properties in Bridgend, South Wales, in 2017. The pilot involved system installations, tests and simulations in four properties followed by the remaining 71 properties throughout the summer of 2017, prior to demand for heat rising during the autumn and winter months. The Freedom Project is a large-scale demonstration trial of smart hybrid heating systems to understand the potential benefits of transitioning UK domestic heat into a demand side response market.

Bridgend was chosen for the trial due to its prominence in hosting a number of surveys, studies and experimental trials in the future of energy sphere. The area is also within the network geographies of both Western Power Distribution and Wales & West Utilities.

The Freedom project's hybrid heating system includes an exterior air source heat pump, a reliable high efficiency gas boiler inside the home and a hybrid controls panel which enables switching between the two heat sources. There are no further modifications or interruptions required in customer properties, and it makes best use of the hot water heating delivery systems installed in most UK housing stock that is going to be around for many years to come.



The objectives of the Freedom Project are to:

- Use the ability of smart switching between gas and electric load to allow the buying of fuel & the sale of heat simultaneously - called fuel arbitrage, to create value and offer highly flexible services that match energy supply with consumer demand for heat;
- Demonstrate and articulate the potential consumer cost, carbon emissions and energy system security benefits from the large-scale deployment of hybrid heating systems; and
- Gain insight into balancing the interests of the consumer, supplier and network operators.

Initial modelling outputs from Imperial College suggest that the UK energy system could save £1.3bn annually by 2030 from reduced network reinforcement and avoided generation capacity investment as a result of hybrid heating systems being installed in preference to pure air-source heat pumps.

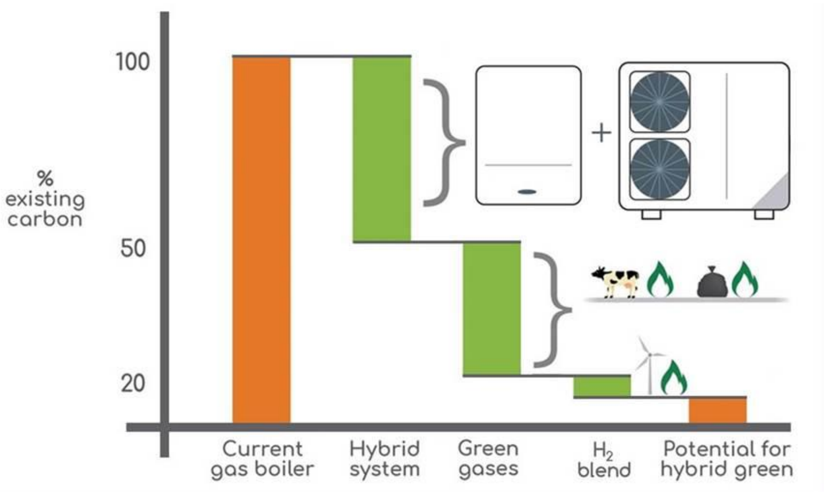
The hybrid system is the ideal way to integrate renewable electricity and renewable gas in domestic homes and keep costs down for bill payers. This enables the benefits of both gas and electricity to be maximised while taking advantage of existing infrastructure and technology.

The Freedom Project also allows benefits to be maximised and dots to be joined up with other projects in the energy futures space too – for example, studies on the conversion of the existing gas network to hydrogen. Hybrid control of heating in potential hydrogen cities would reduce production requirements for hydrogen from steam methane reformation, allow a greater impact from electrolysis-derived hydrogen and reduce the volume of CO_2 requiring capturing for storage or reuse. Hybrid hydrogen cities will also, therefore, provide consumers with duel fuel heating to benefit from the value of flexibility, avoid being tied to one fuel and its price fluctuations and shave peak electricity demand by switching to the hydrogen boiler. Switching can take place between the hybrid heating system when there is excess renewable electricity available for the heat pump, and then make use of the boiler when it is too cold or to flexibly fill in for renewable intermittencies, making use of the inherent storage capacity of the gas network – Wales & West Utilities deploy 58GWh of storage each day. This switching is demonstrating through the Wales & West Utilities' 'Pathfinder 2050' whole energy system simulations that the heat pump can displace 50% of gas throughput for domestic heat over a year and therefore decarbonise domestic heat by 50%.

Current calculations based upon published Cadent and UKCCC data on green gas feedstock indicates over 30% of current domestic heat demand could be met by biomethane and BioSNG, excluding any potential for synthesis gas. Wales & West Utilities have 17 renewable gas connections to the gas network, equalling the number of fossil gas connections, with a combined capacity of ~1.5TWh.

Further decarbonisation by blending hydrogen into the gas grid at 20% would displace 7% of natural gas for domestic heat (due to lower energy potential of hydrogen) – this is being explored in the HyDeploy trial (Cadent & Northern Gas Networks) and the Liverpool-Manchester Hydrogen Cluster project (Cadent).

