

Long Term Development Plan 2016

National Grid Gas Distribution Limited



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Foreword



Welcome to our 2016 Long Term Development Plan (LTDP) for National Grid Gas Distribution Ltd (NGGDL). The LTDP document is designed to be the start of the conversation with anyone considering connecting to our system or working with us to transport gas.

As NGGDL prepares to operate independently through its planned sale by National Grid Plc., we are committed to delivering a continuity of service without disruption to our customers and stakeholders.

We own and operate four of the UK's gas networks, covering the East of England (EofE), North London (NL), North West (NW) and the West Midlands (WM). We transport gas safely and reliably to 11 million homes, schools and businesses through a 131,000 kilometre pipe network.

This document provides you with a view of our plans and investments for the years to come. It describes our assessment of future gas use and the demand on our network under a range of different scenarios.

Both Government and public interest in the future direction of the energy industry continues to rise. Energy supply in the future will need to be:

- **secure** – continuing to operate safely and reliably 365 days a year
- **sustainable** – facilitating decarbonisation of the energy industry
- **affordable** – reducing the number of families living in fuel poverty.

The World Energy Council calls this need the 'energy trilemma'.

Delivering the future energy needs of our customers efficiently in a low carbon economy is a complex task. We need to provide clarity on the role gas can play in the long term to meet the challenge of the energy trilemma, supporting Government to make the right decisions to ensure we continue to meet the needs of our customers.

In response, we are maintaining our focus on new sources of renewable gas for heat and transport and examining how the capability and versatility of the gas network can be used to meet customer demands. We are planning now to meet the needs of the future.

While developing the gas network of the future, we are also continuing to invest to increase the reliability, safety and efficiency of today's network. To do this we are prioritising our investment and focusing on deploying innovation and new ways of working to deliver the service our customers need.

Our plans to invest approximately £4.1bn in our assets during the RII0-GD1 price control review period, 2013 to 2021 have not changed. This includes investment in network reinforcements and new connections for industrial, commercial and domestic customers. For example, we continue to see substantial activity in connecting new sources of gas to the grid, particularly for biomethane sites.

Innovation is about doing something different to benefit our customers, deliver a low carbon economy and improve efficiencies. Our track record of introducing new technology and approaches into our business continues, and we are looking to deploy and embed more innovative solutions in the years ahead. We depend on two things to make this happen: helping our people to be creative and try new things; and successfully taking advantage of innovative solutions from our partners, suppliers and customers.

I hope you find our LTDP both interesting and informative. We welcome any views you have on the plan, including ideas for improvement, via the [Feedback Form](#) on the National Grid Gas Distribution website.

David Parkin
Director
Safety & Network Strategy
National Grid Gas Distribution Limited

Our approach to stakeholder engagement

We need our stakeholders to help us shape the services we provide, and the way we maintain and develop our network now and in the future. To do this, we need your views. We welcome your feedback at any time throughout the year.

We hold an annual stakeholder consultation 'Have Your Say'. This is an opportunity for you to tell us what you think about how we engage and the service we provide, as well as what you'd like us to focus on in the coming year.

Once we have received our stakeholders' views, we publish an annual summary and, in our publication 'Acting on Your Ideas', we outline the actions we have taken following your feedback.

We received more than 136 responses to our 2015/16 formal 'Have Your Say' consultation. Our stakeholders told us how we were doing and what we should focus on next.

Our stakeholder philosophy of listen, discuss and act means that we gather views from our Stakeholders on how we can improve our business and the services we offer.

We are determined to improve upon how our stakeholders inform our decision making. We actively listen to our stakeholders' views, and we have changed our consultation timelines so that we can incorporate vital feedback in our business planning cycles to help shape how we manage our business.

You can read all of our stakeholder engagement documents on our Talking Networks website. You can register to get automatic updates, news and information about our consultations and review our new stakeholder priorities.

In our 2015/16 consultation, our stakeholders told us what their key priorities were for 2016/17. We are committed to delivering in all these areas.

Inform and educate on the 'Future of gas'

Continue to focus on fuel poverty and supporting our vulnerable customers

Continue to drive vital industry change

Continue to improve working relationships with key stakeholders

Deliver a right first time customer approach

Ensure continuity of service delivery with the sale of National Grid Gas Distribution

Continual feedback from our stakeholders really helps us plan and improve. So please do get in touch with us, your views can make a difference to the communities we serve and the services we provide.



Background

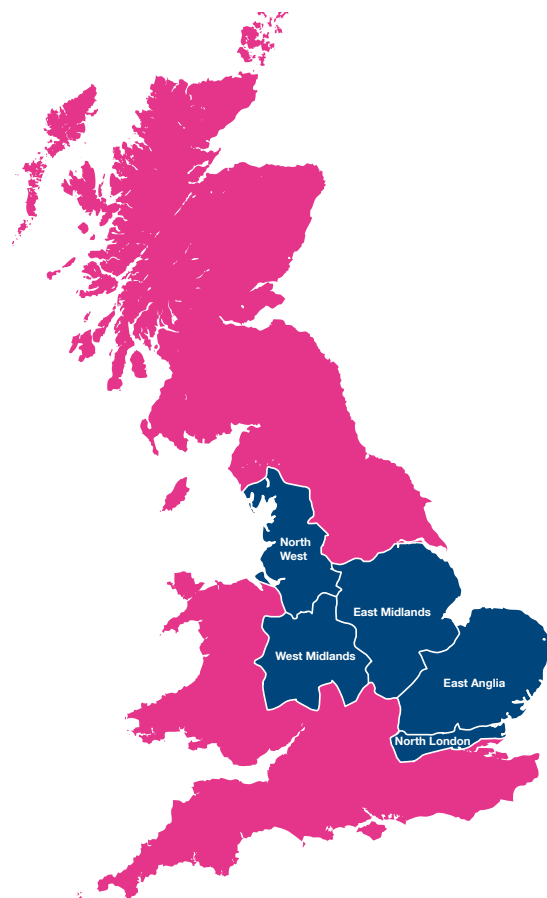
This document outlines our assessment of future demand for National Grid Gas Distribution Ltd.

NGGDL manage the development, operation and maintenance of the High Pressure (HP) and below 7 barg Gas Distribution Networks. These Networks extend from the Gas Inlet Valve of the Pressure Regulating Installations (PRIs) at the National Transmission System (NTS) interface to the outlet of the customers' Emergency Control Valve in the North West (NW), East Midlands (EM), West Midlands (WM), East Anglia (EA) and North London (NL) local distribution zones (LDZs).

Most of our supply is from the NTS and as the gas industry develops further this will facilitate more greener and sustainable energy supplies into the future.

When deciding how to invest in our networks, we look at supply and demand needs, what's important to our stakeholders and how our customers want to use our system.

This document contains essential information on our planning processes, including our demand forecasting, our system reinforcement projects and their associated investment as well as actual demands for the previous year (provided in the Appendix A2).



Demand overview

The latest peak gas demand forecast reduces by around 0.95% per year on average, over the last ten years. All forecasts are based on annual demands, which are then converted into peak demands. These are established through the analysis of historical behaviour.

Investment implications

Our investment will be approximately £513m per annum, of which £457m is related to the mains replacement programme and £56m is related to other network capital investments, which is the focus of this document. These average annual spends reflect the RIIO-GD1 Final Proposals agreed with Ofgem in February 2013, and it is stated in 2009/10 prices. However, it excludes operating expenditure (Opex) recharges.

Even though overall demand is going down, we must still invest to add exit capacity because of possible local constraints within the networks, to help meet Local Authority Strategic Development proposals for new developments. Other factors may include the dynamic nature of existing loads, as well as industries and customers migrating and changing within our networks.

We may also need to invest to help connect new sources of gas, including renewable gas, and to address shallow cover (due to soil erosion), on our Local Transmission System (LTS) pipelines.

Your feedback

The 2016 planning cycle culminates in the LTDP. The 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).

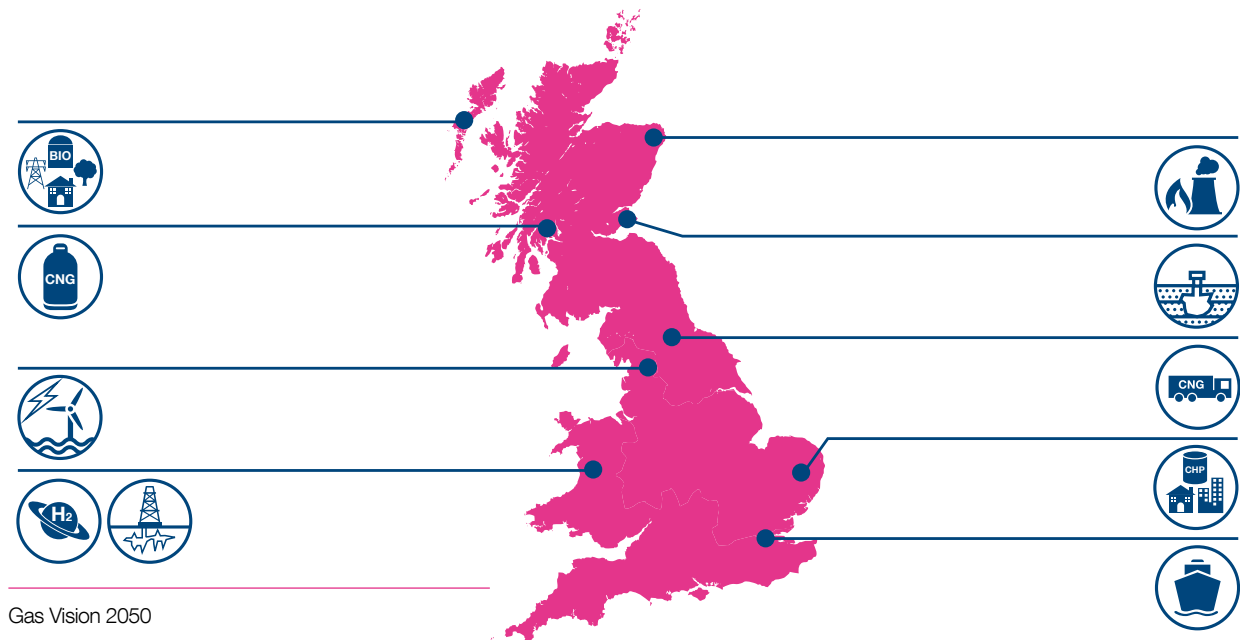
We want this plan to deliver what's important to you so please let us know your views. You can contact us by:

- taking part in our annual consultation 'Have Your Say'
- emailing admin.netstrat.ukd@nationalgrid.com
- writing to:

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The future of gas

Before we look at our ten-year forecast for supply and demand, we want to highlight some of our key focus areas and long-term network development plans.



