National Grid Gas Distribution

Long Term Development Plan

October 2014

Disclaimer

This Statement is produced for the purpose of and in accordance with National Grid Gas' obligations in Standard Special Condition D3 of its DN Gas Transporter Licence and Section O 4.1 of its Network Code in reliance on information supplied pursuant to Section O of its Network Code. Section O 1.3 of its Network Code applies to any estimate, forecast or other information contained in this Statement.

National Grid Gas Distribution UK's Long Term Development Plan is not intended to have any legal force or to imply any legal obligations as regards capacity planning, future investment and the resulting capacity.

Foreword

Since the publication of last year's Long Term Development Plan (LTDP) we have completed our first year of operating under our new RIIO Regulatory regime. Along with new incentives, a drive for innovation and a much closer alignment of our activities with our customers and stakeholders' requirements, the framework provides the longest period of regulatory clarity through an eight year control and stands for:

Revenue = Incentives + Innovation + Outputs

Energy remains at the forefront of the public agenda, and this is reflected in an ongoing level of significant political attention. The complex policy framework needed to meet conflicting requirements of security of supply, affordability and emissions reductions remains under close scrutiny. Gas networks are at the heart of the UK's ability to meet these challenges, both today and in the future. This document sets out our approach for assessing future demand under a range of different scenarios, and the impact that these scenarios has on investment in the network.

The Gas Distribution system operated by National Grid is a vital part of the UK's energy infrastructure, and is the asset by which energy is transported to over 10 million customers. The Government recognises the role of gas in achieving an affordable transition to 2050 and, in response to this, we are seeing substantial activity in connecting new sources of gas to the grid. Over the last year we have connected five bio-methane sites to the grid, and have a comprehensive forward programme of new connections for the remainder of the RIIO period. In addition to bio-methane, we are starting to undertake preliminary studies for shale gas connections.

As our thinking around future gas scenarios matures, we continue to explore new opportunities for the use of our asset in powering the economy of the future. We see considerable opportunities for natural gas power vehicles utilising a network of filling stations on our network, and there are also compelling propositions to use the gas network as a form of energy storage by converting peak electricity generation into hydrogen using power to gas technologies.

In parallel with developing the gas network of the future, we invest to safely and efficiently operate and improve the network of today. We plan to invest approximately £3.8bn over the RIIO period across a number of our asset types. The majority of our spend is on our mains replacement programme, aimed at reducing risk and extending the life of the network. We also invest in network reinforcements and new connections for industrial, commercial and domestic customers.

We firmly believe that there remains a vital need for the gas network to affordably supply energy to today's consumers, and to support the transition to 2050 scenarios. This document contains essential information on our planning processes, including demand forecasting, system reinforcement projects and associated investment as well as actual demands for the previous year. The main body of the document provides an overview of the key issues, with further information provided in the appendices.

I hope you find our LTDP both interesting and informative. We would welcome your views on the Plan, including suggestions as to how it might be improved via the Feedback Form, which is available on the National Grid website.

David Parkin
Director, Network Strategy
Gas Distribution
National Grid
October 2014

Contents

Chapter One

1. Executive Summary

The purpose of this document is to set out our assessment of the future demand position for National Grid Gas Distribution, our supply from the NTS (National Transmission System), and the consequences for investment in the National Grid Gas Distribution network.

National Grid Gas UK Distribution manages the development, operation and maintenance of the High Pressure and below 7barg Distribution Networks. These Networks extend from the Inlet Valves of the Pressure Regulating Installations at the National Transmission System interface to the outlet of the consumers' Emergency Control Valves in the North West (NW), East Midlands (EM), West Midlands (WM), East Anglia (EA) and North London (NL) LDZs.

1.1 Context

The Long Term Development Plan has been developed using demand scenarios produced by UK Gas Transmission, supported by feedback from their industry-wide consultation process – "National Grid's UK Future Energy Scenarios (FES)".

1.2 Demand Outlook

The latest peak demand forecast reduces by around 1.2% per year on average over a ten year period. All forecasts are based on annual demands, which are then converted into peak demands via relationships established through analysis of historical behaviour. Our analysis shows this relationship remains the same as last year, so the same relationship has been used. Further, more instances of cold weather in the 2013/14 winter have substantiated the continued use of this relationship.

1.3 Investment Implications

The indicative investment implications will be approximately £73.8m per year over the remainder of the RIIO period, 2014/15 to 2020/21.

This average annual spend is reflective the RIIO-GD1 Final Proposals agreed with Ofgem on the 28th of February 2013. The figure is in 09/10 prices, and also does not allow for replacement-related expenditure.

It is worth noting that investment to add exit capacity is still required even with overall demand reducing. This is a result of local constraints that can arise within the networks due to Local Authority Strategic Development proposals enabling new developments, and the dynamic nature of existing loads, industries and customers migrating and changing within our networks.

It is also possible that in the future, significant investment will be required to facilitate the connection of new sources of gas, including renewable gas. However, our current plan does not include this investment at this time.

Chapter Two

2. Document Scope

2.1 Overview of Process

The production of the Long Term Development Plan is essentially the conclusion to the planning process for the current planning cycle 2014. The Plan is based on UK Transmission demand scenario data, which is formulated from the 2014 Future Energy Scenarios (FES) consultation.

The proposed programme for next year's plan is as follows:

- Publish 2014 Long Term Development Plan - October 2014
- Produce outline investment proposals - October 2014
- Seek feedback via feedback form - November 2014 to April 2015
- Receive 2015 Demand Scenario Data - May 2015
- Produce initial strategy proposals - July 2015
- Publish 2015 Long Term Development Plan - October 2015

2.2 Structure of Document

Chapter 3 provides an overview of our latest demand scenarios; Chapter 4 outlines our plans for investment in National Grid Gas Distribution (UK); Chapter 5 covers the latest commercial developments affecting our Distribution systems and Chapter 6 addresses the requirements in respect of Network Entry.

The Appendices provide details of the methodologies used to produce the demand and supply forecasts, the latest demand and supply scenarios, actual gas flow data, system maps, connection and specifications including gas quality. The final sections of the document contain a glossary and conversion matrix.

The demand and supply data shown in this year's document is also available on an Excel spreadsheet file, from our website.

The Feedback Form may be accessed via the internet. We would be pleased to hear your views about this publication.

Chapter Three

3. Demand

3.1 Overview

This Chapter describes the forecast for demand ten years ahead for each LDZ within National Grid Gas Distribution (UK). It also includes analysis on how current scenarios relate to previously published forecasts. An overview of these scenarios is provided in Section 3.3. Further information is provided in Appendix 2.

3.2 Scenarios

Our demand scenarios are based upon an extensive range of planning assumptions, stakeholder engagement and our own market observations. This section provides an outline of our latest gas demand scenarios and the key underlying assumptions.

The demand scenarios take into account trends of reducing our carbon emissions which is critical if we are to meet government targets in 2050. They also include planning assumptions derived from market observations, the view of specialist consultancies and data collected from UK Transmission's FES consultation process. The consultation involves a broad cross section of market participants including suppliers, consumers and consumer groups. It provides important feedback on the impact of market developments and data relating to the consumption of new and existing loads.

3.2.1 Forecast Demands

This section provides an overview of our latest gas demand scenarios through to 2023/24. A more detailed view can be found in Appendix 2, which includes our view for both annual and peak demand on a year-by-year basis. During the next ten years, annual gas demand is forecast to reduce not quite as steeply as last years forecast.

As part of the demand forecast update for the 2014/15 winter, a range of demand scenarios were developed. Due to the scenario changes described in section 1.2 Demand Outlook additional sensitivity scenarios were created to understand the changes within this year's scenarios. As in previous years we have worked with our service provider (UK Transmission) to develop these scenarios, as summarised below.

Gone Green is a world of high affordability and high sustainability. The economy is growing, with strong policy and regulation and new environmental targets, all of which are met on time. Sustainability is not restrained by financial limitations as more money is available at both an investment level for energy infrastructure and at a domestic level via disposable income.

Slow Progression is a world of low affordability and high sustainability. Less money is available compared to Gone Green, but with similar strong focus on policy and regulation and new targets. Economic recovery is slower, resulting in some uncertainty, and financial constraints lead to difficult political decisions. Although there is political will and market intervention, slower economic recovery delays delivery against environmental targets.

Low Carbon Life is a world of high affordability and low sustainability. More money is available due to higher economic growth and society has more disposable income. There is short term volatility regarding energy policy and no additional targets are introduced. Government policy is focussed on the long term with consensus around decarbonisation, which is delivered though purchasing – power and macro policy.

No Progression is a world of low affordability and low sustainability. There is slow economic recovery in this scenario, meaning less money is available at both a government and consumer level. There is less emphasis on policy and regulation which remain the same as today, and no new targets are introduced. Financial pressures result in political volatility, and government policy that is focused on short-term affordability measures.

The key differences between the scenarios impacting UK distribution gas demand are forecast levels of energy efficiency, views of the economy and how new houses are to be heated.

Sensitivity Scenario (S1) - which is the adopted forecast for 2014, is a scenario based on axioms used across the 2014 FES scenarios. The chosen axioms represent result in a plausible scenario that National Grid Gas Distribution (UK) has adopted as a forecast. This forecast balances the risk of security of supply and customer impact and gives the opportunity to validate a number of the new assumptions.

FIGURE 3.2A – East Anglia LDZ Historical and Forecast Annual Gas Demand – EP2 SNCWV

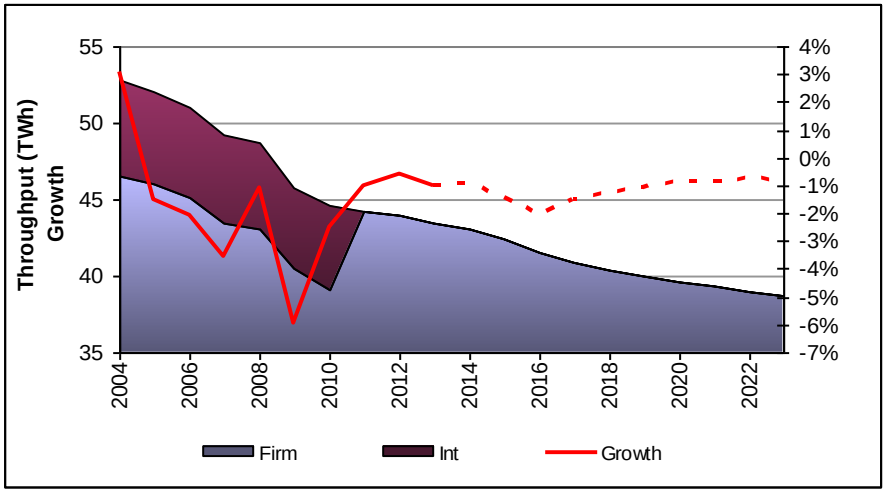


FIGURE 3.2B – East Midlands LDZ Historical and Forecast Annual Gas Demand– EP2 SNCWV

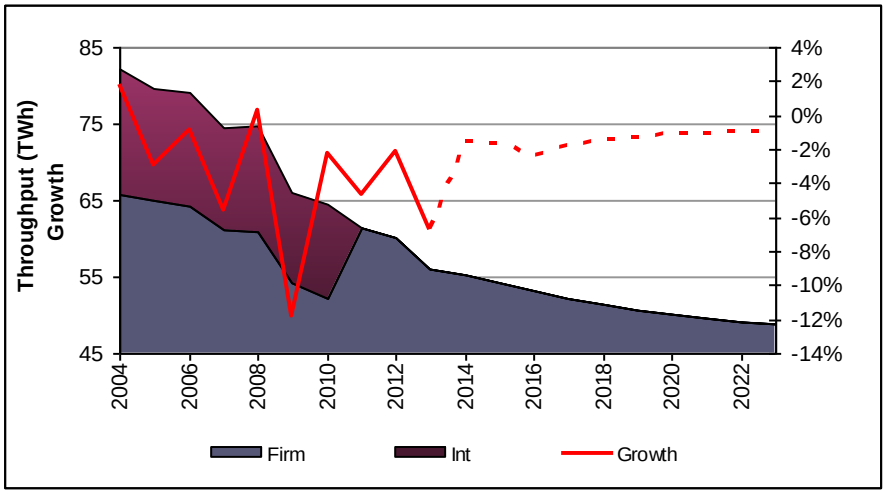


FIGURE 3.2C – North London LDZ Historical and Forecast Annual Gas Demand – EP2 SNCWV

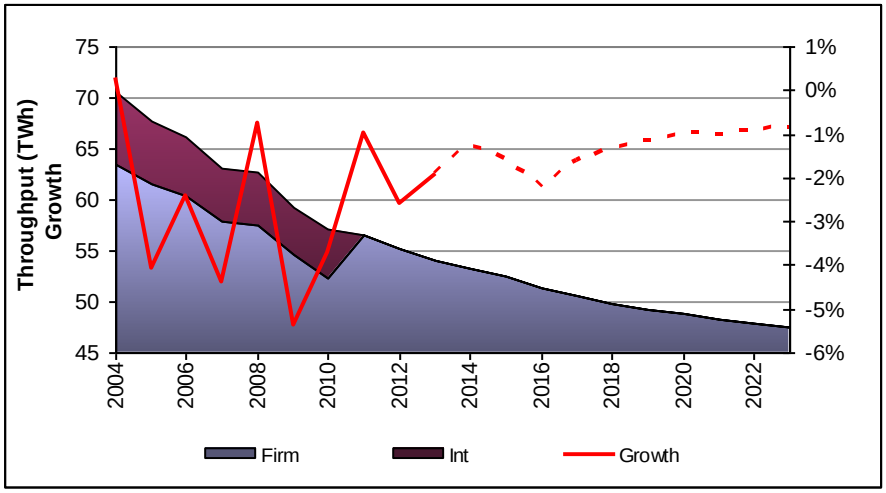


FIGURE 3.2D – North West LDZ Historical and Forecast Annual Gas Demand – EP2 SNCWV