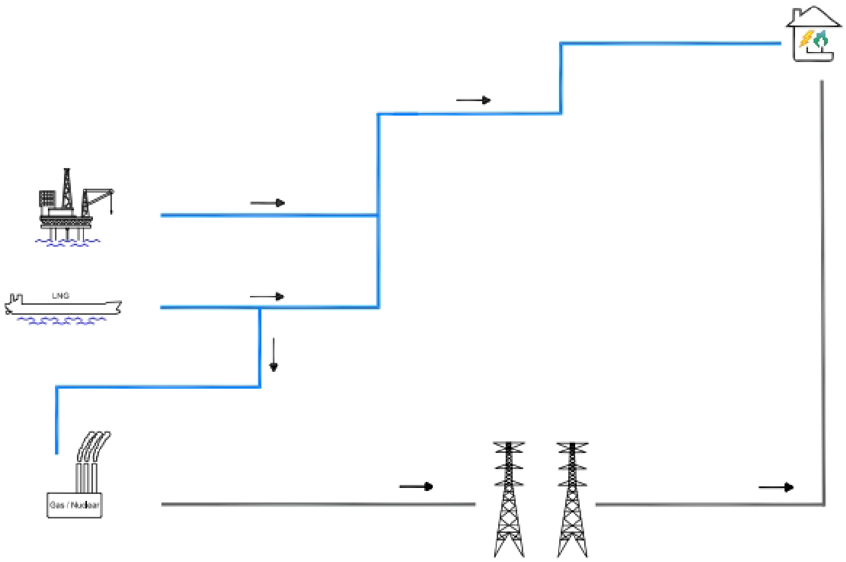
Overall, simulating actual supply and demand shows that at least an 87% reduction in carbon for domestic heat can be met by 2030 from renewable electricity via the heat pump and largely renewable gas through the boiler, with considering the heating efficiency benefits applied since the 1990 baseline year. Avoiding green gas use in potential future hydrogen cities could facilitate total decarbonisation of domestic heat, with renewable gas remaining to contribute to decarbonisation of heavy goods vehicles and bus fleets.



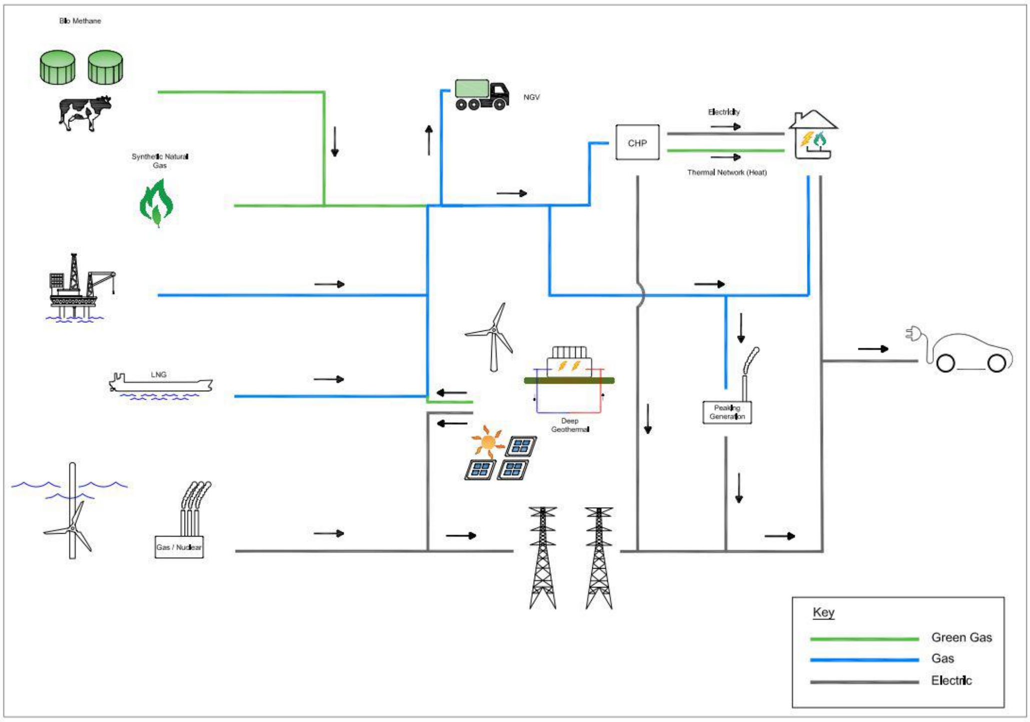
With the technology to deliver smart hybrid green heating being here already, decarbonisation of heat could be achieved sooner than most people think, without needing to carry out major heating delivery upgrades in existing housing stock nor significant electricity network reinforcement for partial electrification of heat. The Freedom Project is also demonstrating the benefit of gas in rural communities with hybrid systems being installed off the gas grid.

8.2 Integrated Energy Simulator

For decades, the gas and electricity transmission and distribution systems have been independent of each other, with gas supplying the majority of heat in homes and businesses and electricity generated from nuclear, coal and gas.



In the last decade, the system has become more complex, with renewable sources of energy connecting to both networks; Biomethane on the gas grid and wind/solar to the electricity grid. More recently, with the continuing rise in combined heat and power (CHP) being connected to the gas distribution system within commercial developments, electrical energy (in addition to heat energy) is being moved through the gas transmission and distribution systems. Very recently, a trend in enquiries about, and the connection of peak electricity generation plant (peakers) to, the gas distribution system has had the same effect; more energy being transported by the gas distribution system. The rise in enquiries has been dramatic, more than 300 in 2016 and 392 to date in 2017, with more than 20 new sites being connected and a further 10 in progress.



Finally, with enquiries to utilise excess generation by feeding electrolysed hydrogen into the gas distribution system (power to gas), plus ever increasing gas and electrical transport, the networks have never been so connected, or indeed reliant on each other. Eighty per cent of heat and power energy starts life by traveling through the gas grid on a cold winter's day.