Energy trilemma

The future of energy in the UK and what the energy network will look like over the next thirty years is a topic that is rapidly gaining momentum throughout the industry. In order to transition to a low carbon economy and meet the UK's carbon emissions targets (reduction by 80% from 1990 levels) by 2050, we need to consider the short- and long-term role of gas as we meet the challenges posed by the energy trilemma. To help improve security, sustainability and affordability of energy supplies.

Gas was first introduced in the UK over 200 years ago and over time there has been significant investment in the gas network, providing flexibility to meet customer demands. It is seen by domestic customers as a preferred energy option, being reliable and easily controllable. It is essential that the move towards a decarbonised energy industry does not increase the number of customers living in fuel poverty. We must consider how energy costs will be managed, offering reasonable and affordable pricing to customers along with energy efficiency measures.

We believe gas distribution networks will play a major part in the future of energy, delivering a reduction in carbon emissions at a lower cost to alternative options, while maintaining a secure supply and continuing to meet customer demands. Introducing new sources of gas into the existing gas network will affect costs and improve the reliability of the UK's energy infrastructure, it will also be the best way to keep our supply secure and avoid relying on renewables such as solar and wind, or on a single electricity infrastructure, to provide all our energy needs.

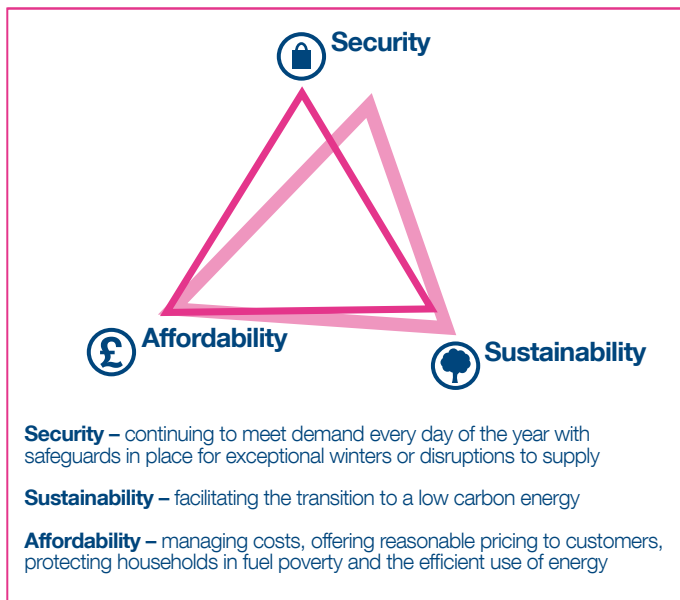
¹ www.nationalgrid.com/futureofgas

Demand, supply of renewable gas, domestic heat and transport are all being considered in an effort to decarbonise the UK to meet the energy reduction target. We expect some of these developments to appear in our demand and supply forecasts during RIIO-GD1. These factors will also influence our investment plans in the next regulatory review period. Currently, we are highlighting the possibilities in this area through the publication of a series of papers under the theme 'Future of Gas'. The series aims to promote discussions with our stakeholders and to inform debate in industry. The papers address the critical role that gas has to play in the future energy mix. The last topic in the series, due for release later in 2016¹, looks at the role the gas distribution network will play looking ahead to 2050.

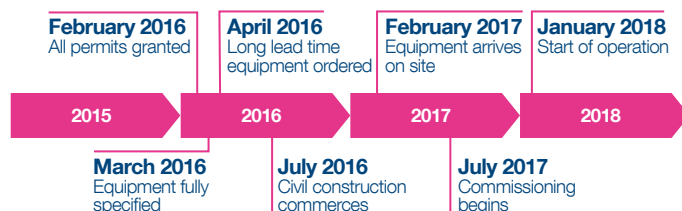
Energy supply

Renewable gas (such as biomethane and bio-substitute natural gas) can play an important part in the decarbonisation of domestic heat, transport and power generation. It does not require significant investment in new infrastructure: it can be injected straight into the existing gas distribution network; and customers won't need to make any significant changes to their appliances for heating or cooking.

Renewable gas could meet as much as 40 to 50% (circa 100TWh) of domestic demand by 2050. This is achievable with continued support for Government incentives such as the Renewable Heat Incentive (RHI). The Government will also have to communicate clearly the message that gas will play an important role in the energy mix, so that investors can have confidence for the long term.



Timeline for the development of a commercial BioSNG plant in the UK



BioSNG pilot plant based in Swindon, converting domestic and commercial black bag waste into renewable gas

The Energy Trilemma
www.worldenergy.org

Looking further ahead, there is increasing interest in how we could transform the energy market to incorporate a hydrogen economy, using the existing gas distribution network to transport hydrogen for domestic heat and transport. The gas industry has started to assess the impact this would have, including the use of hydrogen blending, along with the potential impact on current replacement processes.

Biomethane connections

The number of renewable gas to grid connections is increasing. Since 2013, we have successfully connected 25 biomethane projects providing heat to over 18,000 homes. Nine more connections are planned for 2016/17 and we are committed to delivering at least 80 projects by 2020.

Since our first connection in 2013, we have asked for customer feedback to help improve our processes and commercial frameworks. This helps us make the connections that will reduce our reliance on the transmission system for gas supply to our customers.

We have worked with our customers on a system to house NGGDL and the customer's equipment in a single box. The first was installed in June 2015 with organic food waste used as feedstock for anaerobic digestion to produce biogas fuel. This is more cost effective for the customer and uses less land, which makes it more feasible to connect other sources of renewable gas to our networks.

In November 2014, we connected our first project to the HP network using suitably qualified contractors to lay the pipeline and connect to our LTS. We now have eight biomethane

connections to the LTS and this has boosted competition in the connections market.

Uncertainty about funding of the RHI is an ongoing challenge. There must be continued investment in renewables and low carbon heat in the UK so the sector can develop. In turn, we will work hard to reduce costs through improvement and innovation.

Renewable gas through gasification (BioSNG)

We will need large-scale production of renewable gas if it is to make a significant contribution to reducing the greenhouse gas emissions associated with domestic heating. The production of low carbon biomethane from thermal sources Bio-Synthetic Natural Gas (BioSNG) has the potential to do this.

In 2013/14, National Grid and its partners: Advanced Plasma Power (APP); Progressive Energy (PEL) and Carbotech initiated a project to create BioSNG from municipal black bag waste, securing funding from Ofgem's Network Innovation Competition (NIC) and the European BESTF-ERANET programme. The purpose of the project is to construct a pilot plant in Swindon to demonstrate the production of BioSNG by the gasification process of residual domestic and commercial waste. The facility will be used as a showcase to demonstrate the technology to industry stakeholders and provide the confidence to move on to the next step: the construction of a larger commercial demonstration plant.

The future of gas

Two and a half years into the project, the plant has been constructed and commissioned and the production of BioSNG has been achieved. Over the final six months of the project, we will continue to refine and optimise the BioSNG production process in order to produce substitute natural gas that is good enough to supply through our grid, meeting the specification of Gas Safety (Management) Regulations (GS(M)R).

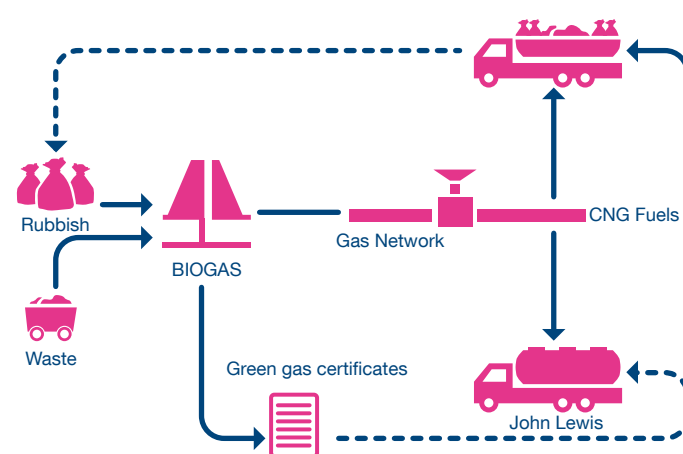
In 2015/16, NGGDL secured further NIC funding, with partners APP, PEL, Compressed Natural Gas (CNG) Services and Wales & West Utilities for a much larger BioSNG plant to demonstrate the technology under commercial conditions. The project started at the beginning of 2016 and it is due for completion by the end of 2018. Black bag waste will be supplied under contract from the local council and the renewable gas will be sold to a local road haulier, who will use the renewable gas to fuel heavy goods vehicles (HGVs). Gas will also be injected into the local Wales & West Utilities network to supply remote CNG fuelling stations. The new plant has also been awarded funding by the Department for Transport's Advanced Biofuels Competition, and it will produce 1 million kg of renewable gas for transport from 2018 (22 GWh/a).