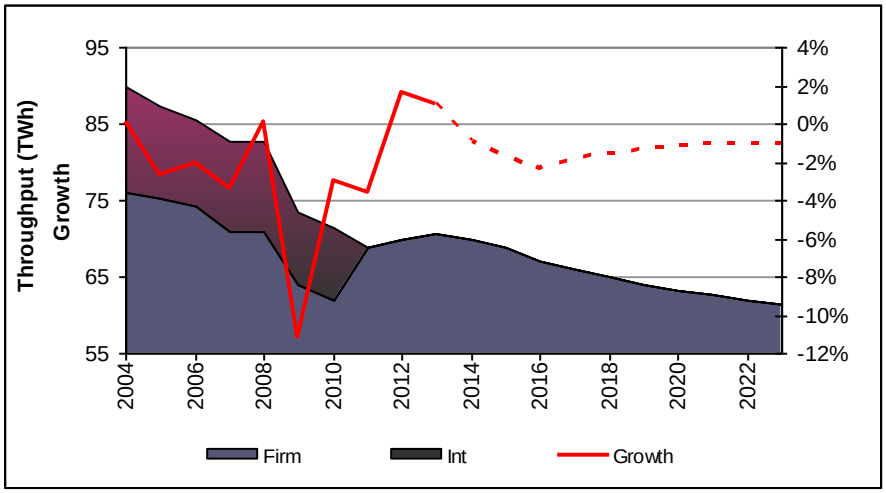


FIGURE 3.2E – West Midlands LDZ Historical and Forecast Annual Gas Demand – EP2 SNCWV

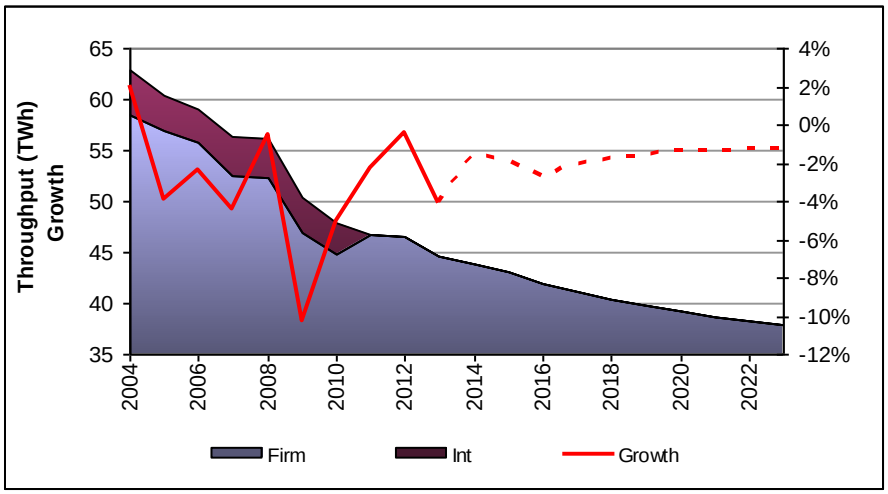
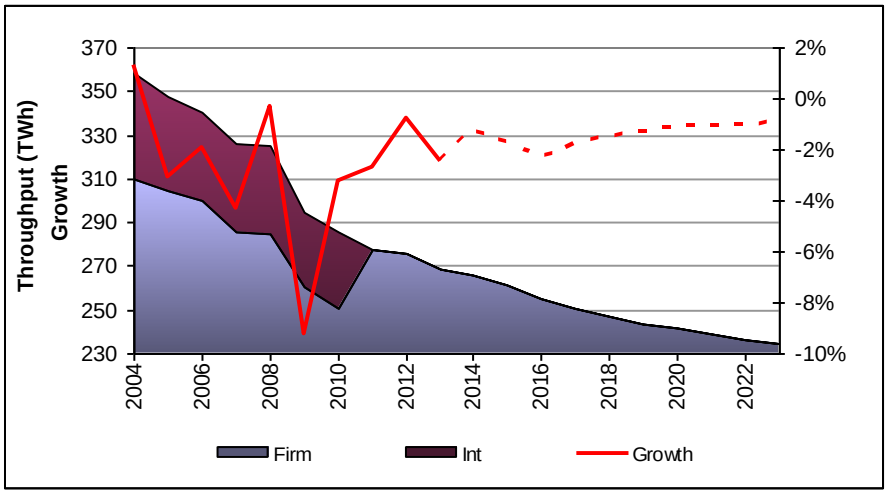


FIGURE 3.2F – Aggregate National Grid Gas LDZ Historical and Forecast Annual Gas Demand – EP2 SNCWV



Figures 3.2G to 3.2L show the equivalent view for peak demand.

FIGURE 3.2G – East Anglia LDZ Historical and Forecast 1 in 20 Peak Gas Demand

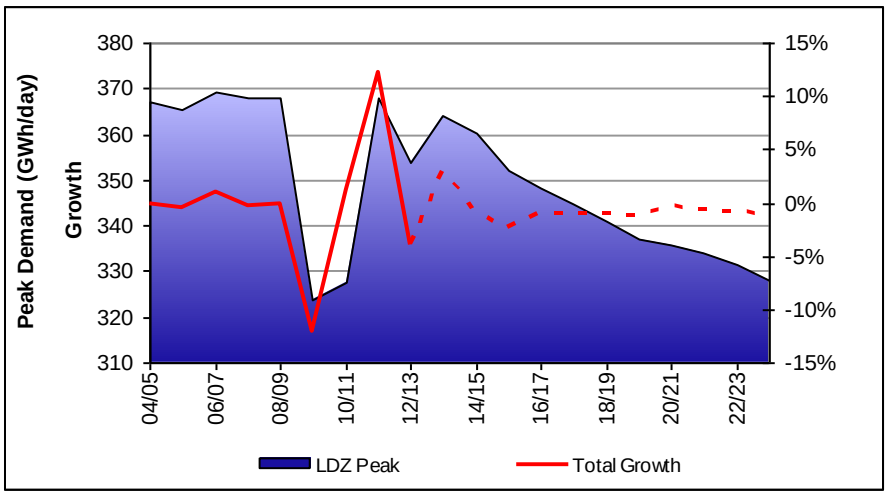


FIGURE 3.2H – East Midlands LDZ Historical and Forecast 1 in 20 Peak Gas Demand

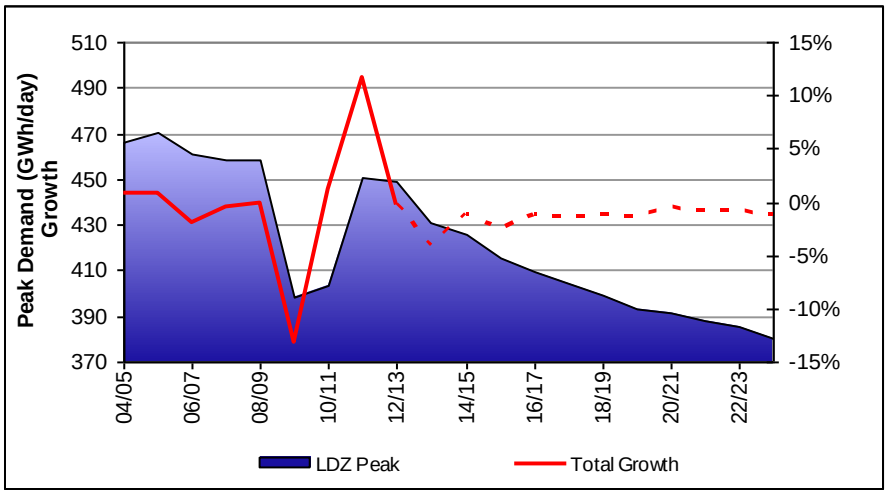


FIGURE 3.2I – North London LDZ Historical and Forecast 1 in 20 Peak Gas Demand

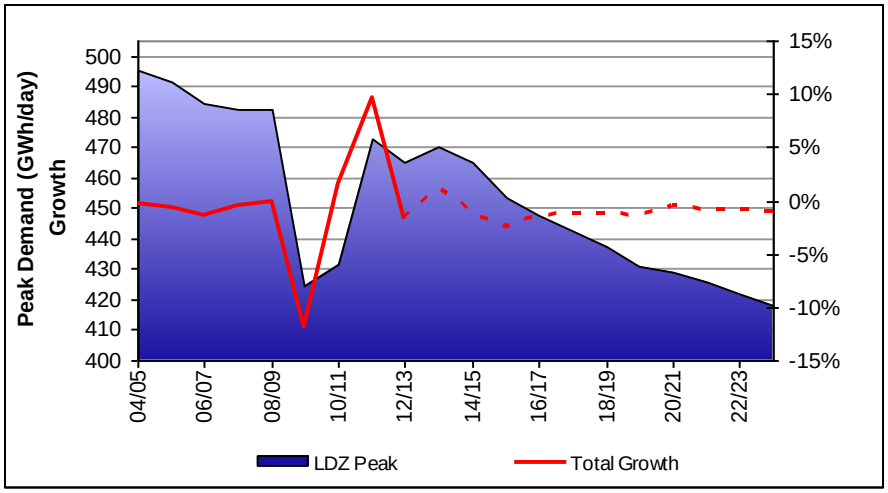


FIGURE 3.2J – North West LDZ Historical and Forecast 1 in 20 Peak Gas Demand

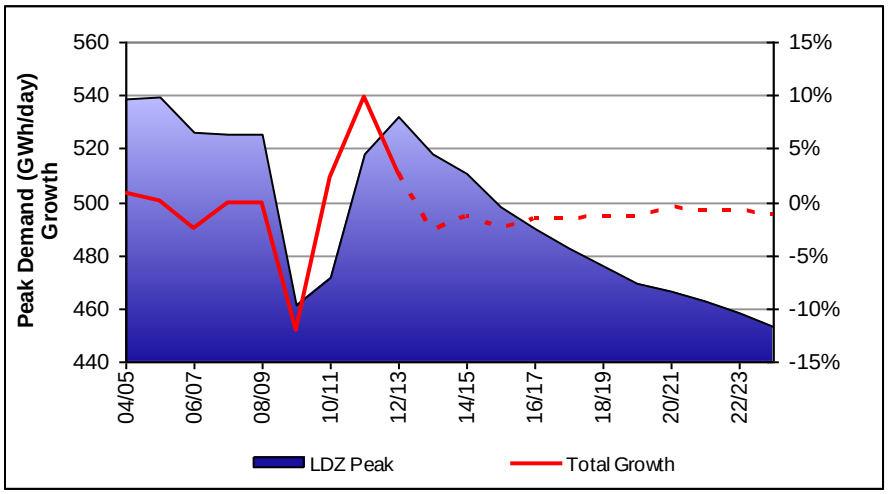


FIGURE 3.2K – West Midlands LDZ Historical and Forecast 1 in 20 Peak Gas Demand

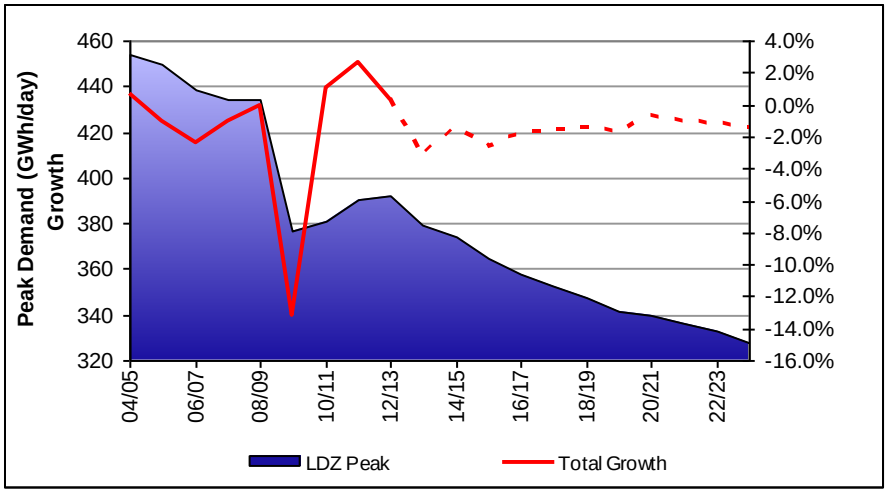
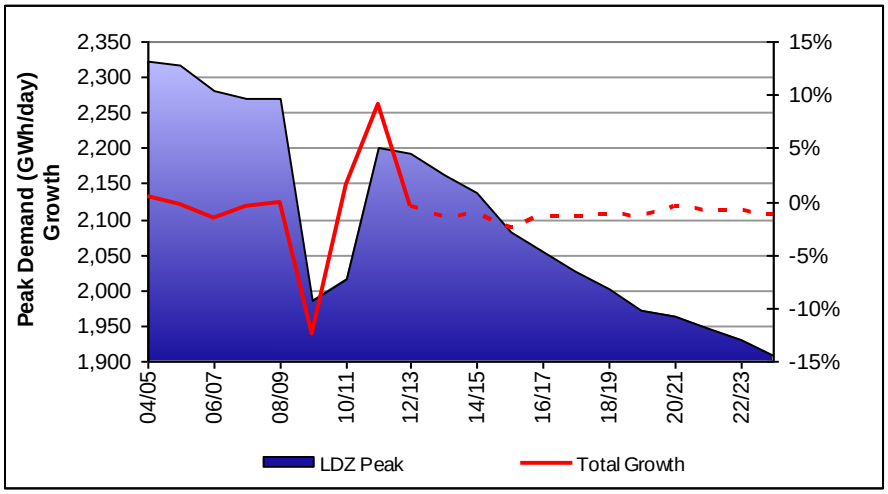


FIGURE 3.2L – Aggregate National Grid Gas LDZ Historical and Forecast 1 in 20 Peak Gas Demand



3.3 Forecast Comparisons

The following charts provide a comparison of the 2014 scenarios with those published in the 2013 Long Term Development Plan. The 2013 figure on the 2014 forecast curve is the actual throughput seen in 2013.