It is evident therefore that variation of demand and supply on the electricity network will have immediate impacts on the gas network. For example, uncontrolled electric vehicle charging with intermittent renewables will create larger swings on the electricity network, and therefore the demand on the gas distribution system will increase as peakers respond to the demand.

8.2.1 Simulator Objective

The 2050 Energy Pathfinder has been built to assess how different future energy mixes would work in practice. It enables any energy scenario, current or future, to be modelled for a town, city, county or country and the results show the costs, carbon impact and any shortfall / surplus in heat and power supply. The simulator can be used to find alternate solutions across all energy types in a more integrated way.

8.2.2 Inputs

As demand, supply and appliance efficiency constantly vary, a high resolution model was required and runs hourly through a year. The simulator looks at

Supply of electricity and gas

- Controllable sources – nuclear, coal, gas, geothermal, biomass
- Intermittent renewables – wind, solar, tidal
- Off grid sources - oil, biomass, bottled gas

Demand for electricity (power) and gas (heat and transport) on an hour by hour basis

- Including the efficiency of heating (e.g. boilers, heat pumps etc)
- Transport (electric & gas powered vehicles) - cars, vans and HGVs

Scalability

- Scale demands e.g. for smaller regions, for colder / warmer winters
- Scale supply e.g. for future renewables plans, new tidal etc

Energy Efficiency

- New Vectors
- Heat Pumps
- Hybrid Heating
- Storage
- Demand Side Response

8.2.3 Outputs

The simulator delivers

- Carbon emission implications for each scenario
- Cost to energy customers of each scenario
- Reliability impact (Heat and power cuts) due to short term energy imbalance
- Annual cumulative imbalance to understand seasonal storage requirements
- Interconnection requirements

8.2.4 Next Steps

The simulator has been independently verified by Delta EE, we are developing a user interface which will be available on our website shortly to enable wider use of the 2050 Energy Pathfinder.

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; NTS Exit Zones and Exit Capacity Constraint Actions

Where available, Biomethane sites are also providing small volumes of gas. 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	2017/18	2018/19	2019/20	2020/21	2021/22	2022/23	2023/24	2024/25	2025/26	2026/27
South West	247	247	247	247	247	247	247	247	247	247
Wales North	48	48	48	48	48	48	48	48	48	48
Wales South	207	207	207	207	207	207	207	207	207	207
Network Total	501	501	501	501	501	501	501	501	501	501

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

Calendar Year	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026
0 - 73.2 MWh	19.48	19.42	19.31	19.19	19.04	18.90	18.72	18.55	18.38	18.17
73.2 - 732 MWh	3.05	3.13	3.20	3.22	3.25	3.25	3.27	3.26	3.25	3.23
>732 MWh	3.86	3.78	3.78	3.75	3.75	3.73	3.76	3.77	3.86	3.88
NDM Consumption	26.39	26.33	26.30	26.15	26.04	25.88	25.76	25.59	25.48	25.29
DM Firm Consumption	2.80	2.74	2.73	2.71	2.71	2.70	2.71	2.71	2.75	2.77
Total LDZ Consumption	29.19	29.07	29.02	28.86	28.75	28.58	28.47	28.30	28.24	28.05
Total Shrinkage	0.27	0.27	0.27	0.27	0.26	0.27	0.27	0.28	0.28	0.28
Total Throughput	29.46	29.34	29.29	29.13	29.02	28.85	28.74	28.58	28.51	28.33
Gas Supply Year	2016/17	2017/18	2018/19	2019/20	2020/21	2021/22	2022/23	2023/24	2024/25	2025/26
Total Throughput	29.37	29.32	29.21	29.02	28.90	28.79	28.67	28.50	28.40	28.18

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

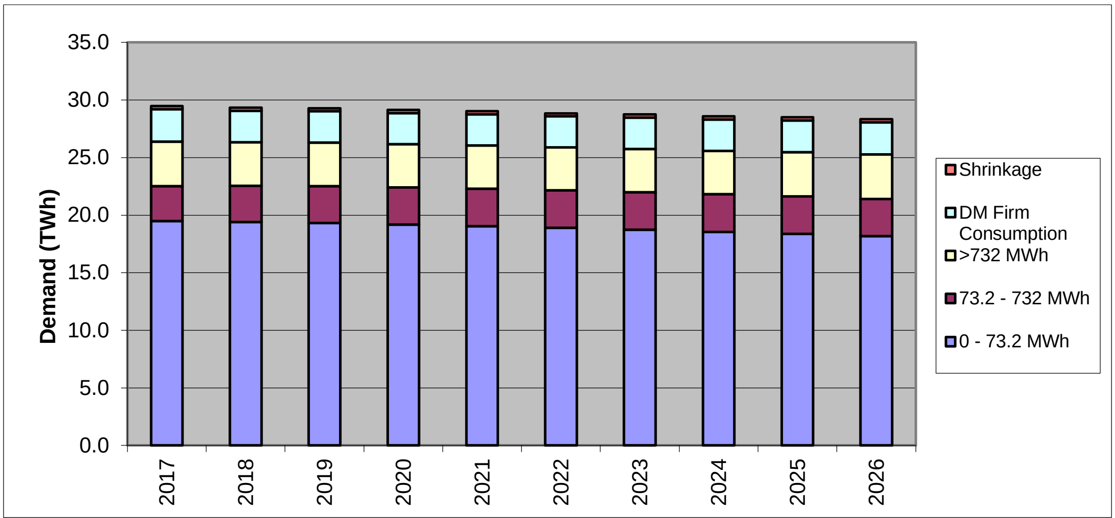


Figure A2.4 – Wales South LDZ Forecast Annual Demand Table – Split by Load Categories (TWh).