We intend the successful continuous operation of the commercial BioSNG plant to provide the necessary confidence for Government and industry to promote commercial investment in the technology, leading to the roll out of large numbers of BioSNG plants across the UK. This in turn will help to achieve the UK's renewable energy targets and to secure the long-term future of the gas distribution network.

Transport – potential growth in CNG vehicles

Transport accounts for 25% of the UK's total greenhouse gas emissions and there is no way to completely decarbonise it. HGVs and buses, which make up only 1.5% of road transport account for 21% of transport emissions. Consideration also needs to be given to noise and air quality, which are both major issues across UK cities.

There is potential for natural gas to play a major role in decarbonising transport; HGVs and buses can be fuelled using CNG². The existing gas network provides an opportunity to create a national filling station infrastructure that offers a clean,



² CNG is methane stored at high pressure. It can be used in place of petrol and diesel and has a number of benefits.

quiet and cheap alternative to diesel for vehicles and provides connections for customers who want to use CNG vehicles. We see the network as the backbone of a future national infrastructure and we expect the market to grow.

In March 2016, working in partnership with CNG Fuels, NGGDL connected the first commercial CNG refuelling station to the gas transmission system in Leyland, Lancashire. Currently, the station is being used by the John Lewis Partnership to fuel their fleet of dedicated CNG HGVs, with the CNG directly from the HP LTS. This connection increases the use of the gas network but no extra investment was required in the transmission system.

This technology is not new, with 85 countries from all five continents using natural gas vehicles; substantial evidence is available to support its case for deployment in the UK. We are also starting to see manufacturers offering dedicated gas HGVs and buses in the UK, providing more choice for haulage and bus companies. Sustainable sources of gas have great potential to support the transport fuel sector. Whether it is from biomethane or gasification, the environmental emissions are

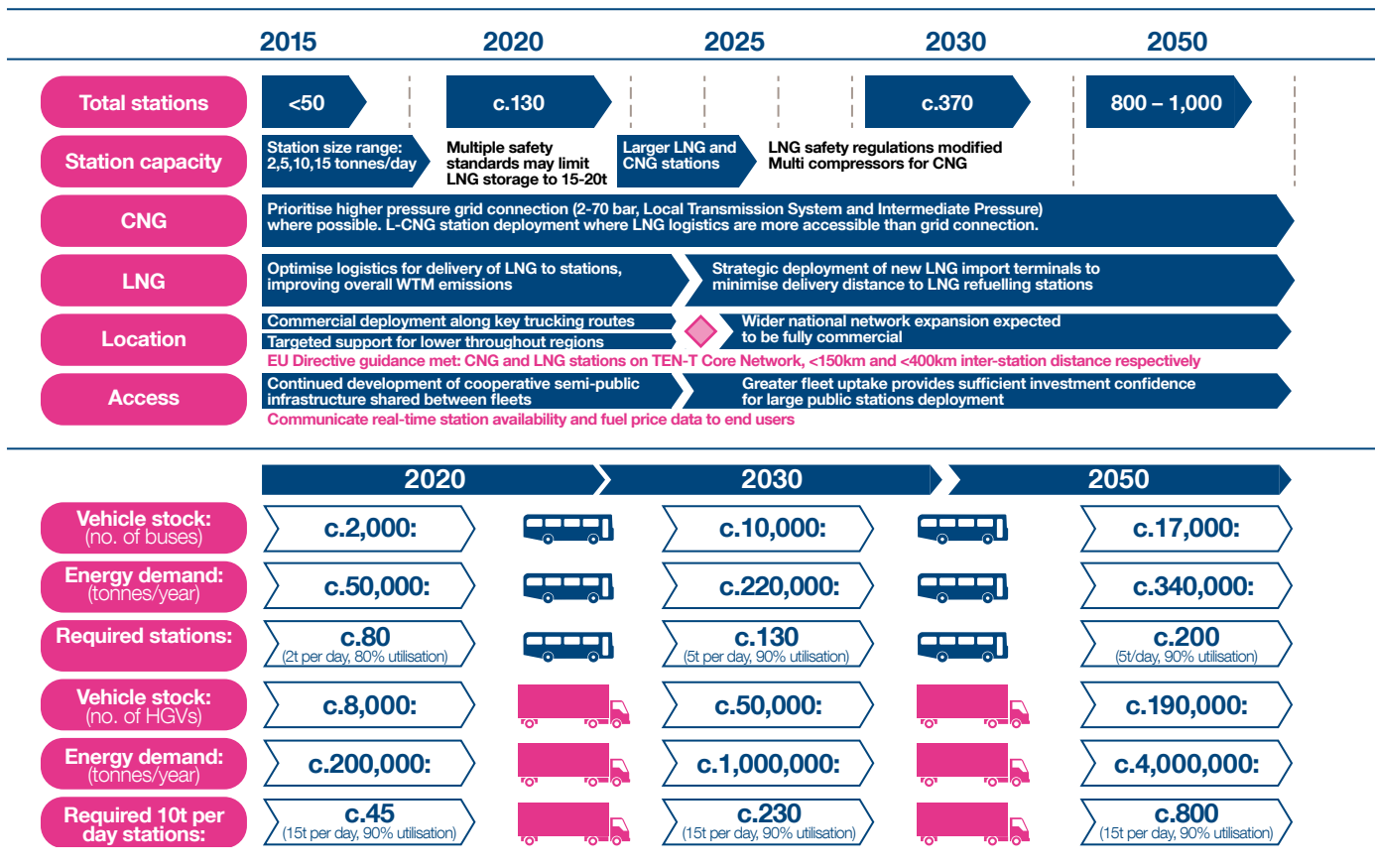
around 70% less than diesel consumption. Approximately 94% of the gas dispensed at the Leyland filling station is certified and tracked through the supply chain by the Green Gas Certification Scheme³.

We have worked closely with the Low Carbon Vehicle Partnership⁴ to develop their vehicle fuels infrastructure roadmap for the Office of Low Emissions Vehicles. As members of the Natural Gas Vehicles (NGV) Network⁵, we are working with industry stakeholders to promote the use of gas in vehicles, to lobby for support and to ensure there are industry standards. This early work will help us to assess how gas supply and demand will be affected.

For UK gas customers, the growth of this transport fuel sector will mean greater network use. This will eventually reduce the transportation cost per customer and help to reduce the environmental impact.

Network Characteristics

Regulatory barriers will be the primary focus for enabling natural gas infrastructure (CNG and Liquid Natural Gas (LNG)), whilst a number of technical issues must also be resolved



Extract from Low Carbon Vehicle Partnership – Transport Infrastructure Roadmap to 2050

³ www.greengas.org.uk

⁴ www.lowcvp.org.uk

⁵ www.ngvnetwork.co.uk

The future of gas

Future demand factors

In order to meet our carbon emission reduction targets and ensure the future of UK energy is sustainable, affordable and secure, the way in which energy is produced and used will need to change. Heat needs to be decarbonised if we are going to meet our targets. In the UK, almost half of the energy consumed is used to provide heat in buildings and industry (for heating, hot water and cooking) of which two thirds come from natural gas.

We have seen demand fall because of the energy efficiency measures employed within the home and in industry. The Future Energy Scenarios published by National Grid Transmission show that a 30% efficiency saving is possible if customers continue to choose solid wall insulation, A-rated boilers and smart thermostats such as BG Hive or Worcester Bosch Wave.

Gas heat pumps could further reduce energy demand, offering efficiencies up to 150% compared against a traditional boiler.⁶

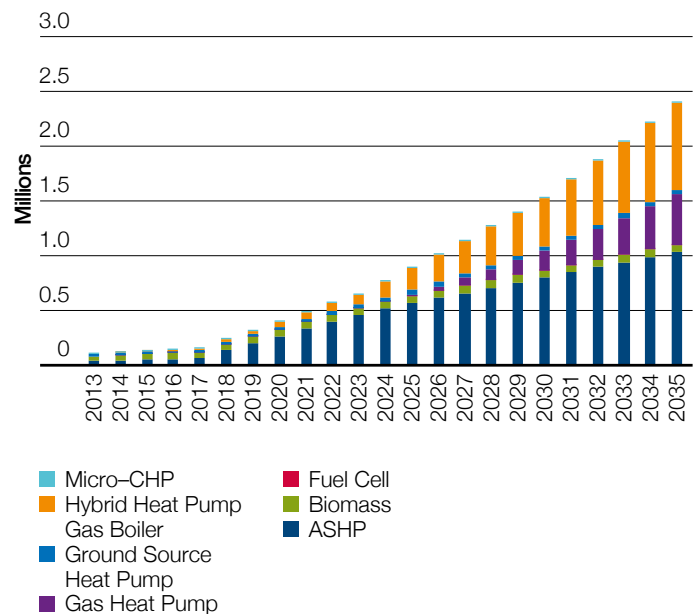
We know there will be more electric heating in the future and gas demand will decrease. However, in all scenarios we've modelled gas will still be needed for heat, particularly on peak demand days.

Our forecast demand includes new technologies, such as, air source heat pumps that will reduce the customer's use of gas. We also include gas efficient appliance technologies like gas sourced heat pumps and micro-combined heat and power (micro-CHP), which reduce carbon intensity. These new and emerging technologies could help us to be flexible as we meet our domestic peak heat demand.

These new technologies will be used across electricity networks as well, helping to reduce the growing pressure on the electricity grid. New hybrid appliances powered from renewable electricity will be able to transfer to gas at peak times or at other times when there is not enough renewable electricity.