FIGURE 3.3A – Comparison of East Anglia LDZ Annual Demand Forecasts – EP2 SNCWV

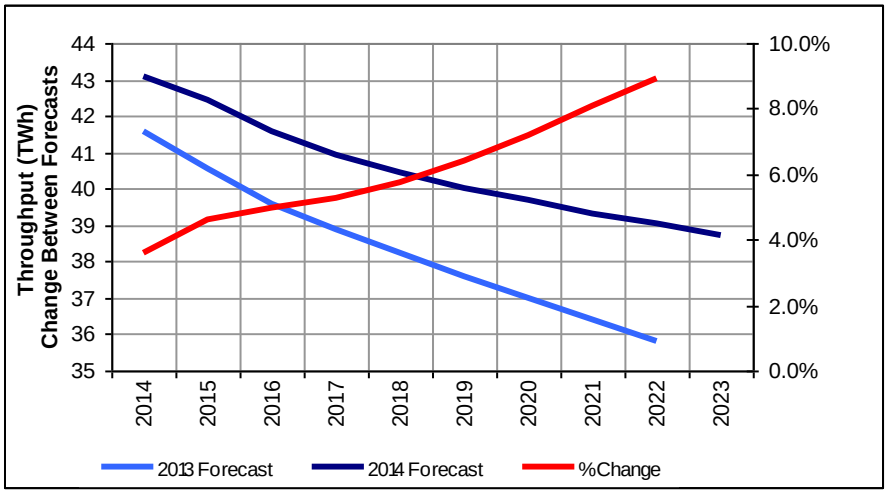


FIGURE 3.3B – Comparison of East Midlands LDZ Annual Demand Forecasts – EP2 SNCWV

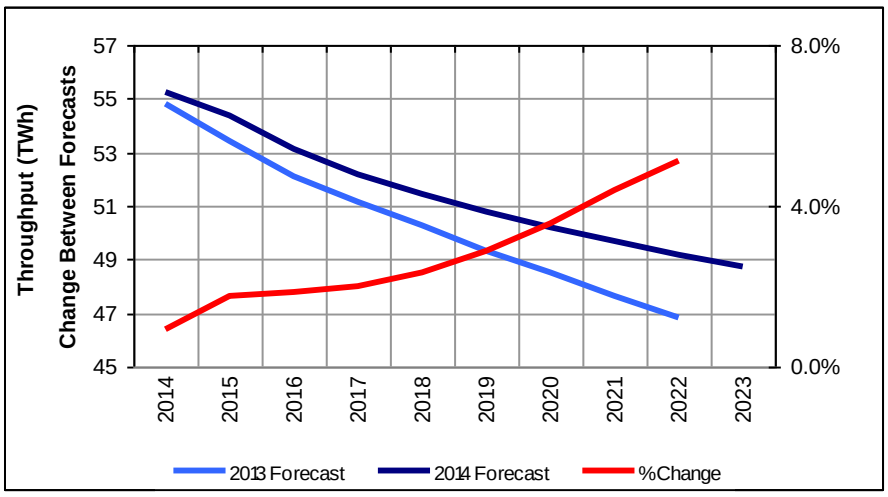


FIGURE 3.3C – Comparison of North London LDZ Annual Demand Forecasts – EP2 SNCWV

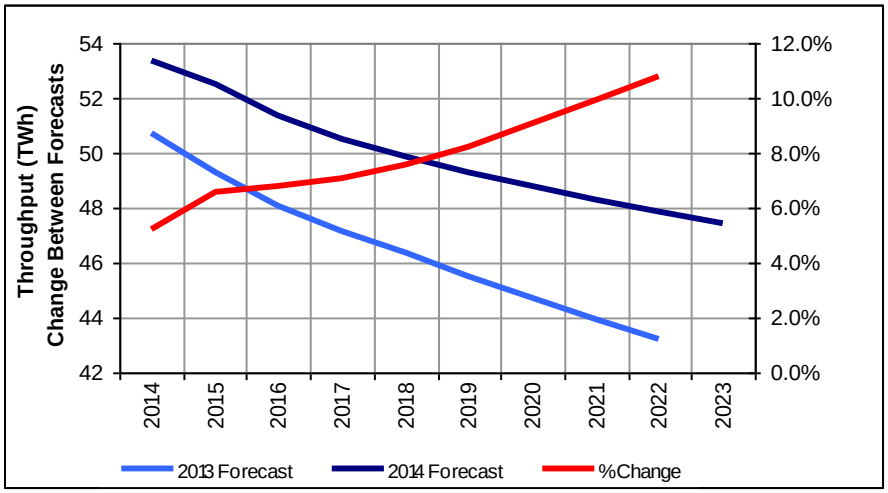


FIGURE 3.3D – Comparison of North West LDZ Annual Demand Forecasts – EP2 SNCWV

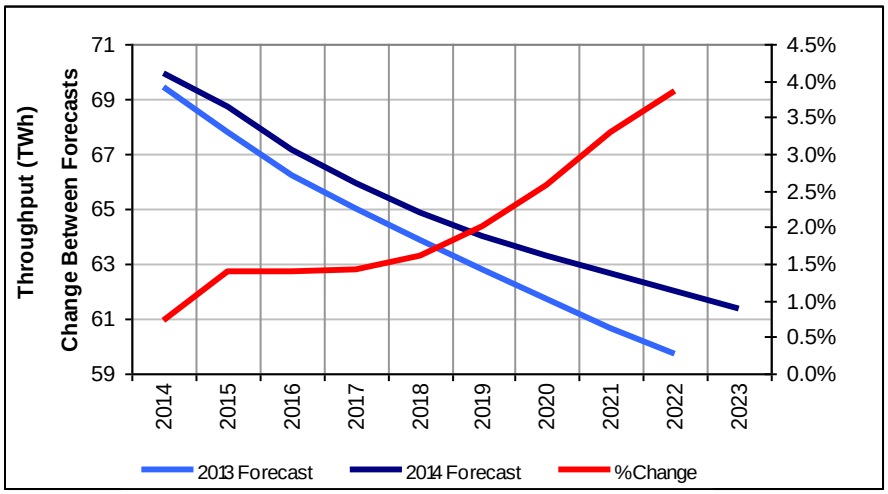


FIGURE 3.3E – Comparison of West Midlands LDZ Annual Demand Forecasts – EP2 SNCWV

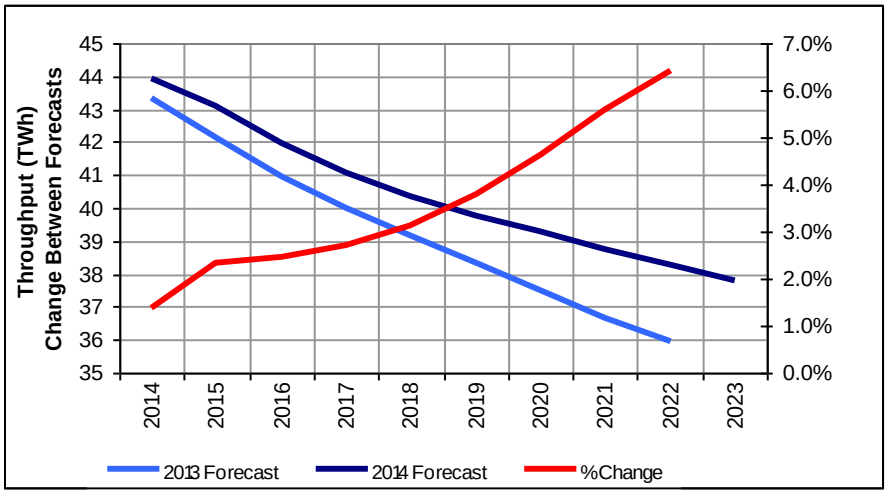
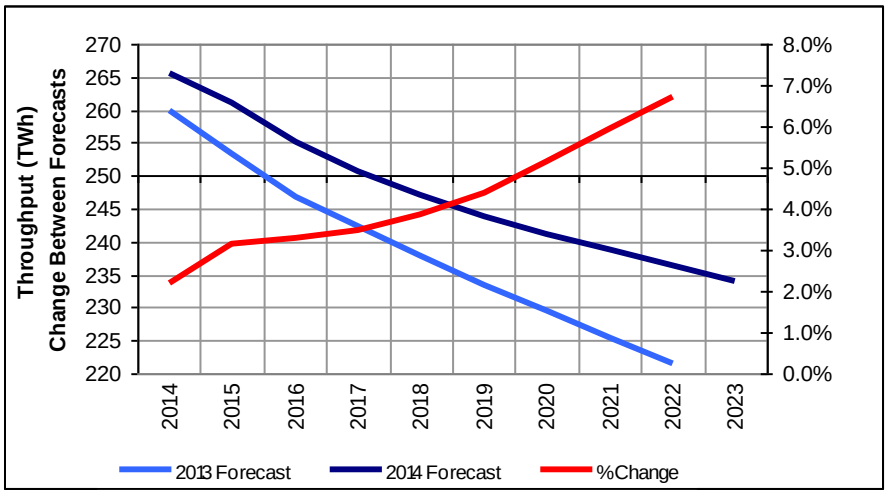


FIGURE 3.3F – Comparison of Aggregate National Grid Gas LDZ Annual Demand Forecasts – EP2 SNCWV



3.4 Forecast Accuracy

The following charts show the accuracy of the forecasts published 1 and 3 years ago for the 2014/15 gas year.

FIGURE 3.4A – Accuracy of 1 and 3 year ahead peak 1 in 20 demand forecasts

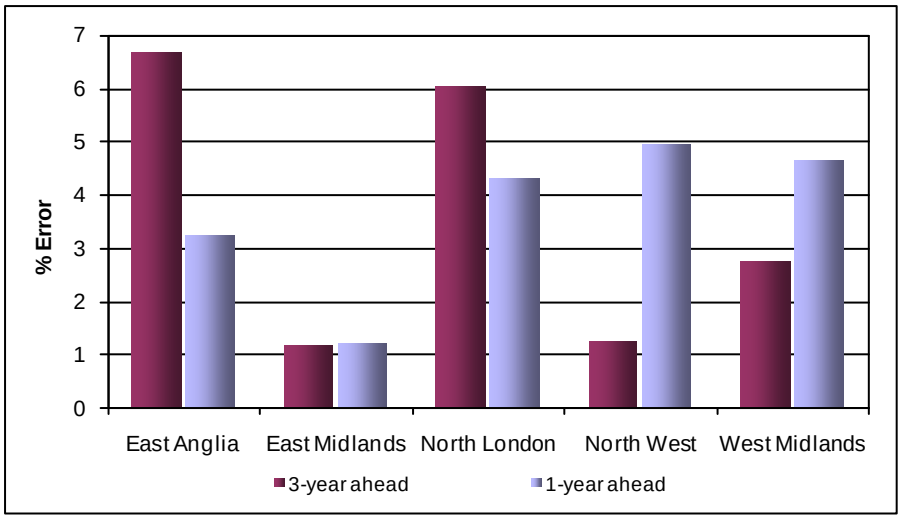


FIGURE 3.4B – Accuracy of 1 and 3 year ahead annual demand forecasts

Chapter Four

4. Capacity Provision and Capital Expenditure

4.1 Overview

The annual update of the supply and demand forecasts is a key building block in developing the investment plans of the National Grid Gas Distribution (UK) business.

Network models are analysed to ensure that the forecast demand levels can be transported in future years and, if not, work is carried out to identify the system reinforcement necessary to meet these demand levels. This reflects our Gas Transporters' Licence obligation to provide transportation capacity consistent with meeting 1 in 20 peak day demand (definition in the Glossary).

National Grid Gas' five gas distribution networks are supplied from the National Transmission System (NTS) via offtakes within the local distribution zones (LDZ's). Transportation and diurnal storage are provided by the high pressure (HP) distribution network, before the gas is cascaded down the intermediate (IP), medium (MP) and low pressure (LP) tiers. The majority of the customers are supplied from the below 7barg distribution network.

This chapter presents an overview of the currently sanctioned reinforcement projects and those that are presently under consideration for construction between 2014/15 and 2019/20.

Appendix 4 shows the current high pressure distribution network.

4.2 Investment Plans

4.2.1 Investment Planning Process

The aim of the investment planning process is to review gas demand and storage requirements in light of winter experience, updated gas demand and supply forecasts and other factors. This information is then used to identify the necessary investment to efficiently and effectively maintain the reliability of the network.

A high level summary of the investment requirements arising out of the latest planning cycle are summarized below.

4.2.2 Planned Investment

Table 4.2 indicates the *expected* level of net capital expenditure over the next 7 years, 2014/15 – 2020/21 (as per our RIIO business plan) split by the following categories:

- 'High Pressure Distribution System' relates to investment in maintaining and developing equipment that operates at pressures greater than 7barg. For example investment in a replacement pre-heater.
- 'Storage' relates to the investment on both low and high pressure storage installations.
- 'Reinforcement & Governors' relates to investment, both general and specific, that increases the capacity of below 7barg systems, typically by constructing new mains and governor installations.
- 'Connections' relates to the net cost to National Grid Gas of connecting new gas consumers, both domestic and non-domestic, to the gas supply network.
- 'Other Capex' relates to investments on lower pressures gas network assets such as Medium Pressure valves or Pressure Management and notably pressure elevation to avoid reinforcement.
- 'Replacement' relates to the money invested in replacing old metallic mains, metallic services and riser pipes in blocks of flats.