Calendar Year	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026
(a) 0 - 73.2 MWh	11.75	11.71	11.65	11.57	11.49	11.40	11.29	11.19	11.09	10.96
(b) 73.2 - 732 MWh	1.40	1.44	1.47	1.48	1.49	1.50	1.50	1.50	1.49	1.49
>732 MWh	2.34	2.29	2.29	2.27	2.27	2.26	2.28	2.28	2.33	2.35
NDM Consumption	15.49	15.44	15.42	15.33	15.26	15.16	15.08	14.97	14.91	14.80
DM Firm Consumption	13.24	12.25	11.99	11.76	11.68	11.46	11.35	11.27	11.17	10.94
Total LDZ Consumption	28.73	27.69	27.40	27.09	26.94	26.62	26.43	26.25	26.08	25.74
Total Shrinkage	0.19	0.19	0.19	0.19	0.18	0.19	0.21	0.22	0.22	0.22
Total Throughput	28.92	27.88	27.59	27.28	27.12	26.81	26.64	26.47	26.30	25.96
Gas Supply Year	2016/17	2017/18	2018/19	2019/20	2020/21	2021/22	2022/23	2023/24	2024/25	2025/26
Total Throughput	28.19	27.70	27.42	27.20	26.95	26.75	26.60	26.40	26.10	25.86

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

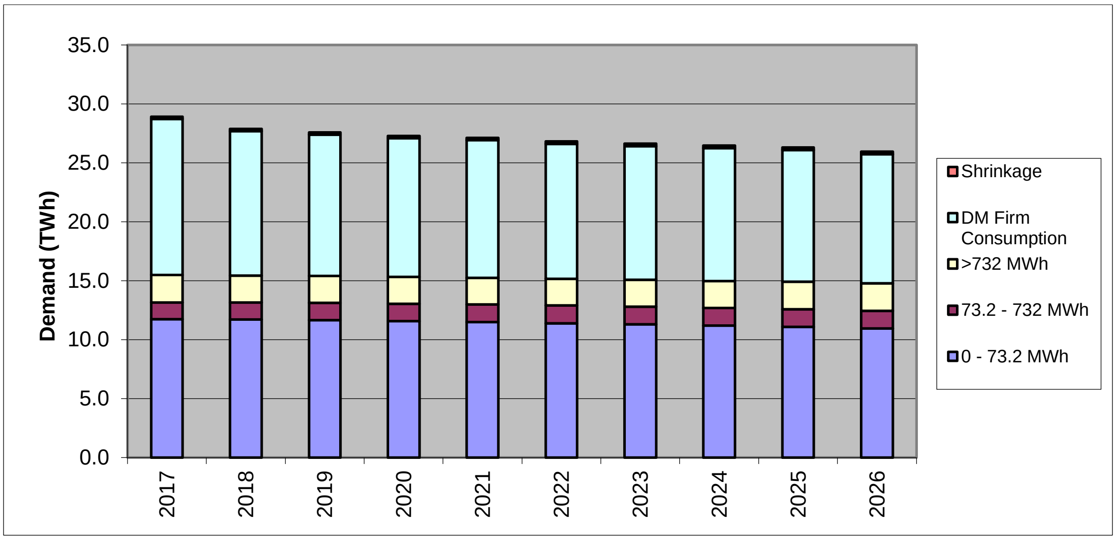
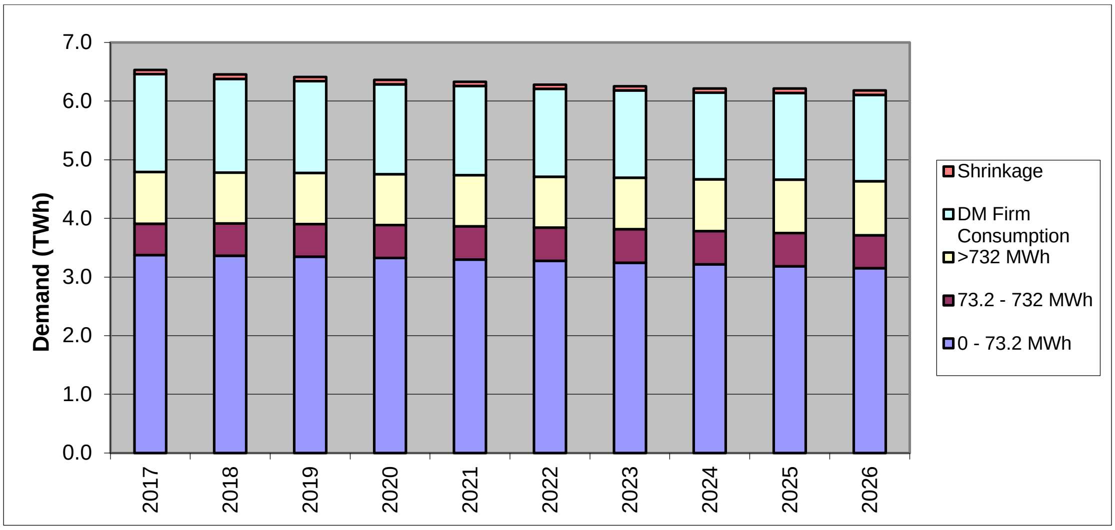


Figure A2.6 – Wales North LDZ Forecast Annual Demand Table – Split by Load Categories (TWh).