Other developments include smart technologies that can switch from electricity to gas depending on changes in the price of electricity, and smart appliances that can choose the cheapest or lowest carbon fuel. Combining all these technologies is the best way to make the most of renewables across both energy supplies. It will also maximise the use of the network and associated assets that customers have already paid for. Looking further ahead, we are starting to research how micro-CHP and fuel cells might help us move towards a hydrogen economy.

The following graph shows the new heating technologies included in our projections:



New Heating Technology Projections

⁶ www2.nationalgrid.com/uk/industry-information/future-of-energy/future-energy-scenarios

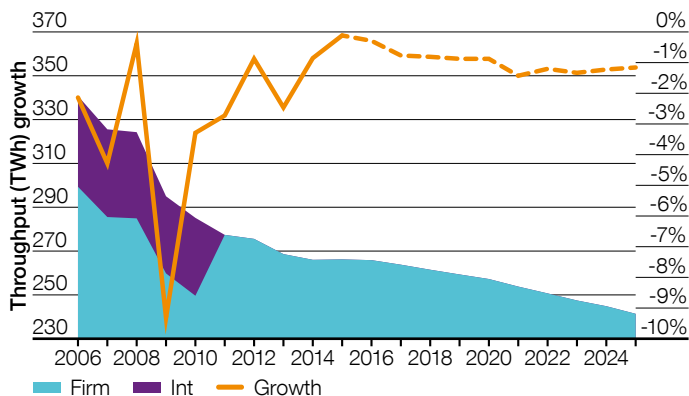
Demand

This section looks at the UK demand forecast for the next ten years for National Grid Gas Distribution Ltd.

Scenario appraisal

Our demand scenarios are based on planning assumptions derived from market observations and stakeholder engagement. The scenarios take into account the need to reduce our carbon emissions, which is critical if we are to meet Government targets by 2050. They also include the view of specialist consultancies and data collected from UK Transmission's FES consultation process.

The FES consultation involves market participants, including suppliers, consumers and consumer groups. It provides important feedback on the impact of market developments and data about the consumption of new and existing loads.



Forecast demand

The graph below shows our gas demand scenarios through to 2025. There's a breakdown by LDZ network in Appendix A1 that includes our view for both annual and peak demand, year-by-year. Annual gas demand is expected to drop in the next ten years.

We worked with our service provider UK Transmission to develop demand scenarios as part of the demand forecast update for winter 2016/17.

The main differences between the scenarios for demand are the expected levels of energy efficiency, views of the economy and how new houses will be heated.

Forecast comparison and accuracy

Appendix A1 contains demand forecast information at a LDZ network level through to 2024/25. Tables in Appendix A2 include:

- a comparison of the actual demands during 2015 with the forecasts published in our 2015 LTDP

(With errors in accuracy ranging from 0.3% for the NW at 0-73 MWh throughput and 17% for NL above 732 MWh)

- maximum and minimum demand days and forecasts for winter and summer 2016.

Prosperity

Consumer Power

Economic – moderate economic growth

Political – government policies focus on indigenous security of supply and carbon reduction

Technological – high innovation focused on market and consumer needs. High levels of local generation and a mixture of generation types at national level

Social – consumerism and quality of life drives behaviour and desire for 'going green', not a conscious decision

Environmental – Long-term UK carbon and renewable ambition becomes more relaxed

Gone Green

Economic – moderate economic growth

Political – European harmonisation and long-term environmental energy policy certainty

Technological – renewable and low carbon generation is high. Increased focus on green innovation

Social – society actively engaged in 'going green'

Environmental – new policy intervention ensuring all carbon and renewable targets are achieved

No Progression

Economic – slower economic growth

Political – inconsistent political statements and a lack of focus on environmental energy policies

Technological – little innovation occurs in the energy sector with gas as the preferred choice for generation over low carbon

Social – society is cost conscious and focused on the here and now

Environmental – reduced low carbon policy support and limited new interventions

Slow Progression

Economic – slower economic growth

Political – European harmonisation, focus on low cost environmental energy policies

Technological – medium levels of innovation lead to a focus on a mixture of renewable and low carbon technologies

Social – society is engaged in 'going green' but choices are limited by cost

Environmental – new policy interventions are constrained by affordability

← Green ambition →

Connections

Exit connections (new demand for gas)

Healthy competition within the British gas industry has been offered for more than ten years in new gas connection services. We offer domestic, non-standard and alteration quotations, while third parties such as gas transporters (GTs) and utility infrastructure providers (UIPs) give customers a different choice.

Whilst the overall trend, in terms of volume, may be decreasing due to improvements in domestic energy efficiency there still remains a strong demand for new connections. In 2015/16, there were around 9,000 third party or competitive connections quoted for adoption by NGGDL (approximately the same as 2014/15). However, so far in 2016/17, there has been a 40% increase seen in the number of potential connections, particularly for large industrial and commercial premises and energy conversion. This calls for us to deal with more reinforcement projects due to load sizing.

Gas Distribution offers the following exit connection services:

- domestic connections and alterations
- non-standard new services: band 1, 2 & 3 (depending on load size and complexity)
- non-standard service alterations: band 2 & 3 (depending on load size and complexity).

Competitive connections fall into the following categories:

- GTs (own and operate) gas transportation systems. A physical connection is made to the distribution network, allowing gas to be supplied to the GT's system. The connection to NGGDL network is the connected system exit point
- UIPs build gas infrastructure for customers. When complete, the UIP asks the gas transporter (i.e. NGGDL) to adopt the pipeline. If the infrastructure has been designed and constructed to gas industry standards, it is owned and operated by the gas transporter.

There's information about our services, charges and terms and conditions at: www2.nationalgrid.com/UK/Services/Gas-distribution-connections

Entry connections (new supply of gas)

Our Biomethane Gas to Grid Customer Connection Guide helps our customers understand the connection process, from the initial customer enquiry, through project construction, to gas flowing on the first day.

You can download the guide at: www2.nationalgrid.com/UK/Our-company/Gas/Sustainable-Gas

We respond to enquiries and give our customers technical guidance and support so they have the information they need to make the important decisions about their projects. We have developed our processes so they can be



Biomethane installation with single box grid entry unit
Inset: Single box grid entry unit

transferred easily to connections of unconventional gas sources such as shale and BioSNG.

We want to make it easy for biomethane producers to connect and inject their renewable gas into the pipeline and grid network. Adding biomethane to the grid will help the UK minimise its carbon footprint and use less unsustainable fossil fuels. It will also increase the security and diversity of energy supplies.

We will continue to work with our stakeholders to make our processes more efficient. During the last year, the introduction of our 'Above 7 bar Self Lay' model has meant that customers have more choice of types of connection, placing us in a unique position across the gas networks with 7 self-lay connections completed at pressures above 7 barg. In areas with restricted capacity, we are now offering variable flow to facilitate further connections.



Lindholme, Doncaster, is operated by Future Biogas and was commissioned in October 2013. The sites' feedstock is supplied in conjunction with local agricultural land break crop cycling, to produce biogas for processing to grid compliant biomethane at a flow rate of 600scm/h.

'Just a quick note to thank you for your support on our gas to grid project over the last couple of weeks. We achieved our gas on date on 24th March so thank you for allowing some flexibility with regards to the E2E onsite tests which certainly enabled us to do this.' – United Utilities

Commercial operation of the network

Industry arrangements, covered by the Uniform Network Code (UNC), have recently changed with modifications made to the rules that govern the processes of gas transportation systems. You can read them on the **Ofgem** website.

The UNC is a contract between shippers, suppliers and gas transporters. It manages the commercial arrangements between the parties and underpins the GB Gas Industry. Any party to the UNC can propose a modification to the contract and all parties then discuss, develop and vote on any recommended changes, which are agreed by Ofgem.

NTS exit reform

A change to the exit capacity regime (providing shippers with an entitlement to take gas off the NTS), introduced in October 2012, means we can now use products of varying capacity to manage the balance between gas supply and demand in our networks safely and efficiently. These include:

- long-term, medium-term, firm and off-peak daily products
- using agreed industry processes to manage our use of capacity and transfer capacity between offtakes if necessary
- long-term, medium-term and daily release of NTS offtake (flexibility) capacity, which is an integral part of our operating strategy.

Future developments

The UNC is revised when needed to facilitate user requirements to ensure fair competition. NGGDL is reviewing future system flexibility requirements of the NTS by engaging with our stakeholders throughout 2016/17 to understand geographic distribution of supply and demand (including 1-in-20 peak levels) and system linepack and pressures (gas stored within a network). Discussion about this could influence the exit regime and current stakeholder outputs are used within our scenarios for gas models. A link to more information is below:

www.talkingnetworkstx.com/SF-What-is-System-Flexibility.aspx

Industry arrangements covered by the Uniform Network Code (UNC) have recently changed and you can read them on the Ofgem website.



Future investments

Key capital investment

The HP distribution network transports and stores the gas, which is then cascaded down the intermediate (IP), medium (MP) and low pressure (LP) tiers. Most customers are supplied from the below 7barg distribution network.

The annual update of the supply and demand forecasts helps develop NGGDL investment plans. This section looks at the sanctioned investment and reinforcement projects being considered for construction between 2015/16 and 2020/21.

Investment planning process

The aim of the investment planning process is to review gas demand and storage requirements in light of winter experience, and update gas demand and supply forecasts along with other factors.