	Amount of investment[1] £m
Type of Investment	**2014/15 – 2020/21**
High Pressure Distribution System	149
Storage	0
Reinforcement & Governors	135
Connections	163
Other Capex	70
Replacement	2,857
Total	**3,374**

[1] The figures above are taken from the net 2009/10 constant cost base plan, which was submitted as part of our April 2012 RIIO submission. The figures represent our current investment proposals and the finalised numbers form part of Ofgem's Final Proposals in December 2012.

No capital investment in the provision of additional Entry Capacity is shown in this table. It is possible that significant investment in such capacity may be required depending upon the rate of development of new sources of gas and the requirement upon National Grid to fund such connections.

4.3 Development of High Pressure Distribution System

The high pressure distribution system is designed for transmission and diurnal storage on the basis of ensuring maintenance of the 1 in 20 peak day criterion. The system is developed, based on demand forecasts, to ensure that this capability is maintained. Significant distribution pipeline projects (greater than £0.5million) approved and under consideration are shown in table 4.3.1.

It should be noted that pipeline construction projects typically take three years to complete. The dates stated are the main year of construction activity and not necessarily the year of commissioning.

4.3.1 Approved Projects and Under Consideration 2014/15 to 2019/20

Year	***Project Name***	***Scope***	***LDZ***	***Status***
2014/15	*Holmes Chapel Offtake*	*PRS Rebuild Capacity*	*North West*	*Under Consideration*
2014/15	*Mickle Trafford*	*Specific Reinforcement*	*North West*	*In delivery*
2018/19	*Birchen Grove*	*PRS Rebuild Capacity*	*North London*	*Under Consideration*
2015/16	*Buttermilk Bridge*	*PRS Rebuild Capacity*	*North West*	*Under Consideration*
2015/16	*Wootton*	*PRS Rebuild Capacity*	*East Of England*	*Under Consideration*
2016/17	*Maltby*	*PRS Rebuild Capacity*	*East of England*	*Under Consideration*
2016/17	*Westfield (Site rebuild)*	*PRS Rebuild Capacity*	*East of England*	*Under Consideration*
2019/20	*Landywood*	*PRS Rebuild Capacity*	*West Midlands*	*Under Consideration*
2018/19	*Halesowen*	*PRS Rebuild Capacity*	*West Midlands*	*Under Consideration*

4.4 Development of Below 7barg Distribution System

The below 7barg system is constrained to operate between levels of pressure defined by statute, regulation and safe working practices. We continue to develop the below 7barg distribution system, investing in mains, services and associated plant to meet the needs of providing capacity to customers wishing to connect to our network and other Gas Transporters' requests for transportation services.

The below 7barg systems are designed to meet a peak six-minute (pk6) 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, assuming reasonable diversity of demand. National Grid Gas Distribution will continue to invest for reinforcement and new connections consistent with the growth in peak day demand forecast in this document.

National Grid Gas Distribution (UK) will also continue to invest in the replacement of existing transportation network assets, primarily the renewal of mains and services within Distribution

systems. This includes expenditure associated with the Enforcement Policy initiated by the HSE in line with the new tiered approach.

Significant below 7barg reinforcement projects (greater than £0.5million) are shown in table 4.4.1. (Replacement projects not shown).

4.4.1 Projects approved and under consideration 2014/15 to 2019/20

Year	***Project Name***	***Scope***	***LDZ***	***Status***
2014/15	*Unilever*	*Specific Reinforcement*	*East of England*	*In delivery*
2014/15	*HMP Stocken*	*Specific Reinforcement*	*East of England*	*In delivery*
2014/15	*Wembley*	*Specific Reinforcement*	*North London*	*In delivery*
2014/15	*Broad Street*	*General Reinforcement*	*West Midlands*	*In delivery*
2015/16	*Needham Market*	*Specific and General Reinforcement*	*East of England*	*Under Consideration*
2015/16	*Silverstone SCJ*	*Specific Reinforcement*	*East of England*	*Under Consideration*
2015/16	*Canonbury Square*	*District Governor (R6) Replacement*	*North London*	*Under Consideration*
2017/18	*Fulham PRS*	*General Reinforcement – linked to London Strategy*	*North London*	*Under Consideration*
2016/17	*Battersea PRS*	*General Reinforcement – linked to London Strategy*	*North London*	*Under Consideration*
2017/18	*Fulham to Battersea Reinforcement*	*General Reinforcement – linked to London Strategy*	*North London*	*Under Consideration*
2019/20	*Leamouth to Bow Reinforcement*	*General Reinforcement – linked to London Strategy*	*North London*	*Under Consideration*
2019/20	*Bow Common PRS*	*General Reinforcement – linked to London Strategy*	*North London*	*Under Consideration*
2019/20	*Leamouth PRS*	*General Reinforcement – linked to London Strategy*	*North London*	*Under Consideration*

Chapter Five

5. Commercial Developments

5.1 Exit Capacity

The industry arrangements contained within the Uniform Network Code (UNC) have been undergoing significant change over recent years. The latest information relating to these can be found on the Ofgem website: http://www.ofgem.gov.uk/.

The NTS Exit Capacity Regime came into effect in October 2012. Our process for booking capacity now reflects:

- User Commitment means that Distribution Newtorks and other NTS direct-connects (e.g. power stations) book and pay for NTS Exit Capacity. All of the capacity that we require was booked within the UNC window that closed at the end of July.
- Long Term, Medium Term and Daily capacity products are available and our booking process makes use of all of these.
- We are also able to make use of agreed industry processes to manage our use of capacity and transfer capacity between off-take points if necessary.
- There are Long Term, Medium Term and Daily Release of NTS Offtake (Flow Flexibility) Capacity which form an integral part of our operating strategy and we no longer rely on local low pressure storage to manage our response to the daily demand profile.
- Our operating strategies are reflected in the Off-take Profile Notifications that we send to NTS in accordance with the new regime.
- These are managed in our new operating system “Cosmos” which also provides a range of tools to support the delivery of our operating strategies.

In the last 12 months three modifications have been implemented which has changed the arrangements regarding daily balancing and the daily capacity products available.

- Modification 0407 - Standardisation of notice periods for offtake rate changes for all National Grid NTS Exit Users. This has amended the rules regarding requesting a waiver to the existing rules regarding the submission of Offtake Profile Notices and provides greater clarity around when the rules are applied.

- Modification 0443S - Arranging Flow Swaps between NTS/LDZ Offtakes with increased lead times or for prolonged periods. This has created an additional daily capacity product that can be purchased (neutral cost) in the event that an Offtake is unavailable for a prolonged period. This product will be used to mitigate any capacity overrun risks that might otherwise arise from the Offtake Constraint.

- Modification 0461 - Changing the UNC Gas Day to align with the Gas Day in EU Network Codes. This changes the Gas Day to start from 05:00 with effect from 01st October 2015. This has an impact throughout the DNCC processes and systems.

A number of modifications to the UNC to support effective operation of the Exit Capacity arrangements across the industry are currently under review that may result in respective changes being implemented in the near future.

5.2 DN Interruption

As of 1st October 2014 we have two Interruption contracts in place; one in East Anglia and one in North West.

Chapter Six

6. Gas Entry

Overview

In addition to gas from the National Transmission System, gas can now enter the system from local gas producers enabling the introduction of renewable sources of gas into the system.

Biologically derived renewable gas is now flowing to consumers. Renewable Gas, also known as Bio-methane is pipeline quality gas derived from biomass that is fully interchangeable with natural gas. Bio-methane can be produced from organic waste and injected into the gas grid and will therefore contribute to decarbonising energy supplies for heat. During the past twelve months we have delivered three connections and we have a further eight scheduled for the forthcoming year. Connections to inject Bio-methane can now be facilitated from medium pressure upwards and sourced from various renewable stock.

Bio-methane is a viable commercial option for producers that can make a significant contribution in delivering the UK's energy needs and in doing so it makes a positive contribution to meeting governments climate change targets.

Renewable Gas enters our Network through a 'Delivery Facility' located downstream of where the biogas is produced.

This is a picture of the Bio-methane facility that was connected to the National Grid Gas Distribution system at Lindholme, Doncaster in October 2013.

The Delivery Facility is connected by a pipeline known as the 'Connection Pipe' to our existing pipe network.

The Gas Safety Management Regulations define the specification that gas has to meet in order to enter our Network. (For your information we have reproduced the gas specification in Appendix 5.3).

To ensure that we are complying with these regulations we carry out gas composition measurements. Should the gas fall outside these specified parameters the facility can be isolated by the use of a remotely operated valve. We also measure the volume and energy content of the gas entering our Network utilising a Volume flow meter to measure the calorific value. The calorific value of natural gas is measured continually at reception terminals on the National Grid pipeline system using process gas chromatographs. The calorific value has to be in a prescribed range which may mean that biogas producers have to enrich the gas with propane under certain circumstances. Additionally GS(M)R stipulates that gas must be Odorised before it enters the Network. This characteristic smell is added to maintain the safety of the public and this process is carried out at the Delivery Facility.

The connection point to our existing Network will be determined by the volume of gas the producer requires to input, as we need to ensure that there will be enough local gas demand in the area where the connection is being made. In circumstances where local Offpeak demand is insufficient, a connection to an alternative part of our system perhaps further away will be required.

As the Bio-methane market is an emerging one we continue to seek new ways to facilitate renewable gas injection from alternative sources. We have commissioned a new project via our Network Innovation Allowance (NIA) to trial a new 19barg connection where injection will be via utilising reinforced thermo-plastic pipe technology whilst other innovation funds will be used to research potential barriers of entry.

Contact Damien Hawke, our Network Design Manager if you want to learn more about putting gas into our Distribution pipes. His contact details are:

Damien Hawke
Network Design Manager
Network Strategy
National Grid
Block 4, Area 3 - Hinckley Operational Centre
Brick Kiln Street
Hinckley
Leicestershire
LE10 0NA

Chapter Seven

7. Innovation

Overview

This LTDP has been published under our second year of operation within our new regulatory framework known as RIIO which replaced RPI-X. RIIO stands for:

Revenue= Incentives + Innovation + Outputs

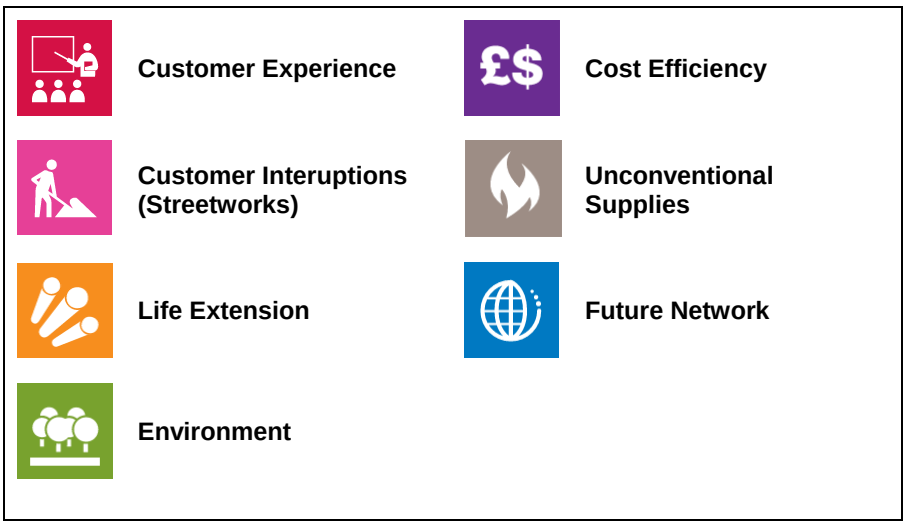
The RIIO model applies from 2013/14 to 2020/21 and offers network companies real incentives for securing investment and driving innovation. This is to ensure the delivery of sustainable energy networks for current and future customers at the lowest cost.

7.1 Innovation approach

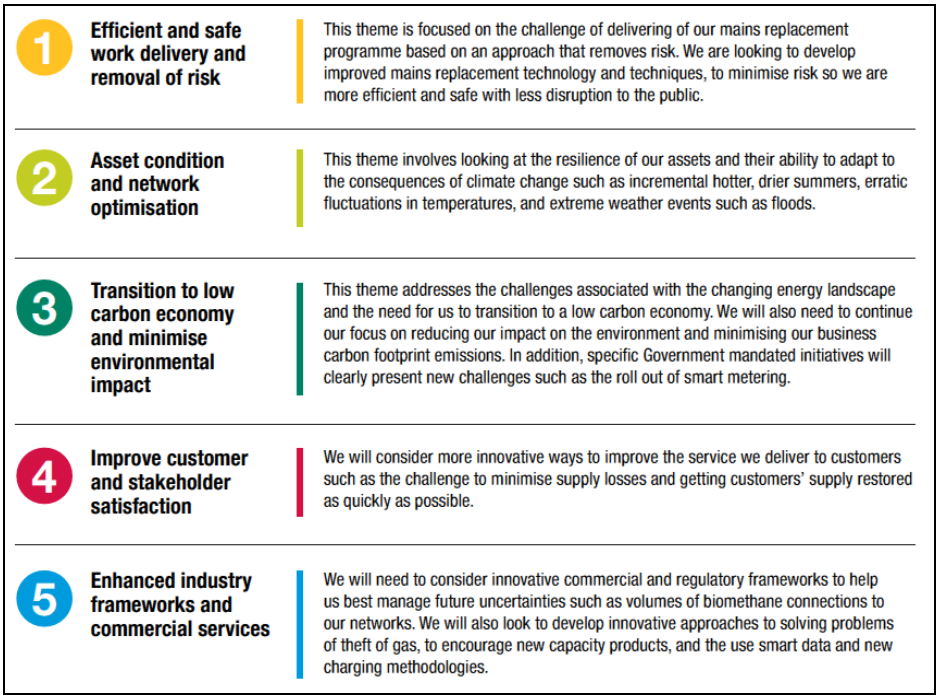
As one of the "I"s in RIIO, innovation has an essential role to play in all of activities as such, our approach is to embed a culture of innovation in everything we do and we aim to continuously improve our business, through both technical and commercial innovation. This helps us develop our knowledge to provide a safe, efficient and reliable network which delivers value to our customers and safeguards our environment.