Calendar Year	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026
(a) 0 - 73.2 MWh	3.38	3.37	3.35	3.32	3.30	3.27	3.24	3.22	3.19	3.15
(b) 73.2 - 732 MWh	0.53	0.55	0.56	0.56	0.57	0.57	0.57	0.57	0.57	0.56
>732 MWh	0.89	0.87	0.87	0.87	0.87	0.87	0.88	0.88	0.91	0.92
NDM Consumption	4.79	4.78	4.78	4.75	4.74	4.71	4.69	4.67	4.66	4.63
DM Firm Consumption	1.67	1.60	1.56	1.53	1.52	1.50	1.49	1.47	1.48	1.48
Total LDZ Consumption	6.46	6.38	6.34	6.29	6.26	6.21	6.18	6.14	6.14	6.11
Total Shrinkage	0.07	0.07	0.07	0.07	0.07	0.07	0.08	0.08	0.08	0.08
Total Throughput	6.53	6.45	6.41	6.36	6.33	6.28	6.25	6.22	6.21	6.18
Gas Supply Year	2016/17	2017/18	2018/19	2019/20	2020/21	2021/22	2022/23	2023/24	2024/25	2025/26
Total Throughput	6.48	6.43	6.38	6.33	6.30	6.26	6.24	6.21	6.20	6.15

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



Appendix 3: Actual Flows 2016

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 2016 (TWh)

	2016 Actual Demand	Weather Corrected Demand	2016 Forecast Demand
0 – 73 MWh	19.50	19.21	18.59
73 – 732 MWh	3.05	3.01	2.73
> 732 MWh Firm	6.96	7.13	7.87
Interruptible	0.00	0.00	0.00
Total Consumption	29.50	29.35	29.20
Shrinkage	0.22	0.22	0.27

Figure A3.2 – Wales South LDZ Annual Demand 2016 (TWh)

	2016 Actual Demand	Weather Corrected Demand	2016 Forecast Demand
0 – 73 MWh	11.70	11.65	11.56
73 – 732 MWh	1.45	1.44	1.32
> 732 MWh Firm	15.92	16.03	16.96
Interruptible	0.00	0.00	0.00
Total Consumption	29.07	29.12	29.84
Shrinkage	0.12	0.12	0.17

Figure A3.3 – Wales North LDZ Annual Demand 2016 (TWh)

	2016 Actual Demand	Weather Corrected Demand	2016 Forecast Demand
0 – 73 MWh	3.39	3.35	3.36
73 – 732 MWh	0.54	0.53	0.49
> 732 MWh Firm	2.46	2.50	2.43
Interruptible	0.00	0.00	0.00
Total Consumption	6.39	6.39	6.27
Shrinkage	0.05	0.05	0.07

The weather corrected demand gives the expected level of demand for 2016 had the weather been at its seasonal normal value. As can be seen in the tables above the Actual Demand in 2016 was very similar to the Seasonal Normal in the Wales North and South West areas but compared to the Forecast Demand, they were all slightly higher.

A3.2 Maximum and Peak Flows

The coldest weather occurred on 26th January 2017 for South West and North Wales and 21st January 2017 for South Wales. These days coincided with the days of maximum firm demand for the Wales South and South West. The maximum firm demand for the whole network this gas year occurred on the 26th January 2017 and was 33.03mcm.

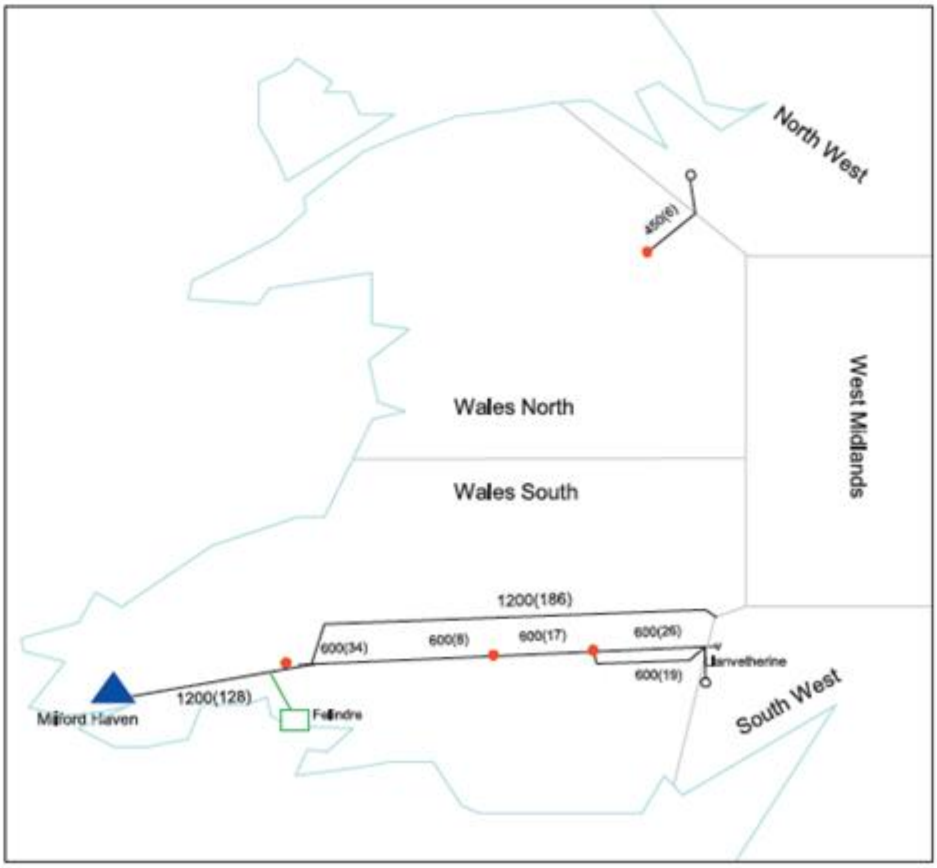
The maximum and minimum for the LDZs are shown in the following table