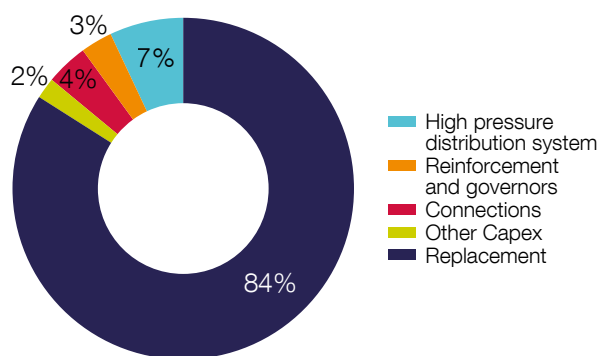
We use this information to identify the investment that is needed to efficiently and effectively maintain a reliable network. Here is a view of the investment needs that came out of the latest planning cycle.

The annual update of the supply and demand forecasts helps develop National Grid Gas Distribution's UK investment plans.

Planned investment

Indicated below is the expected level of net capital expenditure (Capex) over the next five years, 2015/16 – 2020/21 (as per our RIIO business plan) split by the following categories:

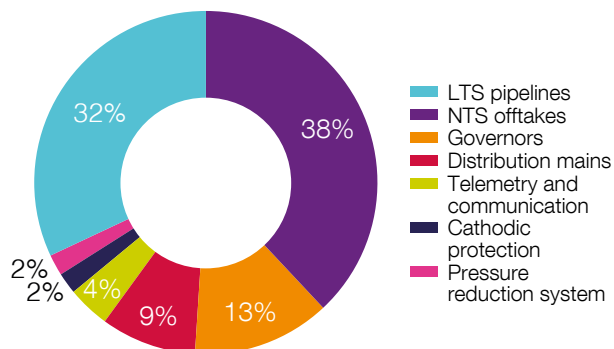
- **'High distribution system'** relates to investment to maintain and develop equipment that operates at pressures greater than 7barg. For example, investment in obsolete equipment or more efficient gas heating technology.
- **'Reinforcement and governors'** relates to investment, both general and specific, that increases the capacity of below 7barg systems, typically by constructing new mains and governor installations. In order to facilitate our London MP Strategy we are building in additional capacity, where required, by upgrading or commissioning new governor installations.
- **'Connections'** relates to the net cost to National Grid Gas of connecting new gas customers, both domestic and non-domestic, to the gas supply network
- **'Other capex'** relates to investments on lower pressures gas network assets such as MP valves or pressure management and pressure elevation to avoid reinforcement
- **'Replacement (Repex)'** relates to the money invested in replacing old metallic mains, metallic services and riser pipes in multi-occupancy buildings.



Total investment by type



This does not show Capex to provide additional entry capacity. There may be significant investment in this capacity depending on how quickly new sources of gas are developed and how many connections Gas Distribution has to fund.



Capital Expenditure 2015/16 – 2020/21

The following capital investment projects represent over half of our capital investment plan (excluding Repex and Connections):

- below 7barg obsolete replacements
- preheating replacement (water bath heaters)
- MP and IP strategic valve remediation
- below 7barg special crossings remediation
- pressure management equipment replacement
- repair of pipeline metal loss defects
- inline pipeline inspections
- reduced depth of cover pipelines.

Below 7barg obsolete replacements

This programme of work replaces equipment that is, or soon will be, obsolete. This ensures that our networks remain reliable, maintaining security of supply. This will represent the largest investment under the ‘reinforcement and governors’ category.



Refurbishment of site pipework on HP reduction installation.

Preheating replacement (water bath heaters)

Without preheating, our pipe network would be subject to much higher levels of expansion and contraction, following pressure changes this would lead to pipelines becoming brittle. We need to invest in our ageing fleet of water bath heaters so we can maintain the integrity of our pipeline and mains networks.

Using reliable and cost efficient systems, we can target expenditure to replace or repair water bath heaters to make sure they perform well to benefit our customers and to prepare for future compliance with the EU Medium Combustion Plant directive that will come in to force in 2025.

MP and IP valve remediation work

We need to maintain our strategic valves so we can ensure security of supply and reduce the impact on customers while we carry out emergency repairs on our gas networks. This investment will make sure that our strategic valves operate correctly and comply with current design standards.

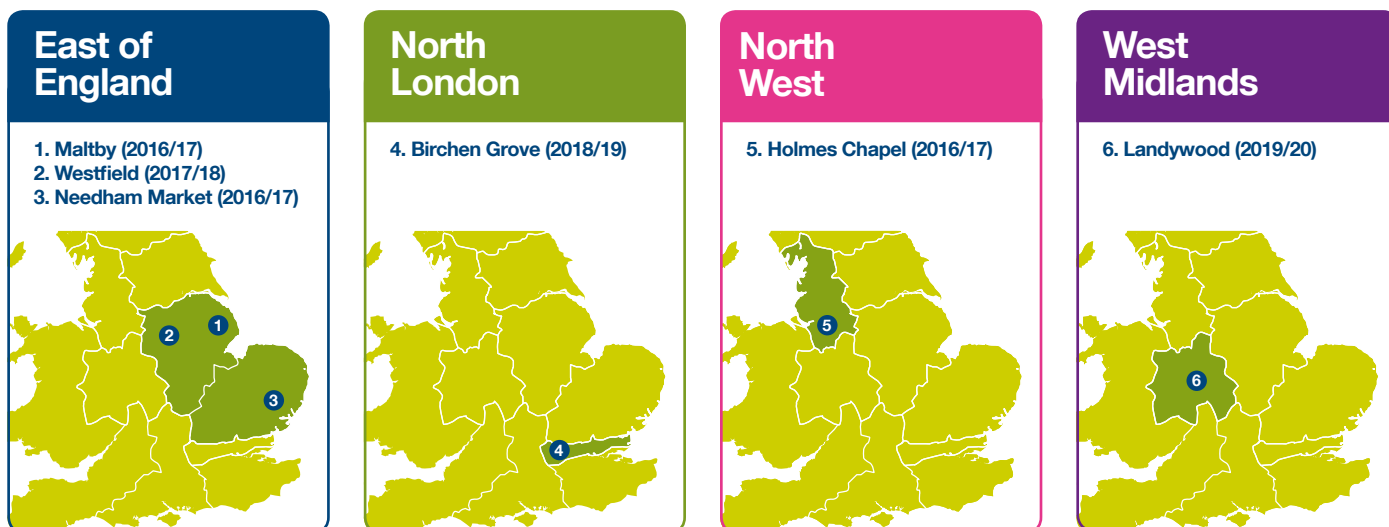
Below 7barg special crossing remediation

Investment in our distribution crossing will maintain a secure supply of gas. This remediation work will include re-validating the pipework coating protection systems and crossing supports structures ensuring the integrity of our assets and safeguarding the public.



Modular boiler gas heating system on a HP reduction installation.

Planned reinforcements



Significant asset investment above £500,000 by NGGDL geographic network

Above 7barg reinforcements

Network models are analysed to make sure that the future forecast demand levels can be transported. If not, work is carried out to identify how the system should be reinforced. This reflects our Gas Transporters' Licence obligation to provide transportation capacity consistent with meeting a 1-in-20 peak day demand⁷.

The HP distribution system is designed to transmit and store gas while meeting the 1-in-20 peak day criterion. Using demand forecasts, the system is developed to maintain this capability. The significant distribution pipeline or associated asset projects (greater than £0.5million) that are approved and under consideration are shown above.

Below 7barg reinforcements

The below 7barg system must operate between levels of pressure defined by statute, regulation and safe working practices. We are developing the below 7barg distribution system, investing in mains, services and associated plant so we can provide capacity to customers who want to connect to our network and to other gas transporters' requests for transportation services. Reinforcement work at Needham Market for domestic and commercial gas use is currently planned for delivery this year.

When we quote any connections to our network, we assess capacity on a first-come, first-served basis. This means that

the capacity available today might not be there tomorrow, so, for long-term projects, information about current available capacity may be out of date by the time a development is complete.

If capacity is not available for a development, it can be provided. The service level agreements within the connections process allow for lead times to deliver any reinforcement requirement. Over the life of a proposed development, there should be no expected issues, but the cumulative effect of a large number of loads may well overload the upstream systems, so they must be carefully managed. Potentially higher pressure system reinforcement can pose a problem, but this is rare and would be picked up at the point when the connections are requested. These are usually phased and shouldn't stop the development.

It is difficult to decide how any site will be developed and what pressure tier will be appropriate. The utility infrastructure providers (UIPs) or gas transporters (GTs) will ask for a connection when it suits them. This means that a site could be connected at any one of many points, and until there's a connection request, it is difficult to plan. A single site might be split into many sites for different GTs, all wanting connections for their part of the 'planned' site.

What we can say initially is whether or not there is infrastructure in an area, and if that infrastructure is capable of supplying an identified development.

⁷ 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.

London supply strategy



Replacement of metallic pipeline, Kings Road, London



Major Gas pipe replacement work in London

The London Supply Strategy is a 15 year project spanning RIIO-GD1 and RIIO-GD2 (2013 to 2029) to make some of the city's medium pressure Victorian metallic pipelines safer. Most of these city centre large pipes are more than 100 years old and close to some nationally important landmarks and buildings.

The project aims to create a robust medium-pressure network in London's city centre operating at 2barg. The RIIO-GD1 workload is valued in the region of £50m. The map above shows where mains are being replaced. The scope in RIIO-GD1 includes:

- replacement of 28km MP mains
- a River Thames tunnel crossing
- renewal of 7 pressure reduction installation sites (pit governors) including one located in Hyde Park
- remediation of 40 large diameter strategic valves along the route of the mains replacement.

To date, we have successfully replaced over 9km of metallic pipelines in key locations including the Kings Road, Chelsea and Gresham Street, City of London.

We have listened to stakeholders and we will consult them throughout the project. Our engagement has included:

- talking to the local community and businesses about the proposed works
- working with Transport for London and the local London borough councils to agree road closures, diversion routes and traffic management plans
- working with the Royal Chelsea Hospital and London Borough of Wandsworth to agree the proposed River Thames tunnel crossing
- working with the Thames Tideway Tunnel project to ensure a coordinated approach to working in similar areas around Chelsea Embankment
- working with local hospitals to ensure alternative fuel supplies while works are ongoing outside.