We continue to seek innovative solutions to both operational and asset management challenges whilst advancing research into longer term strategic opportunities aligned to National Grid's company vision. We also leverage third party innovation, share experience and knowledge and actively collaborate with external organisations including other network operators.

We have identified seven main objectives where we seek innovative solutions, as detailed below:



In developing our approach to innovation we have consulted widely with our Stakeholders who provided us with some invaluable insights into where we should focus our efforts in light of the challenges we face. Stakeholders told us that Innovation would be vital to meet these challenges, that our innovation themes are "sensible and wide ranging" although specifically asked to be open and transparent around our innovation activities. The following figure details our innovation themes for RIIO-GD1.



The themes take into account the main challenges that we will face during RIIO-GD1 such as the changing energy landscape and the continued requirement to minimise the impact we have on the environment as a result of our operations.

7.2 Further Information

Specific information on our innovation projects, along with our Annual Summary, can be accessed through the ENA Smarter Networks Portal (www.smarternetworks.org). If you want to learn more about our innovation activities please contact Darren White, our Innovation Project Manager. His contact details are:

Darren White
Project Manager (Innovation)
Network Innovation and Investment Strategy
National Grid
Block 4, Area 3 - Hinckley Operational Centre
Brick Kiln Street
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Appendix One

A1 Process Methodology

A1.1 Demand

Our gas demand forecasts are currently developed using the methodology set out in the 2013 UK Future Energy Scenarios Document produced by National Grid Transmission (NTS) (published on 18th July 2013) but with slightly different input assumptions to the scenarios presented in the document. For more information on this methodology please see the Gas Demand Forecasting Methodology document on the National Grid website.

The development of annual gas demand forecasts considers a wide range of factors from complex econometrics and scenario axioms to an assessment of individual load enquiries. For any forecasting process a set of planning assumptions is required which, if necessary, can be flexed to create alternative scenarios. For the forecasts presented in this document these assumptions cover areas including, but not restricted to, the economy, fuel prices, environmental considerations and government policies. A number of these assumptions are based on data from independent organisations and our forecasts are also benchmarked against the work of a number of recognised external sources.

A1.1.1 LDZ Modelling

LDZ demand is split into market sectors according to load size and supply type (i.e. daily or non daily metered). For each sector models have been developed that make allowance for economic conditions, local demand intelligence, new large load enquiries, relative fuel prices, potential new markets and other factors, such as government policy, that could affect future growth in demand. By adopting this approach we are able to take account of varying economic conditions and specific large loads within different LDZ's.

A1.1.2 Demand/Weather Modelling

Due to the temperature sensitivity of LDZ markets, forecasts of annual demand are based upon an assumed average weather condition to allow underlying year-on-year changes to be identified. The related demand models developed for overall LDZ demand and a number of sub-LDZ load categories, are based on factors known as Composite Weather Variables (CWVs). The CWVs are derived mainly from temperature and wind speed data which is defined and optimised for each LDZ and so gives a predominately straight-line relationship between demand and weather.

The annual demand forecasts have been calculated using EP2 SNCWVs. These SNCWVs are calculated from the climate warming data for 2013/14 forecast by the Met Office for the energy industry. This has had no impact on the 1 in 20 peak day demands or the 1 in 50 severe load duration curves which continue to be calculated, as per the relevant statutory and license obligations, from a longer period of weather data, in this case 1928/29 to 2013/14.

A1.1.3 Peak Day Demand Modeling

Once the annual demand forecasts and daily demand/weather models have been developed a simulation methodology is employed using historical weather data for each LDZ to determine the peak day (in accordance with statutory/License obligations) and severe winter

demand estimates. This process is detailed in the forecasting methodology document referred to at the beginning of this chapter.

A1.2 High Pressure Distribution Planning

Although the development of the HP Distribution Systems is largely demand led, the capacity planning processes are not dissimilar to those utilised for the development of the NTS. Forecast demands are used 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 High Pressure Distribution capacity constraints include:

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

As well as planning to ensure that High Pressure Distribution 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 may consist of gas held in linepack, low-pressure gasholders or high-pressure vessels.

A1.3 Below 7barg Distribution Planning

The lower pressure below 7barg 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, costed, and programmed for completion. Reinforcement is usually carried out by installing a new main, pressure elevation within the pressure tier, or by taking a new Offtake point from a higher-pressure tier.

A1.4 Investment Procedures and Project Management

All investment projects must comply with our Investment and Disposals Guidelines, which set out the broad principles that should be followed when evaluating high value investment or divestment projects. Proposals should reflect the drive for efficiency, safety and the environmental benefits that form the core of our asset management framework.

The investment guidelines define the methodology to be followed for undertaking individual investments in a consistent and easy to understand manner. Together with the planning and budgeting methodology, they are used to ensure maximum value is obtained. For non-mandatory projects, the key investment focus in the majority of cases is to undertake only those projects that carry an economic benefit. For mandatory projects, such as safety-related work, the focus is on minimising the net present cost whilst not undermining the project objectives or the safety or reliability of the network. The successful management of major

investment projects is central to our business objectives. Our project management strategy involves:

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

When a major investment project is approved, a multi-discipline team prepares an Invitation to Tender in accordance with the EC Utilities Directive. For major projects, specialist consultants with experience of preparing and evaluating tender documents are used.

Tenders are received and evaluated against previously agreed technical, quality, safety, financial and programme criteria. An award is then made to the most economically advantageous tender consistent with these criteria.

The successful contractor completes the project in accordance with an agreed programme of works. We manage the project, but on some major projects we utilise project services support from specialist contractors and professional consultants, all of whom are appointed subject to competitive tender. We also manage the funding of the project by careful financial monitoring and cost control. It remains the contractor's responsibility to directly manage and supervise the works. Following completion, a Post Completion Review is carried out to provide feedback to management on project performance and to improve future decision making processes.

Our project management of major investment projects is designed to ensure that they are delivered on time, to the appropriate quality standards, at minimum cost.

Appendix Two

A2. Gas Demand & Supply Volume Forecasts

A2.1 Demand (figures are based upon scenario S1)

TABLE A2.1A – East Anglia LDZ Forecast Annual Demand – Split by Load Categories (TWh)

Load Category	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
0 to 73 MWh	27.7	27.4	27.0	26.7	26.5	26.4	26.2	26.1	26.0	25.9
73 to 732 MWh	3.6	3.5	3.5	3.5	3.4	3.4	3.4	3.4	3.4	3.4
NDM >732 MWh	4.8	4.6	4.3	4.1	4.0	3.8	3.7	3.6	3.4	3.3
Total NDM	36.0	35.5	34.8	34.3	33.9	33.6	33.3	33.1	32.8	32.6
Total DM	6.8	6.7	6.5	6.4	6.3	6.2	6.2	6.1	6.0	5.9
Total LDZ	42.9	42.2	41.3	40.7	40.2	39.8	39.5	39.1	38.9	38.6
Shrinkage	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
Total Demand (Throughput)	43.1	42.4	41.6	40.9	40.4	40.0	39.7	39.3	39.0	38.7

Gas Supply Year	13/14	14/15	15/16	16/17	17/18	18/19	19/20	20/21	21/22	22/23	23/24
Total Demand (Throughput)	43.2	42.7	41.9	41.0	40.6	40.1	39.8	39.4	39.1	38.9	38.6

Notes

- Volumes are based on weather data from the EP2 standard.
- Figures may not sum exactly due to rounding.

FIGURE A2.1A – East Anglia LDZ Forecast Annual Demand – Split by Load Categories (TWh)

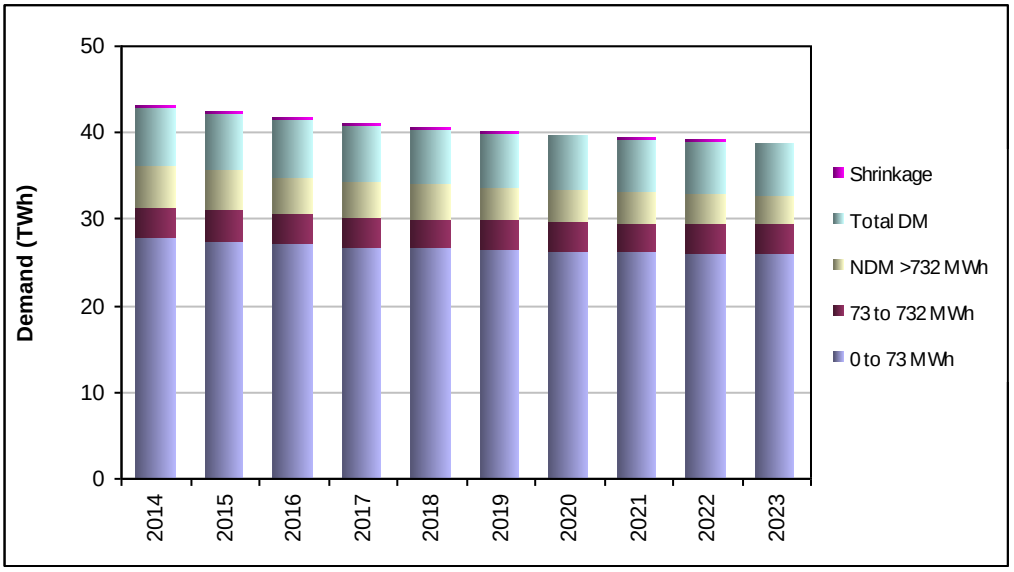


TABLE A2.1B – East Midlands LDZ Forecast Annual Demand – Split by Load Categories (TWh)

Load Category	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
0 to 73 MWh	33.3	32.9	32.4	32.0	31.7	31.5	31.2	31.1	30.9	30.7
73 to 732 MWh	4.2	4.2	4.1	4.0	4.0	4.0	4.0	3.9	3.9	3.9
NDM >732 MWh	7.1	6.8	6.4	6.1	5.8	5.6	5.4	5.2	5.0	4.8
Total NDM	44.6	43.9	42.8	42.1	41.5	41.0	40.6	40.2	39.8	39.5
Total DM	10.4	10.2	10.0	9.8	9.6	9.5	9.4	9.3	9.2	9.1
Total LDZ	55.0	54.1	52.8	51.9	51.2	50.5	50.0	49.5	49.0	48.5
Shrinkage	0.3	0.3	0.3	0.2	0.2	0.2	0.2	0.2	0.2	0.2
Total Demand (Throughput)	55.3	54.4	53.1	52.2	51.4	50.8	50.2	49.7	49.2	48.7

Gas Supply Year	13/14	14/15	15/16	16/17	17/18	18/19	19/20	20/21	21/22	22/23	23/24
Total Demand (Throughput)	55.4	54.7	53.5	52.3	51.6	50.9	50.4	49.8	49.4	48.9	48.5

Notes

- Volumes are based on weather data from the EP2 standard.
- Figures may not sum exactly due to rounding.

FIGURE A2.1B – East Midlands LDZ Forecast Annual Demand – Split by Load Categories (TWh)

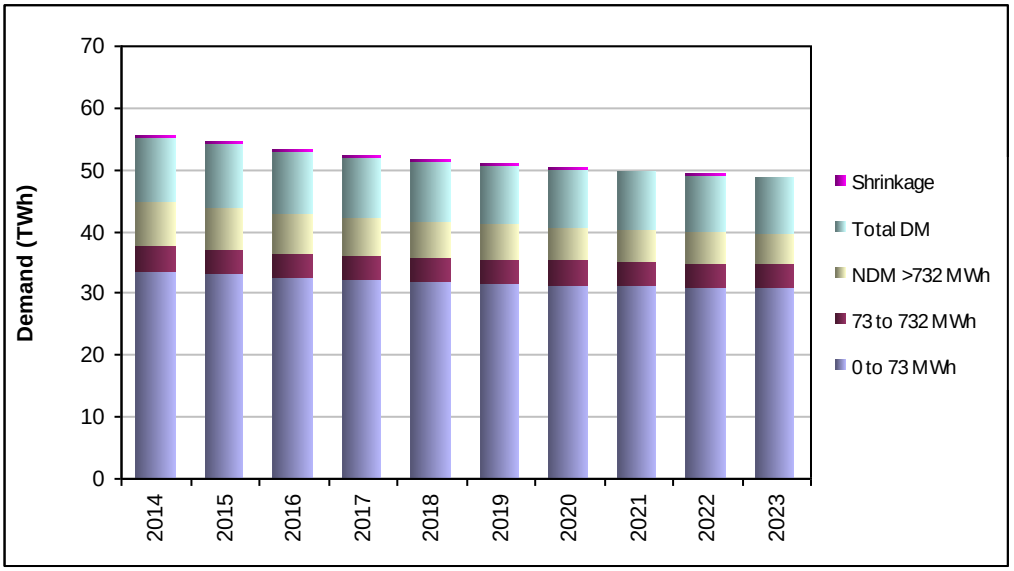


TABLE A2.1C – North London LDZ Forecast Annual Demand – Split by Load Categories (TWh)

Load Category	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
0 to 73 MWh	35.0	34.6	34.0	33.7	33.4	33.2	33.0	32.8	32.6	32.5
73 to 732 MWh	6.1	6.1	6.0	6.0	6.0	6.0	6.0	5.9	5.9	6.0
NDM >732 MWh	8.7	8.4	7.9	7.5	7.2	6.9	6.7	6.4	6.2	5.9
Total NDM	49.8	49.0	47.9	47.2	46.6	46.0	45.6	45.2	44.8	44.4
Total DM	3.3	3.3	3.2	3.1	3.0	3.0	3.0	2.9	2.9	2.8
Total LDZ	53.1	52.3	51.1	50.3	49.6	49.0	48.6	48.1	47.6	47.2
Shrinkage	0.3	0.3	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
Total Demand (Throughput)	53.4	52.5	51.3	50.5	49.8	49.3	48.8	48.3	47.8	47.4

Gas Supply Year	13/14	14/15	15/16	16/17	17/18	18/19	19/20	20/21	21/22	22/23	23/24
Total Demand (Throughput)	53.6	52.8	51.8	50.7	50.0	49.4	49.0	48.4	48.0	47.5	47.3

Notes

- Volumes are based on weather data from the EP2 standard.
- Figures may not sum exactly due to rounding.