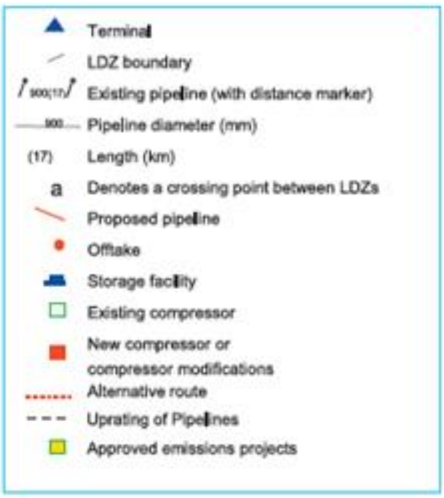
Figure A3.4 – LDZ Peak and Minimum Flows (mcm)

LDZ	Maximum MCM	Maximum Occurred on	Minimum MCM	Minimum occurred on	1:20 forecast peak 2016/17
WS	13.81	26/01/2017	2.56	27/08/2017	19.56
WN	2.91	21/01/2017	0.65	19/07/2017	4.50
SW	16.34	26/01/2017	2.44	27/08/2017	23.11

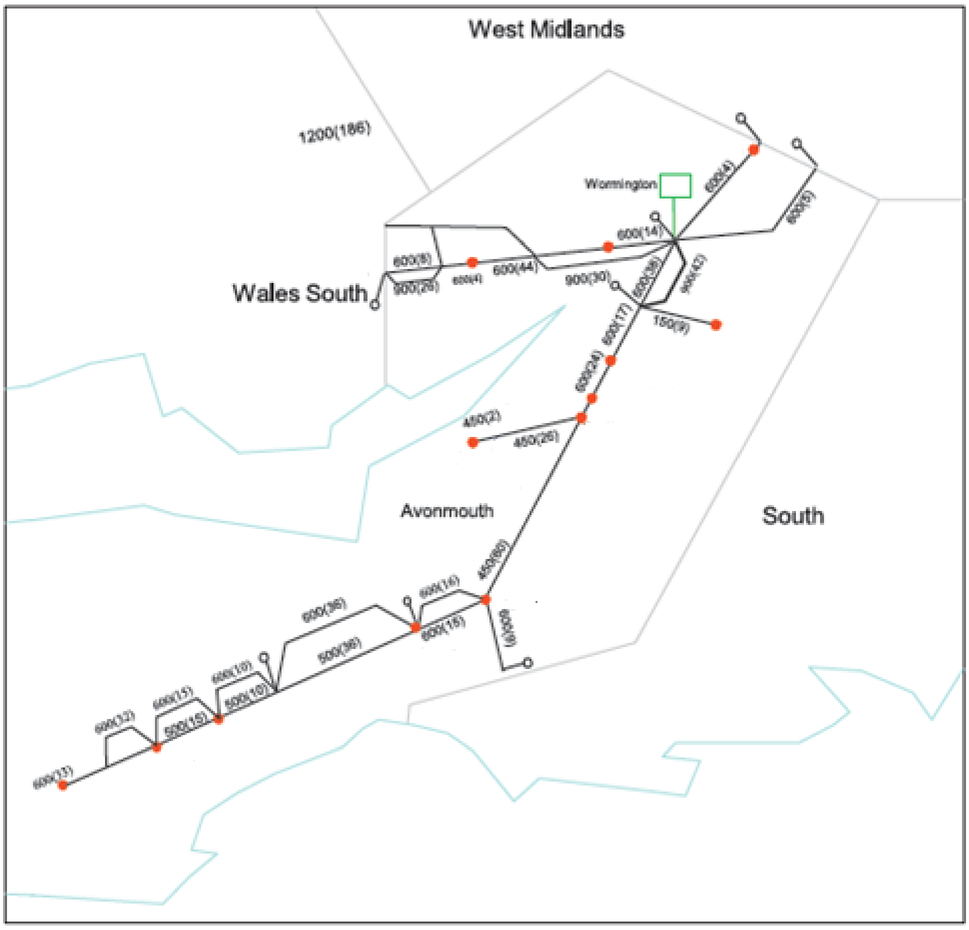
Appendix 4: The Gas Transportation System

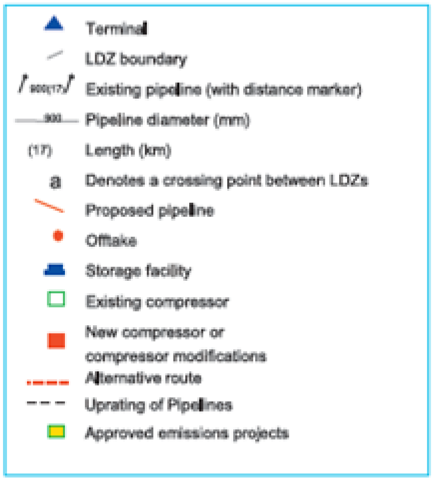
A4.1 Wales North and Wales South (WN & WS) NTS