After the London Supply Strategy RIIO-GD1 project is complete, a RIIO-GD2 project will replace another 24km of mains to further reduce process safety risks associated with the Victorian metallic pipelines. The projects will provide vital infrastructure to support London's economic growth and help maintain its position as a leading 21st century city.



£50m

The RIIO-GD1 LMP workload is valued in the region of £50m

Other considerations

Reduced depth of cover pipelines

A shallow or reduced depth of cover is when the pipeline is below the industry's recommended minimum depth. This recommended depth is to minimise the risk of third party damage, for example, from agricultural activities such as ploughing. Even where pipelines were originally laid to industry standard, farming and weather can lead to soil erosion over time.

Line walking inspections have been reintroduced to help spot pipes that are not well covered. We are now in our fourth year and have surveyed the entire LTS pipeline network.

Walking inspections of the LTS pipeline network is an accurate method to record the depth of LTS pipelines and identify how we could respond.



Initial line walking inspections show that 255km (5%) of our LTS pipelines have shallow depth of cover. Once identified, these pipe sections will be resurveyed and the affected pipeline lengths will be quantified. However, mitigation for the total length may not be required as third party damage is unlikely for pipelines in non-agricultural areas such as land development for canal tow paths. Where there is no suitable measure to quantify the lengths due to, for example, ground instability, detailed feasibility studies will be carried out to determine the appropriate solution.

Making sure pipes are deep enough are of high priority, as damage or failure to an LTS pipeline could mean loss of supply and safety, as well as being an environmental risk. We have allocated £11.4m in our business plan over the remaining RIIO period to deal with this issue. However, as these shallow pipes were not identified earlier, they were excluded from our Final Proposal Business Plans to Ofgem and our set allowance did not account for this additional expenditure.

We must make sure that we can manage the risk posed by these pipelines. Steps to mitigate risk include:

- legal agreements
 - restrictive covenants
 - easement amendments
- improved pipeline marking and liaison with landowner (in non-agricultural areas)
- top soil replacement and reinstatement
- pipeline crossing construction
- pipeline diversions.

We expect that these activities will address approximately 5km of LTS pipelines per year from 2017/18. We will have to draw up legal agreements with involved parties, which will take time. In principle, NGGDL will seek legal agreements first because physical solutions such as diverting the pipeline will be expensive.

Property portfolio

We continue to review the supply network to ensure it remains effective and provides the best possible value. Where sites are now considered surplus to requirements, we will work with stakeholders and our partners to reduce cost and consider opportunities for rationalisation. For example, we are on track with our RIIO-GD1 commitment to demolish over 100 gas holders, and we are currently supporting the redevelopment of a number of former holder sites, including those at Battersea and Fulham.



The pictures above show the location of the Battersea Holder station and the future development proposed for this site.



255km

of LTS pipelines
have shallow depth



Innovation

For Today



Customer Experience

Reduce the size and duration of our replacement and remediation activities. Continually improve our safety standards and improve our customer and stakeholder experience through proactive engagement.



Life Extension

Extend the life of our assets through increased monitoring and new remediation techniques. Increase our utilisation and network reliability, thereby reducing disruption of service.



Cost Efficiency

Continually reduce the cost of running our network by optimising the way we work, improving the efficiency of assets and the cost effectiveness of our investment decisions.



Environment

Reduce our impact on the environment through energy demand and waste reduction and wherever possible have a positive impact on the environment in which we work.

For Tomorrow



Unconventional Supplies

Open up the use of our network to alternative energy sources. Increase diversity and security of supply through the identification of renewable gas sources.



Future Network

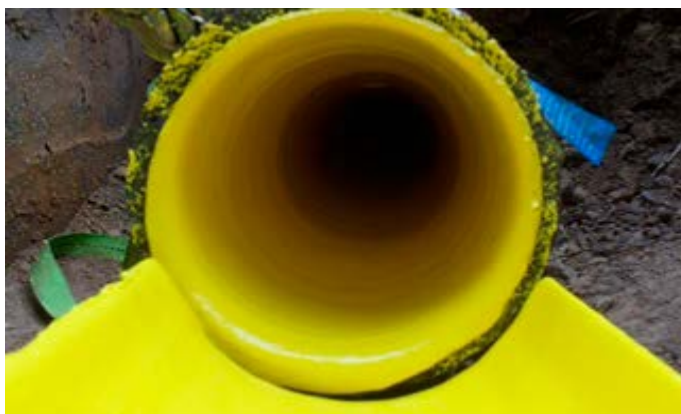
Facilitate integration of our network into the wider energy chain to ensure least cost energy provision for our customers.

Over the next three to five years we plan to continue to embed innovative outputs and best practice into our business.

We are now in our fourth year of Network Innovation Allowance (NIA) funding under RIIO, and our portfolio has continued to grow. We strive to deliver value to our customers and uphold our stakeholder commitments: to keep people safe, be reliable, safeguard future generations, provide value for money and deliver quality service for all. With that in mind, we have a diversified set of projects, and our focus is continuing to shift towards implementing the outputs of these projects. We are focusing on six 'Value Areas', which reflect the RIIO Outputs and our Gas Distribution Ambition. These areas have been split into two categories: 'For Today' and 'For Tomorrow', as illustrated on the opposite page.

Customer experience

We continue to emphasise 'No Dig' projects, using technologies to reduce disruption and interruptions to our customers. Alongside more mature projects such as PRISM (pipe replacement in-situ manufacturing) project, where we are spray-lining existing cast iron pipes with a polymer to create a fully structured liner, we have also made real progress towards supporting NGGDLs strategy in remediating pipes in multi-occupancy buildings. To optimise our customer experience we are now fully focussed on either repairing or remediating the pipe with replacement being the last option. One of the techniques that we are developing and planning to deploy into the business this year is Epoxy Liners. These liners are blown through the existing riser system and can be used to seal leaking joints providing a means of remediation.



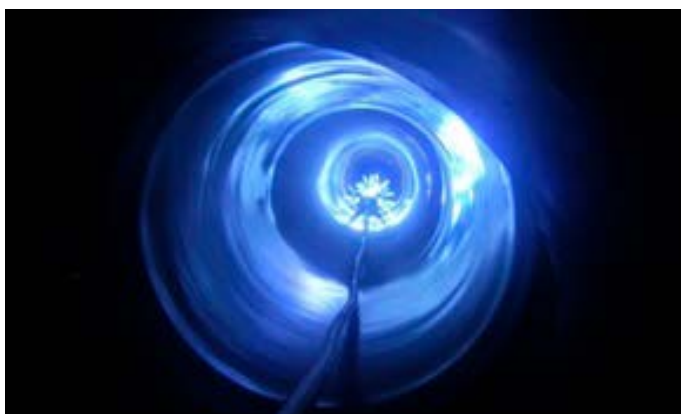
Polymer liner sprayed onto cast iron pipe

Cost efficiency

By optimising our processes, improving the efficiency of assets and the cost effectiveness of our investment decisions, we can continually reduce the cost of running our network. The UK Gas Distribution Industry is in the process of implementing a monetised risk methodology, enabling a consistent measure of the performance of asset investment. This will provide a platform to ensure investment is efficiently targeted against our asset portfolio, creating the greatest benefit for our customers and stakeholders.

Life extension

Monitoring and remediation techniques help reduce service disruption and increase our network reliability. We have been trialling Cured in Place Pipe Lining (CIPP) for use on our distribution networks as an alternative to replacing our larger diameter iron pipes.



Resin lining tube inserted into pipe and cured to harden

Environment

We strive to reduce our waste and energy demand, which will help us meet our 2050 environmental commitments.

This year, we initiated a new collaborative project hosted by Keele University, which focused on understanding the impact of transporting hydrogen through our pipe networks. When burned, hydrogen produces water only which has no adverse environmental impact.

The aim of this project is to demonstrate that natural gas containing levels of hydrogen beyond those currently permitted in the Gas Safety (Management) Regulations (GS(M)R) can be safely and efficiently distributed and used in a representative section of our distribution network. It is proposed to try a blend of 20% hydrogen to 80% natural gas. We will also try supplying pure hydrogen in a small and isolated section of our pipes.

Successful demonstration of hydrogen in the network has the potential to unlock significant decarbonisation of heat.

Unconventional supplies

Security of supply is an essential element of our research, so it is important that our network can transport gas from a variety of different renewable sources. Through the NIC funding opportunity, we are planning to deliver pipeline quality gas at a BioSNG pilot plant in Swindon. The gasification plant and associated gas quality equipment have been built and we are now underway with a larger BioSNG plant, to demonstrate the technology under commercial conditions.

Future network

We are integrating our network into the wider energy chain to provide the lowest cost of energy for our customers. This year saw the successful connection of the first HP local transmission system Compressed Natural Gas (CNG) filling station in Leyland, Lancashire. The filling station which will eventually be capable of refuelling more than five hundred HGVs per day already has a major customer: John Lewis Partnership; which has a regional distribution centre close by. The success of this project has initiated the purchase of NGGDL first CNG fuelled vacuum extraction truck.

Looking ahead

As our portfolio continues to mature, we are shifting our focus to deployment and over the next three to four years we plan to continue to embed innovative outputs into our business.

Appendices

A1 – Supply and demand data

This section contains the forecast for demand looking ten years ahead by geographic network.

Each network contains four graphs detailing:

- historical and forecasted annual gas demand
- historical and forecasted 1-in-20 peak gas demand
- comparison in demand between 2015 and 2016
- load breakdown by category.