FIGURE A2.1C – North London LDZ Forecast Annual Demand – Split by Load Categories (TWh)

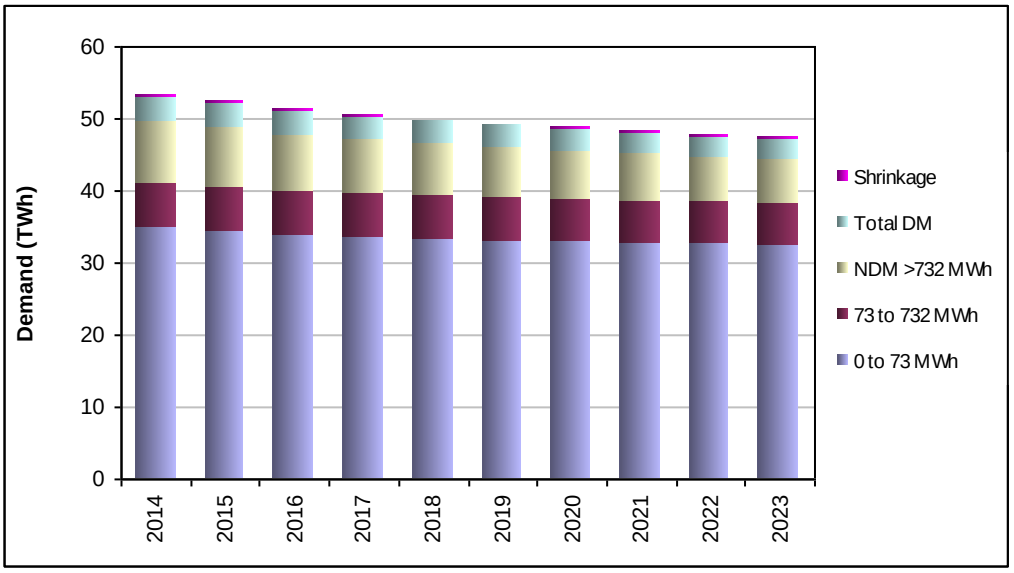


TABLE A2.1D – North West LDZ Forecast Annual Demand – Split by Load Categories (TWh)

Load Category	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
0 to 73 MWh	39.6	39.1	38.4	37.9	37.6	37.2	36.9	36.7	36.5	36.3
73 to 732 MWh	5.3	5.2	5.1	5.0	5.0	4.9	4.9	4.9	4.8	4.8
NDM >732 MWh	8.4	8.0	7.5	7.1	6.8	6.5	6.3	6.1	5.8	5.6
Total NDM	53.3	52.3	51.0	50.1	49.3	48.7	48.1	47.6	47.1	46.7
Total DM	16.3	16.1	15.7	15.5	15.2	15.1	14.9	14.7	14.6	14.4
Total LDZ	69.6	68.4	66.8	65.6	64.6	63.7	63.0	62.4	61.7	61.1
Shrinkage	0.4	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3
Total Demand (Throughput)	70.0	68.7	67.1	65.9	64.9	64.0	63.3	62.6	62.0	61.4

Gas Supply Year	13/14	14/15	15/16	16/17	17/18	18/19	19/20	20/21	21/22	22/23	23/24
Total Demand (Throughput)	70.2	69.2	67.7	66.1	65.2	64.3	63.6	62.8	62.2	61.6	61.1

Notes

- Volumes are based on weather data from the EP2 standard.
- Figures may not sum exactly due to rounding.

FIGURE A2.1D – North West LDZ Forecast Annual Demand – Split by Load Categories (TWh)

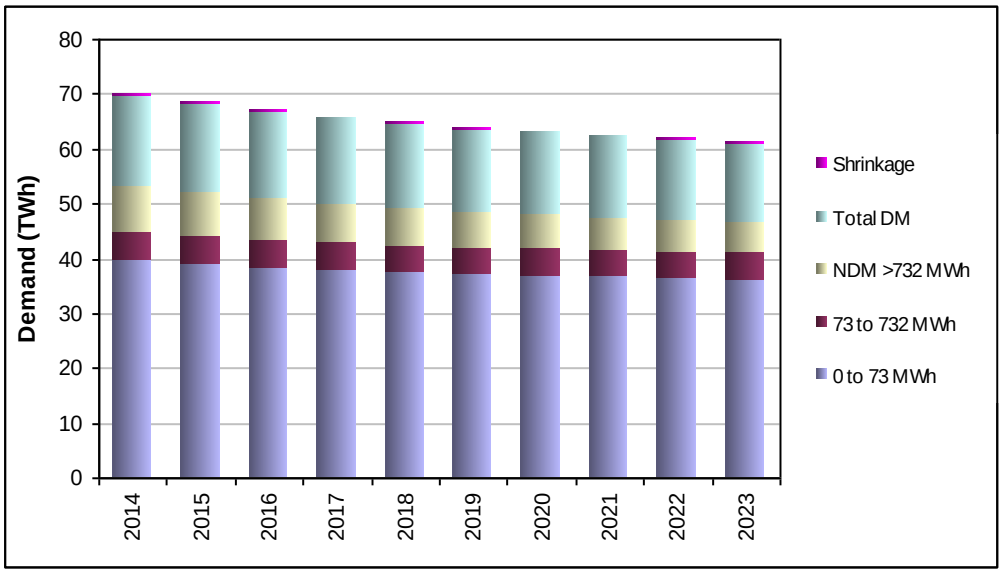


TABLE A2.1E – West Midlands LDZ Forecast Annual Demand – Split by Load Categories (TWh)

Load Category	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
0 to 73 MWh	28.6	28.3	27.8	27.5	27.2	27.0	26.7	26.6	26.4	26.3
73 to 732 MWh	4.0	4.0	3.9	3.9	3.8	3.8	3.8	3.7	3.7	3.7
NDM >732 MWh	6.6	6.4	6.0	5.7	5.4	5.2	5.0	4.8	4.6	4.4
Total NDM	39.3	38.6	37.7	37.0	36.4	35.9	35.5	35.1	34.7	34.4
Total DM	4.3	4.2	4.0	3.8	3.7	3.6	3.5	3.4	3.3	3.2
Total LDZ	43.6	42.8	41.7	40.8	40.1	39.5	39.0	38.5	38.0	37.6
Shrinkage	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.2
Total Demand (Throughput)	43.9	43.1	41.9	41.1	40.4	39.8	39.3	38.7	38.3	37.8

Gas Supply Year	13/14	14/15	15/16	16/17	17/18	18/19	19/20	20/21	21/22	22/23	23/24
Total Demand (Throughput)	44.1	43.4	42.3	41.2	40.6	40.0	39.5	38.8	38.4	37.9	37.5

Notes

- Volumes are based on weather data from the EP2 standard.
- Figures may not sum exactly due to rounding.

FIGURE A2.1E – West Midlands LDZ Forecast Annual Demand – Split by Load Categories (TWh)

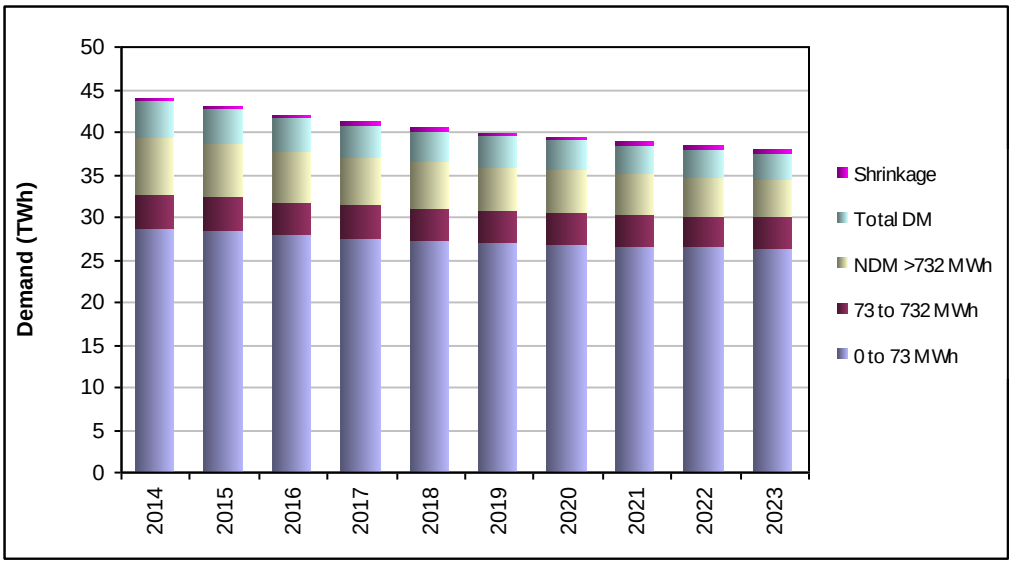


TABLE A2.1F – Aggregate National Grid Gas LDZs Forecast Annual Demand – Split by Load Categories (TWh)

Load Category	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
0 to 73 MWh	164.2	162.3	159.6	157.8	156.4	155.1	154.1	153.3	152.5	151.7
73 to 732 MWh	23.2	23.0	22.6	22.4	22.2	22.1	22.0	21.8	21.7	21.8
NDM >732 MWh	35.6	34.1	32.1	30.5	29.1	28.0	27.0	26.0	25.1	24.1
Total NDM	223.0	219.3	214.3	210.7	207.8	205.2	203.2	201.1	199.3	197.6
Total DM	41.2	40.5	39.4	38.6	37.9	37.4	36.9	36.4	35.9	35.4
Total LDZ	264.2	259.8	253.7	249.3	245.7	242.6	240.1	237.5	235.2	233.0
Shrinkage	1.4	1.4	1.3	1.3	1.3	1.2	1.2	1.2	1.1	1.1
Total Demand (Throughput)	265.6	261.2	255.0	250.6	247.0	243.8	241.3	238.7	236.4	234.1

Gas Supply Year	13/14	14/15	15/16	16/17	17/18	18/19	19/20	20/21	21/22	22/23	23/24
Total Demand (Throughput)	266.5	262.9	257.1	251.4	248.0	244.7	242.3	239.1	237.1	234.7	233.0

Notes

- Volumes are based on weather data from the EP2 standard.
- Figures may not sum exactly due to rounding.

FIGURE A2.1F – Aggregate National Grid Gas LDZs Forecast Annual Demand – Split by Load Categories (TWh)

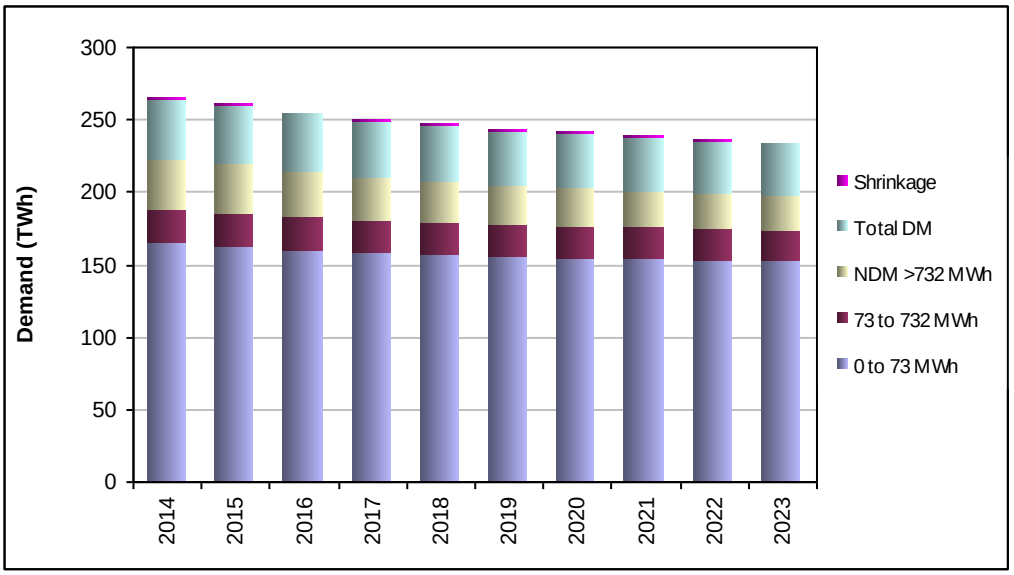


TABLE A2.1G - Forecast LDZ Annual Demands – Split by Supply Type (TWh) EP2

LDZ	Load Category	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
EA	Firm	43	43	42	42	41	40	40	40	39	39
	Int	0	0	0	0	0	0	0	0	0	0
	Total	43	43	42	42	41	40	40	40	39	39
EM	Firm	56	55	54	53	52	51	51	50	50	49
	Int	0	0	0	0	0	0	0	0	0	0
	Total	56	55	54	53	52	51	51	50	50	49
NL	Firm	54	53	53	51	51	50	49	49	48	48
	Int	0	0	0	0	0	0	0	0	0	0
	Total	54	53	53	51	51	50	49	49	48	48
NW	Firm	71	70	69	67	66	65	64	63	63	62
	Int	0	0	0	0	0	0	0	0	0	0
	Total	71	70	69	67	66	65	64	63	63	62
WM	Firm	45	44	43	42	41	40	40	39	39	38
	Int	0	0	0	0	0	0	0	0	0	0
	Total	45	44	43	42	41	40	40	39	39	38
LDZ Total	Firm	269	266	261	255	251	247	244	241	239	236
	Int	0	0	0	0	0	0	0	0	0	0
	Total	269	266	261	255	251	247	244	241	239	236