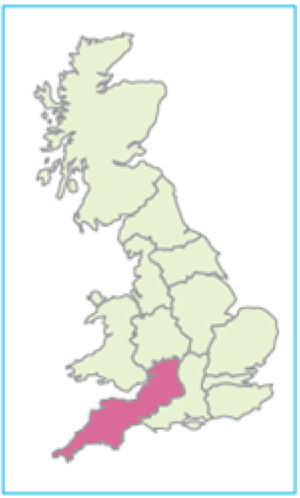




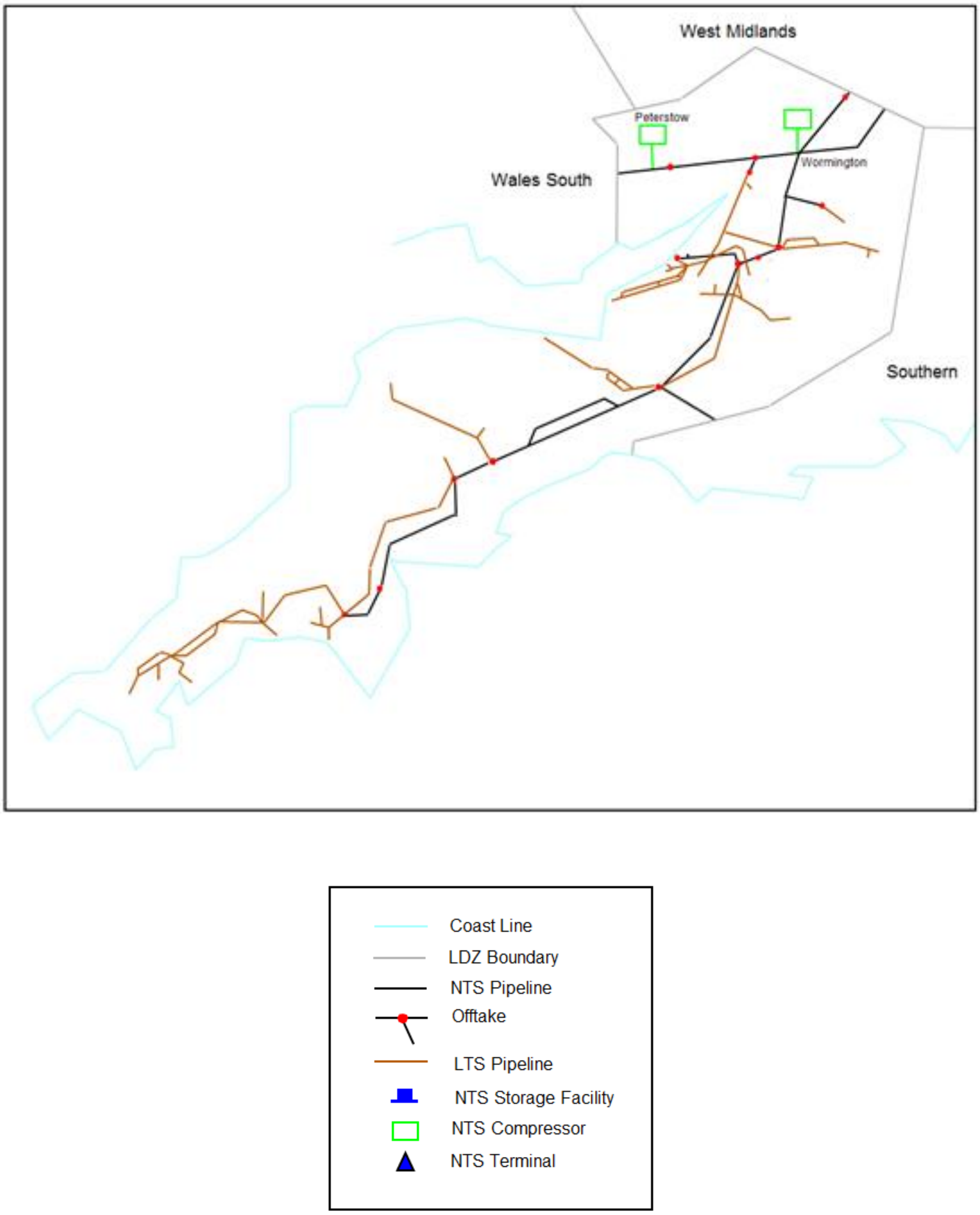
A4.2 South West (SW) NTS



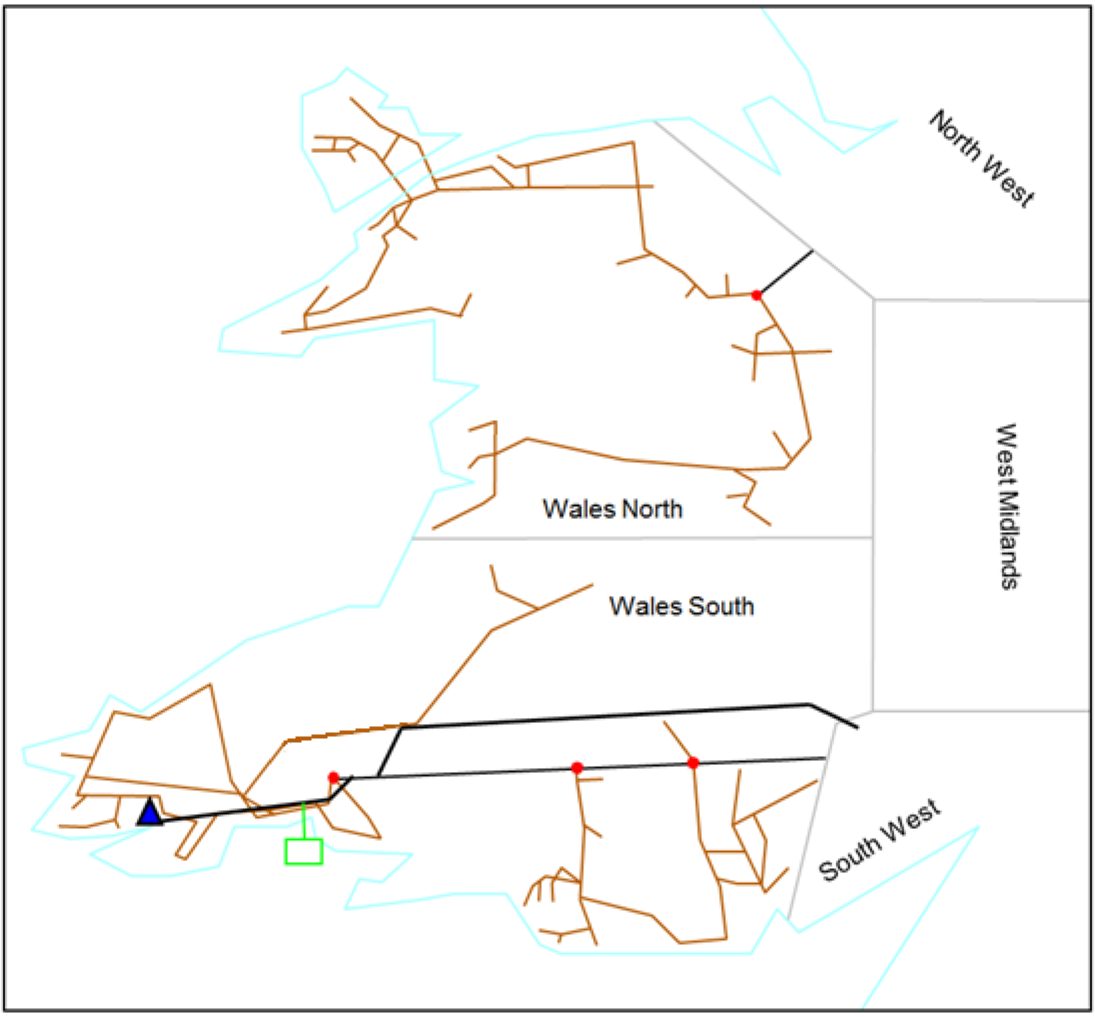




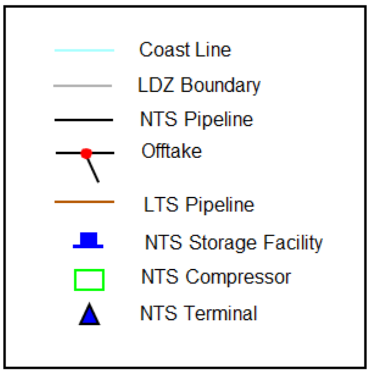
A4.3 South West (SW) LDZ - LTS



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°C at any pressure up to 85barg

6. Water Dewpoint
   - Not more than -10°C at 85barg
7. Wobbe Number (real gross dry)
   - The Wobbe Number shall be in the range 47.20 to 51.41MJ/m3
8. Incomplete Combustion Factor (ICF)
   - Not more than 0.48

9. Soot Index (SI)

- Not more than 0.60

10. Gross Calorific Value (real gross dry)

- The Gross Calorific Value (real gross dry) shall be in the range 36.9 to 42.3MJ/m3, in compliance with the Wobbe Number, ICF and SI limits described above. Subject to gas entry location and volumes, we may set a target for the Calorific Value within this range

11. Inerts

- Not more than 7.0% (molar) subject to
- Carbon Dioxide: not more than 2.0% (molar). Please note that there is a proposal by NG to modify the UNC to a limit of 2.5% (as mentioned above the limit is indirectly limited by the GS(M)R)

12. Contaminants

- The gas shall not contain solid, liquid or gaseous material that may interfere with the integrity or operation of pipes or any gas appliance within the meaning of regulation 2(1) of the Gas Safety (Installation and Use) Regulations 1998 that a consumer could reasonably be expected to operate

13. Organo Halides

- Not more than 1.5 mg/m3

14. Radioactivity

- Not more than 5 Becquerels/g

15. Odour

- Gas delivered shall have no odour that might contravene the statutory obligation not to transmit or distribute any gas at a pressure below 7 barg, which does not possess a distinctive and characteristic odour

16. Pressure

- The delivery pressure shall be the pressure required to deliver natural gas at the Delivery Point into our Entry Facility at any time taking into account the back pressure of our System at the Delivery Point as the same shall vary from time to time
- The entry pressure shall not exceed the Maximum Operating Pressure at the Delivery Point

17. Delivery Temperature

- Between 1°C and 38°C

18. Siloxanes

- Tests for siloxanes and the determination of safe limits are subject to ongoing work.

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

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

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

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

Wales & West Utilities Limited

Wales & West House
Spooner Close
Celtic Springs
Coedkernew
Newport, NP10 8FZ