This information will help our stakeholders to review the changes in our forecasted demand through to 2024/25 so that they can anticipate how the information could influence any potential commercial considerations.

All graphs shown in this section, and the data that sits behind them, can be downloaded in an **Excel** format from the National Grid website.

East Anglia Network

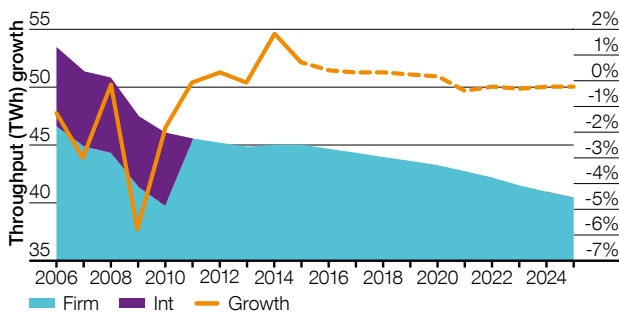


Figure A1.1A – East Anglia LDZ Historical & Forecast Annual Gas Demand

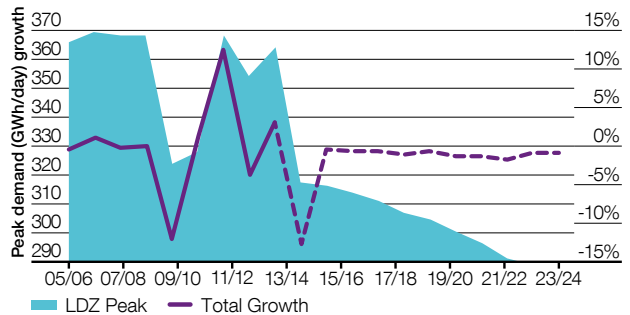


Figure A1.1B – East Anglia LDZ Historical & Forecast 1-in-20 Peak Gas Demand

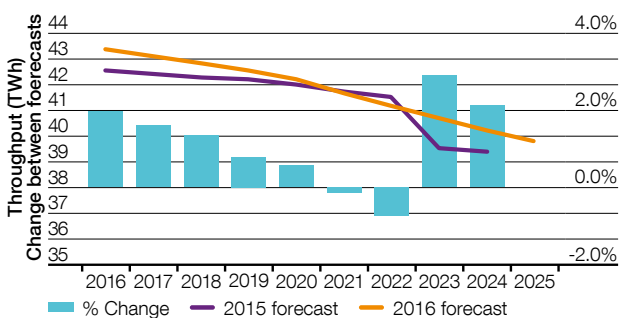


Figure A1.1C – Comparison of East Anglia LDZ Annual Demand Forecasts

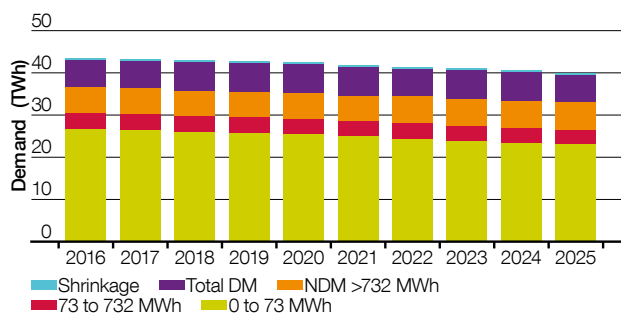


Figure A1.1D – East Anglia LDZ Forecast Annual Demand – Split by Load Categories

East Midlands Network

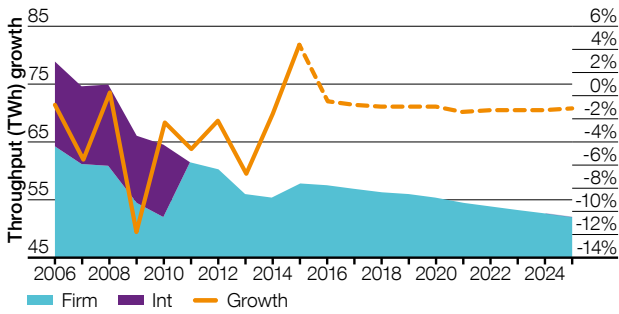


Figure A1.2A – East Midlands LDZ Historical & Forecast Annual Gas Demand

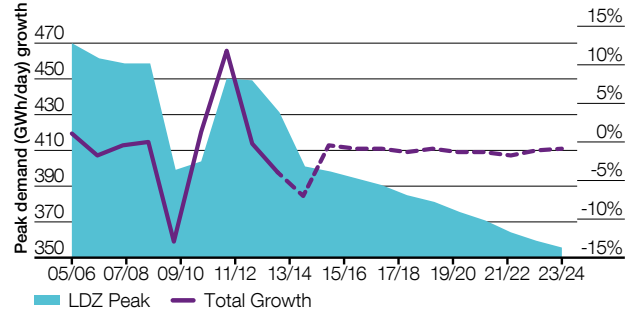


Figure A1.2B – East Midlands LDZ Historical & Forecast 1-in-20 Peak Gas Demand

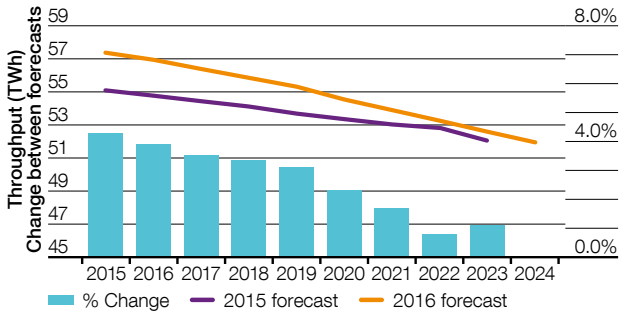


Figure A1.2C – Comparison of East Midlands LDZ Annual Demand Forecasts

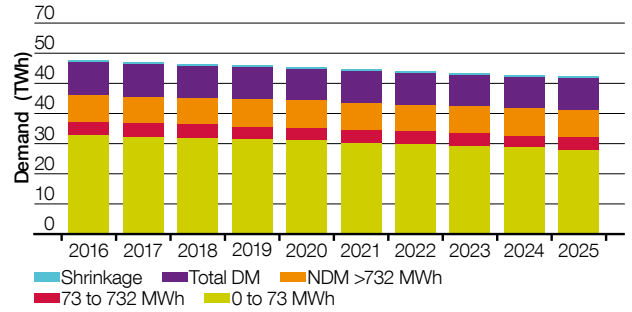


Figure A1.2D – East Midlands LDZ Forecast Annual Demand – Split by Load Categories

North London Network

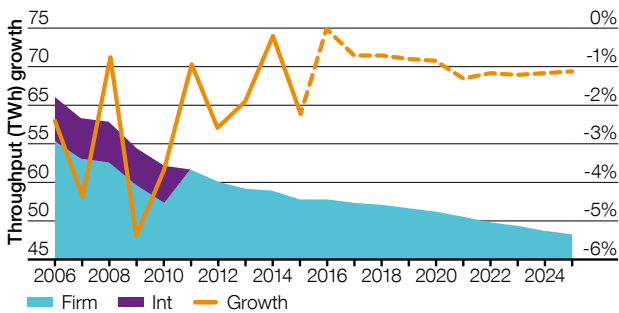


Figure A1.3A – North London LDZ Historical & Forecast Annual Gas Demand

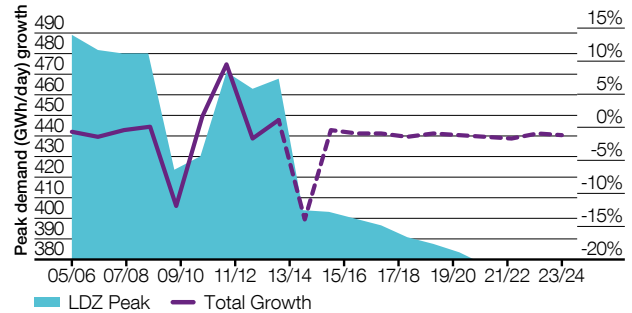


Figure A1.3B – North London LDZ Historical & Forecast 1-in-20 Peak Gas Demand

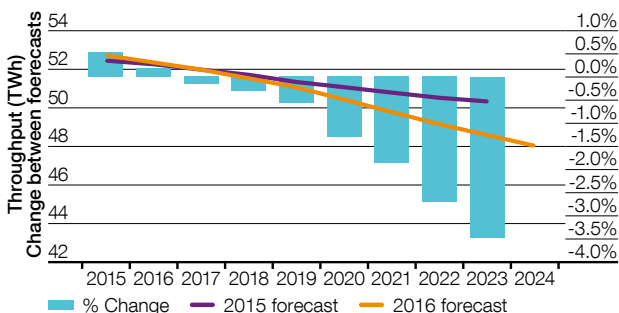


Figure A1.3C – Comparison of North London LDZ Annual Demand Forecasts

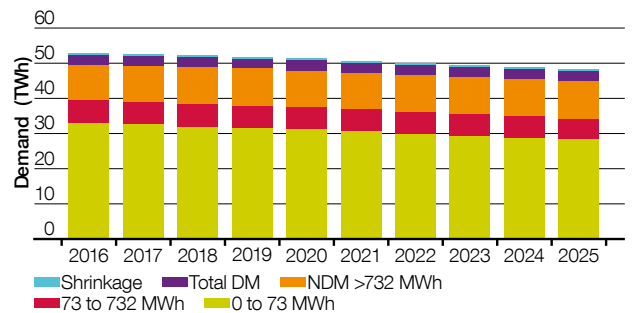


Figure A1.3D – North London LDZ Forecast Annual Demand – Split by Load Categories