TABLE A2.1H - Forecast 1 in 20 Peak Day Firm Demand by LDZ (GWh per day)

LDZ	13/14	14/15	15/16	16/17	17/18	18/19	19/20	20/21	21/22	22/23	23/24
EA	364	360	352	348	345	341	337	336	334	331	328
EM	431	426	415	410	404	399	393	391	388	385	381
NL	470	465	454	447	442	437	431	429	426	422	418
NW	518	511	498	490	483	476	469	467	463	459	453
WM	380	374	364	358	353	348	342	340	336	332	328
LDZ Total	2,163	2,136	2,083	2,054	2,027	2,001	1,973	1,963	1,947	1,930	1,907

FIGURE A2.1H - Forecast 1 in 20 Peak Day Firm Demand by LDZ (GWh per day)

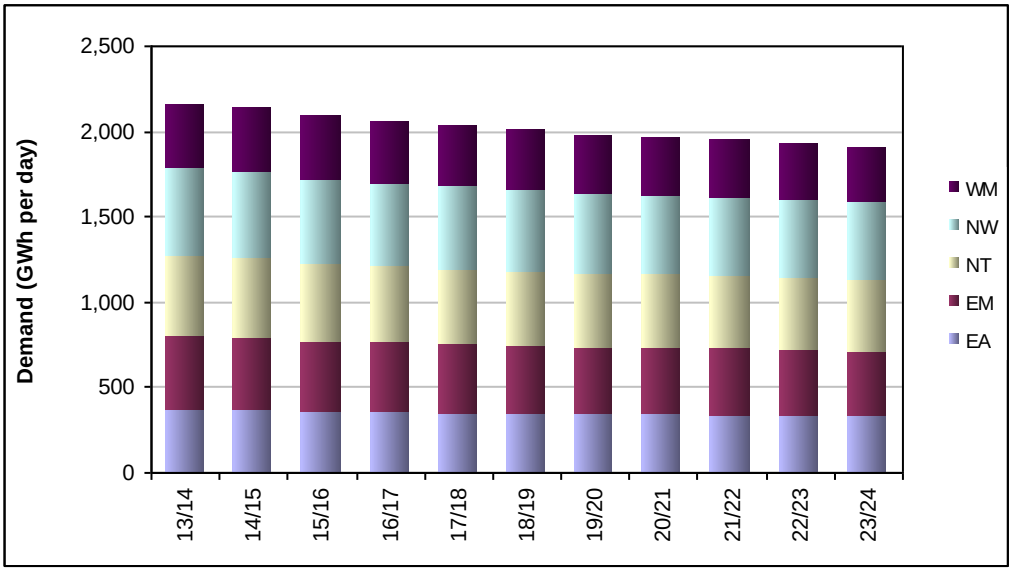
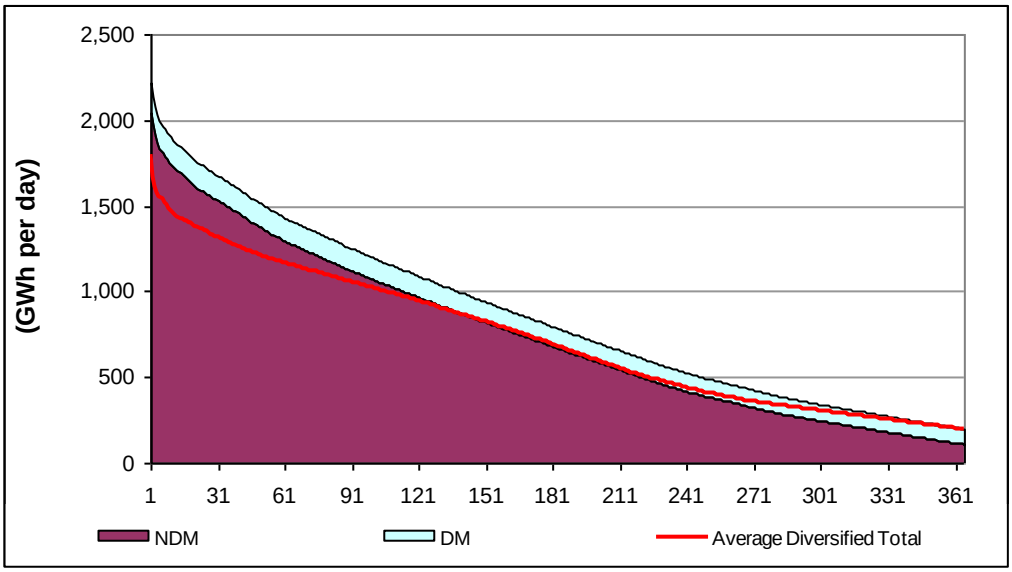


FIGURE A2.1I – 1 in 50 Severe Load Duration Curve



Appendix Three

A3. Actual Flows 2012

This Appendix describes annual and peak flows during the calendar year 2013.

A3.1 Annual Flows

Forecasts of annual demand are based on average weather conditions. Therefore, when comparing actual demand with forecasts, demand must be adjusted to take account of the difference between actual weather conditions and seasonal normal weather. The result of this adjustment is the weather corrected demand.

Recent winters have included some of the warmest of any in the weather data history employed for demand modelling, dating back to 1928/29, and consequently the weather corrected annual demands and forecasts were based on a 17-year seasonal normal condition derived from gas years 1993/94 to 2009/10. Following industry consultation, this moved to the EP2 basis from 2010.

Tables A3.1A to A3.1E provide a comparison of actual demands during the 2013 calendar year with the forecasts presented in the 2013 Long Term Development Plan. Annual demands are presented in the format of LDZ bands/categories, consistent with the basis of system design and operation. All figures have been corrected to the new EP2 basis.

TABLE A3.1A - East Anglia LDZ Annual Demand for 2013 (TWh)

TWh	2013 Actual Demand	Weather Corrected Demand	2013 LTDP Forecast Demand
0-73 MWh	27.9	33.2	27.4
73-732 MWh	3.6	4.2	3.4
>732 MWh Firm	11.8	18.7	11.6
Interruptible	0.0	0.0	0.0
Total Consumption	43.3	56.1	42.4
Shrinkage	0.2	0.3	0.2
Total Throughput	**43.5**	**56.4**	**42.6**

TABLE A3.1B - East Midlands LDZ Annual Demand for 2013 (TWh)

TWh	2013 Actual Demand	Weather Corrected Demand	2013 LTDP Forecast Demand
0-73 MWh	33.6	27.0	33.7
73-732 MWh	4.2	3.6	4.0
>732 MWh Firm	18.0	11.8	18.4
Interruptible	0.0	0.0	0.0
Total Consumption	55.8	42.4	56.1
Shrinkage	0.3	0.2	0.3
Total Throughput	**56.1**	**42.6**	**56.4**

TABLE A3.1C - North London LDZ Annual Demand for 2013 (TWh)

TWh	2013 Actual Demand	Weather Corrected Demand	2013 LTDP Forecast Demand
0-73 MWh	35.3	33.6	34.1
73-732 MWh	6.1	6.0	5.8
>732 MWh Firm	12.4	12.3	12.0
Interruptible	0.0	0.0	0.0
Total Consumption	53.8	51.9	51.9
Shrinkage	0.3	0.3	0.3
Total Throughput	**54.0**	**52.2**	**52.2**

TABLE A3.1D - North West LDZ Annual Demand for 2013 (TWh)

TWh	2013 Actual Demand	Weather Corrected Demand	2013 LTDP Forecast Demand
0-73 MWh	40.1	38.9	40.1
73-732 MWh	5.3	5.3	5.0
>732 MWh Firm	24.8	24.3	24.3
Interruptible	0.0	0.0	0.0
Total Consumption	70.3	68.5	69.4
Shrinkage	0.4	0.4	0.4
Total Throughput	**70.6**	**68.8**	**69.8**

TABLE A3.1E - West Midlands LDZ Annual Demand for 2013 (TWh)

TWh	2013 Actual Demand	Weather Corrected Demand	2013 LTDP Forecast Demand
0-73 MWh	29.0	28.4	29.3
73-732 MWh	4.0	3.9	3.8
>732 MWh Firm	11.3	11.8	11.2
Interruptible	0.0	0.0	0.0
Total Consumption	44.3	44.1	44.4
Shrinkage	0.3	0.3	0.3
Total Throughput	**44.6**	**44.4**	**44.7**

TABLE A3.1F - Aggregate National Grid Gas LDZ Annual Demand for 2013 (TWh)

TWh	2013 Actual Demand	Weather Corrected Demand	2013 LTDP Forecast Demand
0-73 MWh	165.9	161.1	164.5
73-732 MWh	23.2	23.0	22.2
>732 MWh Firm	78.4	78.9	77.6
Interruptible	0.0	0.0	0.0
Total Consumption	267.5	263.0	264.3
Shrinkage	1.4	1.5	1.4
Total Throughput	**268.9**	**264.5**	**265.7**

A3.2 Maximum and Peak Day Flows

Table A3.2A - Actual LDZ Entry Flows on the Maximum Demand Day of Gas Year 2012/13 Compared to the Forecast Peak Daily Flows in a 1 in 20 Cold Winter.

LDZ	Maximum Day	Demand	1 in 20 Forecast Peak for 2013/14
East Anglia	12-Feb-14	20.37	31.76
East Midlands	12-Feb-14	26.92	39.52
North London	20-Nov-13	24.48	41.37
North West	12-Feb-14	31.96	46.94
West Midlands	30-Jan-14	22.47	34.64

Note

- Peak forecast refers to the 1 in 20 Peak Day Firm Demand forecast in the 2012 Long Term Development Plan.

TABLE A3.2B - Actual GD UK Input Flows on the Minimum Demand Day of Gas Year 2013/14 (mcmd)

LDZ	Minimum Day	Demand
East Anglia	26-Jul-14	3.21
East Midlands	26-Jul-14	4.37
North London	26-Jul-14	3.87
North West	26-Jul-14	5.69
West Midlands	26-Jul-14	3.05

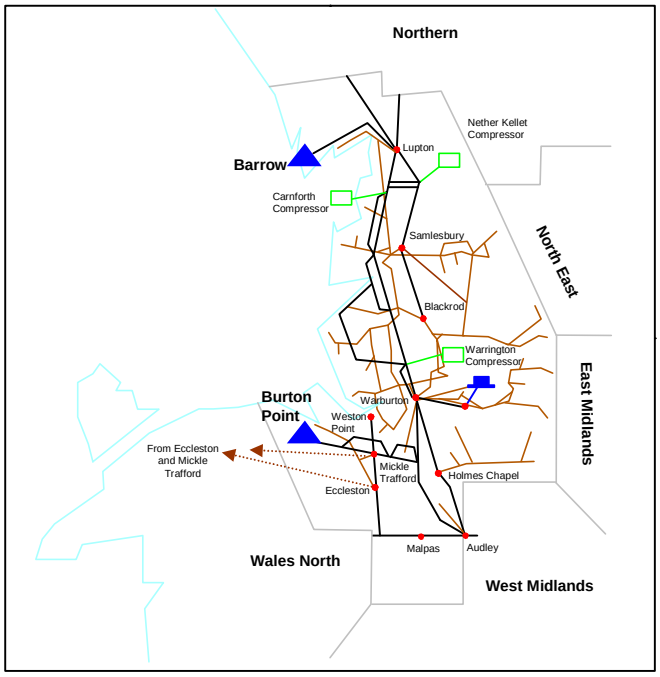
Note

- Due to linepack changes, there may be a small difference between total demand and total supply on the day.

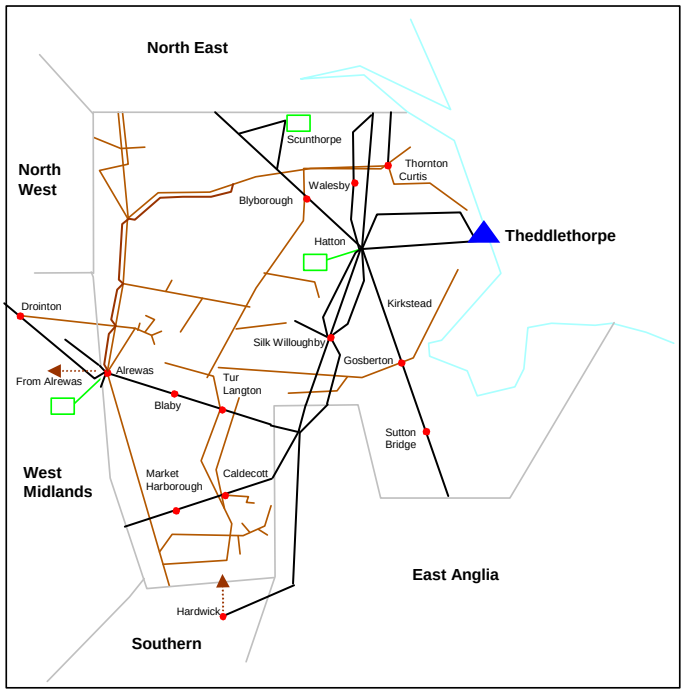
Appendix Four

A4. The Gas Transportation System

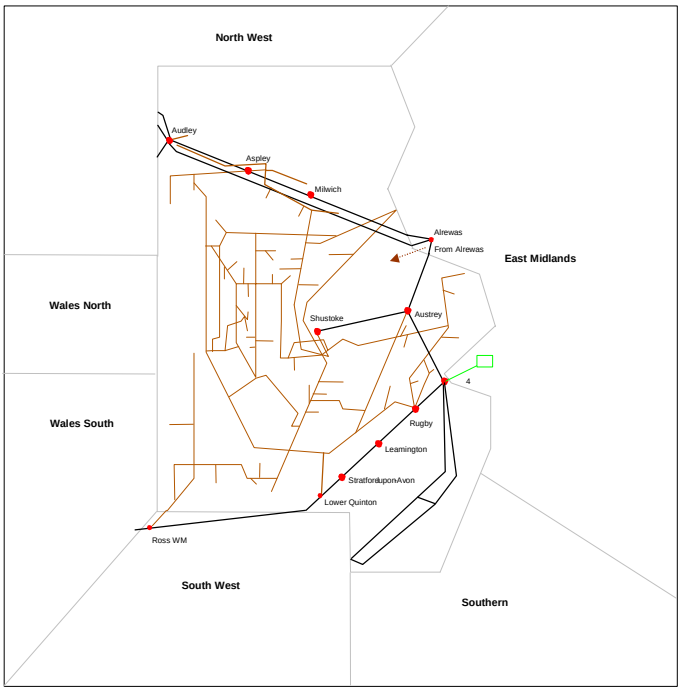
A4.1 North West (NW) Network Code LDZ – HP Distribution System



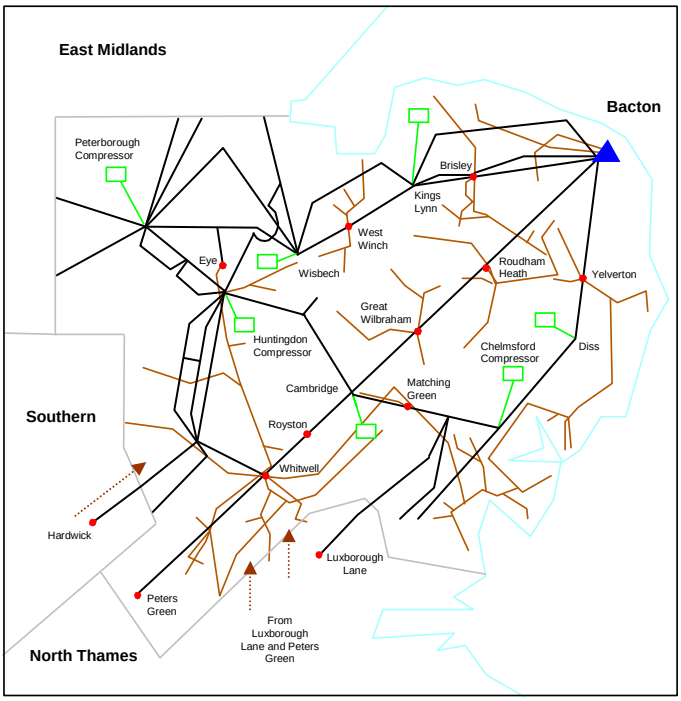
A4.2 East Midlands (EM) Network Code LDZ – HP Distribution System



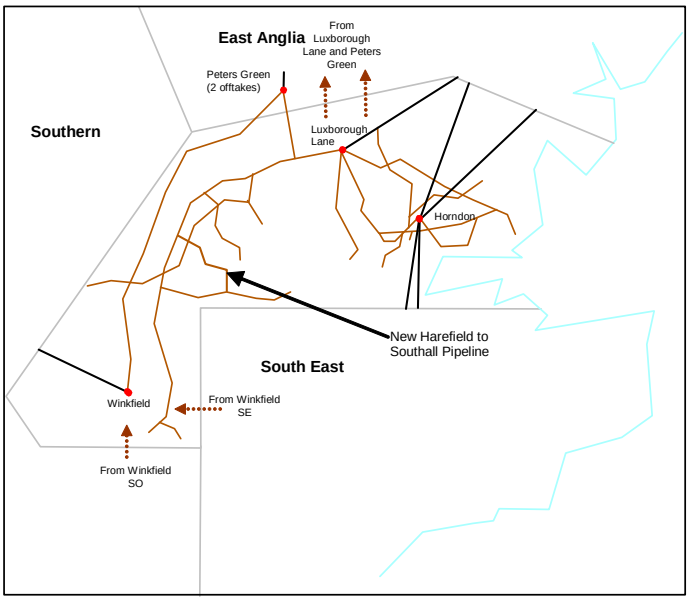
A4.3 West Midlands (WM) Network Code LDZ – HP Distribution System



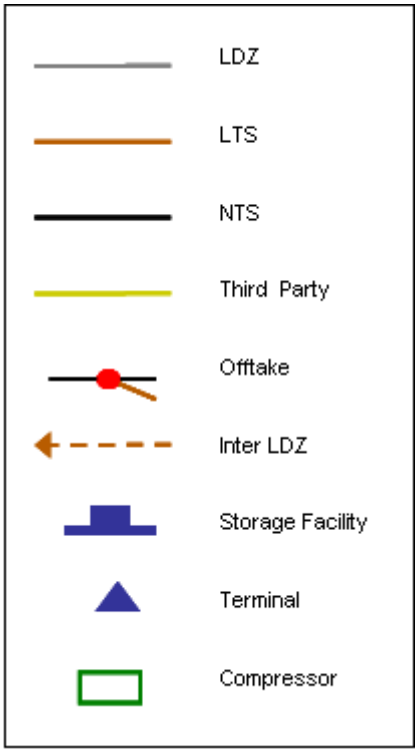
A4.4 East Anglia (EA) Network Code LDZ – HP Distribution System



A4.5 North London (NL) Network Code LDZ – HP Distribution System



A4.6 Key - Network Code LDZ Map



Appendix Five

A5. Connections to the National Grid Gas Distribution System

A5.1 Introduction

Within the space of a few years, the gas industry in Britain has evolved to where many alternative connection services are now available on a competitive basis.

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

The following are the generic classes of connection:

- Entry Connections: connections to gas delivery facilities processing gas from renewable sources e.g. Anaerobic Digestion plants, gas producing fields or, LNG vaporisation facilities, for the purpose of delivering gas into our system.
- Exit Connections: connections that allow gas to be offtaken 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-National Grid pipeline transporting gas to premises consuming more than 2,196MWh per annum.
- Storage Connections: connections to storage facilities for the purpose of temporarily offtaking gas from our system and delivering it back at a later date.

Please note that Storage may both deliver gas to the system and offtake gas from the system and therefore, specific arrangements pertaining to both Entry and Exit Connections will apply.

In addition to new pipes being termed connections, any requirement to increase the quantity of gas delivered or offtaken 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 – National Grid Gas Statement Of Principles And Methods To Be Used To Determine Charges Of Connection Services" (Licence Condition 4B Statement), which is supported by the Connections Services Charges Document.

Both documents can be downloaded from our web site, or can be obtained by writing to the following address:

Damien Hawke
Network Design Manager
Network Strategy
National Grid
Block 4, Area 3 - Hinckley Operations Centre
Brick Kiln Street
Hinckley
Leicestershire
LE10 0NA

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 Additional Information Specific to System Entry and Storage

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

A5.3.1 Network Entry Quality Specification

National Grid is proactively working with producers, Ofgem, DECC, HSE, equipment suppliers and other GDN's to ensure technical and commercial barriers to entry are speedily removed where demonstrated to enhance the market and not affect the operation of the Network whilst working within the prescribed limits associated with National Grids Licence to Operate and taking into account our existing statutory and contractual obligations.

National Grid has implemented it's Legal, Commercial and Technical process to assist the developing market of Bio Methane production for Grid Injection and embed such process developments as business as usual. This process is periodically reviewed so that it is aligned with market developments and continues to deliver Bio Methane connections to customer's expectations. The connecting Party should contact National Grid (renewablegas.ukd@nationalgrid.com) at the earliest possibility in the project to establish the required entry points, network capacity and to further discuss the requirements associated with Network Entry Quality Specifications.

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:

a) Our ability to continue to meet statutory obligations (including, but not limited to, the Gas Safety (Management) Regulations 1996 (GS(M)R));

b) The implications of the proposed gas composition on system running costs; and

c) 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/m^3
2. Total Sulphur
    - Not more than 50mg/m^3
3. Hydrogen
    - Not more than 0.1% (molar)
4. Oxygen
    - Not more than 1.0% (molar)[1, 2]
5. Hydrocarbon Dewpoint
    - Not more than -2°C at any pressure up to 85bar
6. Water Dewpoint
    - Not more than -10°C at 85bar
7. Wobbe Number (real gross dry)
    - The Wobbe Number shall be in the range 47.20 to 51.41MJ/m^3
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/m^3, 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)
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/m^3

14. Radioactivity
    - Not more than 5 Becquerels/g
15. Odour
    - Gas shall be odorised with odorant NB (80% tertiarybutyl mercaptan, 20% dimethyl sulphide) at an odorant injection rate of 6 mg/SCM, which may be varied at the DN Operator's request by up to plus or minus 2 mg/SCM to meet operational circumstances
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

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.

Under the requirements of the Gas (Calculation of Thermal Energy) Regulations 1996 and Amendment 1997, we are required to determine calorific value at locations directed by, and in a manner approved by, the Industry Regulator Ofgem. Instrumentation we use to determine calorific value is approved by Ofgem for use only within a composition range specified by Ofgem for that type of instrument. Consequently, we may require limits in hydrocarbon and inerts content so as to allow us to comply with the approval range of such calorific value determination instrumentation. 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.

We are working with the DTI and Ofgem in assessing the compatibility of existing specifications (both statutory and contractual) with the longer term needs of the UK in respect of additional gas supplies, and the European Association for the Streamlining of Energy Exchange (EASEE-gas) in the development of a Gas Quality harmonisation Common Business Practice. The outcomes of these projects could ultimately result in changes to our network entry quality specifications in the future.

[2] Following issue of an industry report to the HSE on increased oxygen limits and risks associated with corrosion with in metallic systems, a class exemption to GS(M)R specifications for oxygen was issued by the HSE. This will be taken into account with entry connection process and does not remove the need to take into account point 1for downstream processes.

A5.4 Additional Information Specific to System Exit Connections

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

A5.4.1 Distribution Network Connections

Gas will normally be made available for offtake to consumers at a pressure that is compatible with a regulated metering pressure of 21mbar. Information on the design and operating pressures of distribution pipes can be obtained by contacting our Network Strategy team at the following address:

Damien Hawke
Network Design Manager
Network Strategy
National Grid
Block 4, Area 3 - Hinckley Operational Centre
Brick Kiln Street
Hinckley
Leicestershire
LE10 0NA

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

Parties considering laying a pipe that will either vest in us or is intended to come into our ownership should refer to the published Licence Condition 4B Statement and make contact with our Network Strategy team at the above address.

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, resourcing 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 Six

A6. 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 the gauge pressure, i.e. relative to atmospheric pressure. All references to bar in this document refer to gauge pressure i.e. barg.

One millibar (mbarg) equals 0.001 bar.

Calorific Value (CV)

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

Climate Change Levy (CCL)

The 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.

Compressor Station

An installation that uses gas turbine or electricity driven compressors to boost pressures in the pipeline system. Used to increase transmission capacity and move gas through the network.

Connected System Exit Point (CSEP)

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 (DN)

An administrative unit responsible for the operation and maintenance of the local transmission system (LTS) and <7bar distribution networks within a defined geographical boundary, supported by a national Emergency Services organisation.

Distribution System

A network of mains operating at three pressure tiers: intermediate (2 to 7bar), medium (75mbar to 2bar) and low (less than 75mbar).

Diurnal Storage

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

EP2

EP2 is the application of Met Office forecasts of UK Climate Change to National Grid's weather data.

Exit Zone

A geographical area (within an LDZ) that consists of a group of supply points that, on a peak day, receive gas from the same NTS Offtake.

Formula Year

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

Future Energy Scenarios (FES)

The annual industry-wide consultation process encompassing the Ten Year Statement, targeted questionnaires, individual company and industry meetings, feedback on responses and investment scenarios.

Gas Transporter (GT)

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

Gasholder

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

Gas Supply Year

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

High Pressure (HP) Distribution System

A pipeline system operating at >7bar that transports gas from NTS offtakes to distribution systems. Some large users may take their gas direct from the HP Distribution System.

Interruptible Service

A service that offers lower transportation charges but where we can interrupt the flow of gas to the supply point.

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 within the High Pressure Distribution System at any time.

Liquefied Natural Gas (LNG)

Gas stored in liquid form. Can be firm or constrained (CLNG). Shippers who book a constrained service agree to allow us to use some of their gas to balance the system.

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 NTS offtakes. Consists of High Pressure (>7 bar) and lower pressure distribution system pipelines.

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 NTS offtakes.

National Transmission System Offtake

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

Network Innovation Allowance (NIA)

A set allowance for each RIIO network licensee, as part of their price control allowance, to fund smaller technical, commercial, or operational projects directly related to the licensees network that have the potential to deliver financial benefits to the licensee and its customers

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. We provide odorisation at NTS offtakes.

Office of Gas and Electricity Markets (Ofgem)

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

Own Use Gas (OUG)

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

Peak Day Demand (1 in 20 Peak Demand)

The 1 in 20 peak day demand is the level of demand, within day gas flow variations, 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.

Price Control Review (PCR)

Ofgem's periodic review of our allowed returns, the next PCR will set returns for the period April 2013 to March 2021.

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.

Seasonal Normal Temperature (SNT)

Seasonal Normal Temperature is the average temperature that might be expected on any particular day, based on historical data.

Shipper or 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.

Unaccounted for Gas (UAG)

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

Uniform Network Code (UNC)

The Uniform Network Code will replace the Network Code and defines the rights and responsibilities for all users of gas transportation systems. It provides all system users with equal access to the transportation services.

UK-Link

A suite of computer systems that supports Network Code operations. Includes Gemini for energy balancing; Supply Point Administration; Invoicing; and the Sites and Meters database.

Appendix Seven

A7. 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.

From: / 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

Note: all volume to energy conversions assume a CV of 39 MJ/m^3

GWh = Gigawatt Hours

mcm = Million Cubic Metres

Thousand toe = Thousand Tonne of Oil Equivalent