Appendices

North West Network

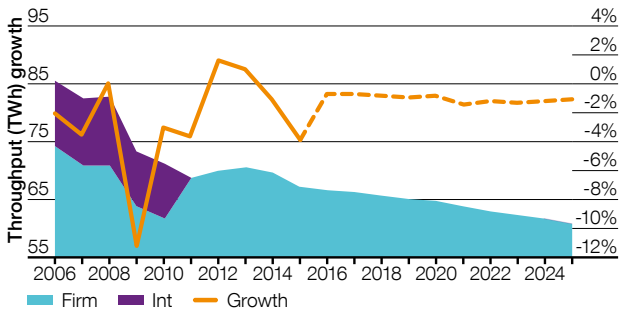


Figure A1.4A – North West LDZ Historical & Forecast Annual Gas Demand

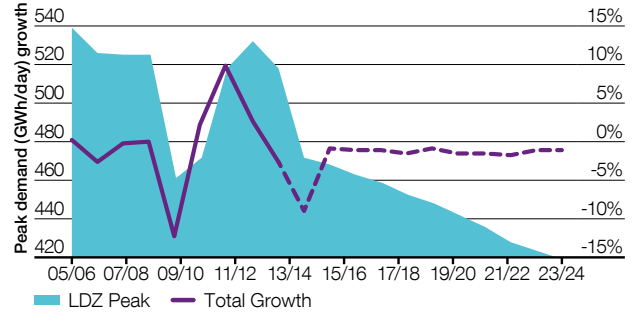


Figure A1.4B – North West LDZ Historical & Forecast 1-in-20 Peak Gas Demand

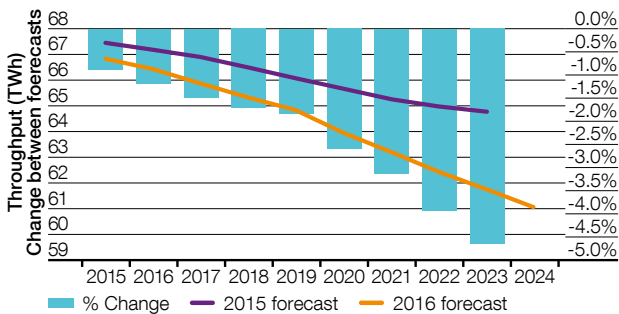


Figure A1.4C – Comparison of North West LDZ Annual Demand Forecasts

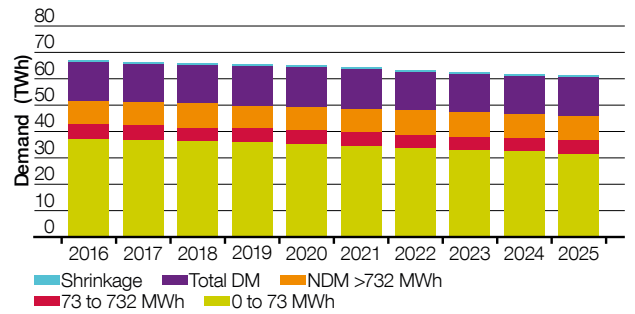


Figure A1.4D – North West LDZ Forecast Annual Demand – Split by Load Categories

West Midlands Network

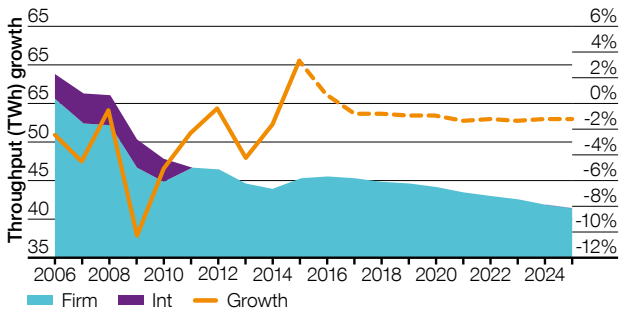


Figure A1.5A – West Midlands LDZ Historical & Forecast Annual Gas Demand

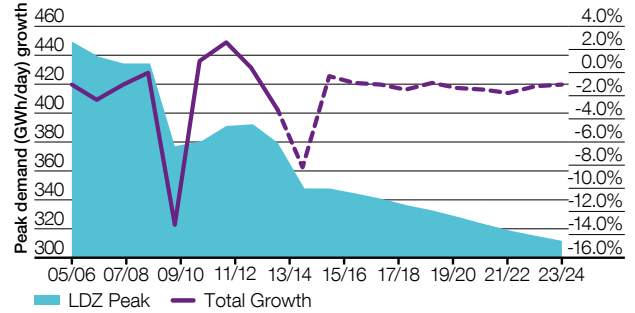


Figure A1.5B – West Midlands LDZ Historical & Forecast 1-in-20 Peak Gas Demand

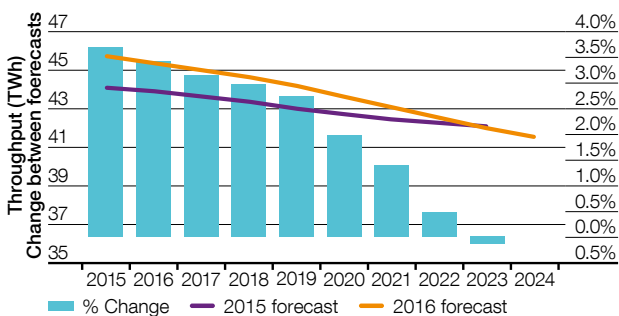


Figure A1.5C – Comparison of West Midlands LDZ Annual Demand Forecasts

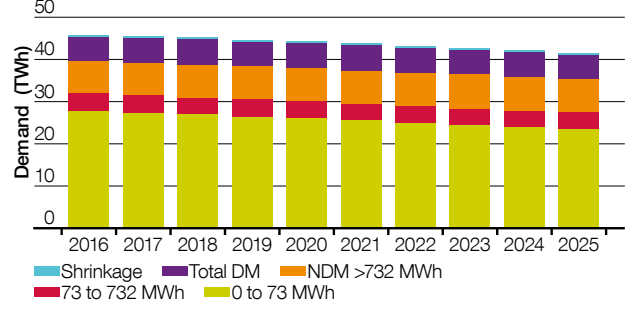


Figure A1.5D – West Midlands LDZ Forecast Annual Demand – Split by Load Categories

A2 – Actual flows 2015

Annual flows

Forecasts of annual demand are based on average weather conditions. So 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.

Seasonal normal weather conditions are recalculated at appropriate frequencies determined by the cross-industry Demand Estimation Sub Committee (DESC). They were last updated in winter 2014/15 and are based on a historic dataset which has been adjusted for the effect of climate change using the Climate Change Methodology (CCM). This replaces the older EP2 method used between 2010 and 2014. For more information please refer to the document '[DESC Approach to derivation of new Seasonal Normal Basis](#)'.

Tables A2.1A to A2.1E compare actual demands during the 2015 calendar year with the forecasts presented in the 2015 LTDP. 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 in line with the CCM approach.

TWh	2015 Actual Demand	Weather Corrected Demand	2015 LTDP Forecast Demand
0–73 MWh	27.5	27.1	26.9
73–732 MWh	3.6	3.7	3.5
>732 MWh Firm	12.3	11.9	13.2
Interruptible	0.0	0.0	0.0
Total Consumption	43.4	42.7	43.6
Shrinkage	0.2	0.2	0.2
Total Throughput	43.6	42.9	43.8

Table A2.1A – East Anglia LDZ Annual Demand for 2015 (TWh)

TWh	2015 Actual Demand	Weather Corrected Demand	2015 LTDP Forecast Demand
0–73 MWh	33.9	33.4	33.5
73–732 MWh	4.3	4.4	4.2
>732 MWh Firm	19.3	18.8	19.1
Interruptible	0.0	0.0	0.0
Total Consumption	57.4	56.6	56.8
Shrinkage	0.3	0.3	0.3
Total Throughput	57.7	56.9	57.0

Table A2.1B – East Midlands LDZ Annual Demand for 2015 (TWh)

TWh	2015 Actual Demand	Weather Corrected Demand	2015 LTDP Forecast Demand
0–73 MWh	34.1	33.6	33.5
73–732 MWh	6.3	6.5	6.1
>732 MWh Firm	12.1	11.7	14.1
Interruptible	0.0	0.0	0.0
Total Consumption	52.5	51.8	53.7
Shrinkage	0.2	0.2	0.3
Total Throughput	52.7	52.0	53.9

Table A2.1C – North London LDZ Annual Demand for 2015 (TWh)

TWh	2015 Actual Demand	Weather Corrected Demand	2015 LTDP Forecast Demand
0–73 MWh	38.8	38.1	38.9
73–732 MWh	5.4	5.6	5.3
>732 MWh Firm	22.7	22.1	25.4
Interruptible	0.0	0.0	0.0
Total Consumption	66.9	65.8	69.6
Shrinkage	0.4	0.3	0.4
Total Throughput	67.3	66.1	69.9

Table A2.1D – North West LDZ Annual Demand for 2015 (TWh)

TWh	2015 Actual Demand	Weather Corrected Demand	2015 LTDP Forecast Demand
0–73 MWh	28.6	28.4	28.4
73–732 MWh	4.1	4.1	3.9
>732 MWh Firm	12.4	12.0	12.9
Interruptible	0.0	0.0	0.0
Total Consumption	45.1	44.5	45.3
Shrinkage	0.3	0.3	0.3
Total Throughput	45.4	44.8	45.6

Table A2.1E – West Midlands LDZ Annual Demand for 2015 (TWh)

Maximum and peak day flows

The following table reflects actual LDZ entry flows on the maximum demand day of gas year 2015/16 compared to the forecast peak daily flows in a 1-in-20 cold winter.

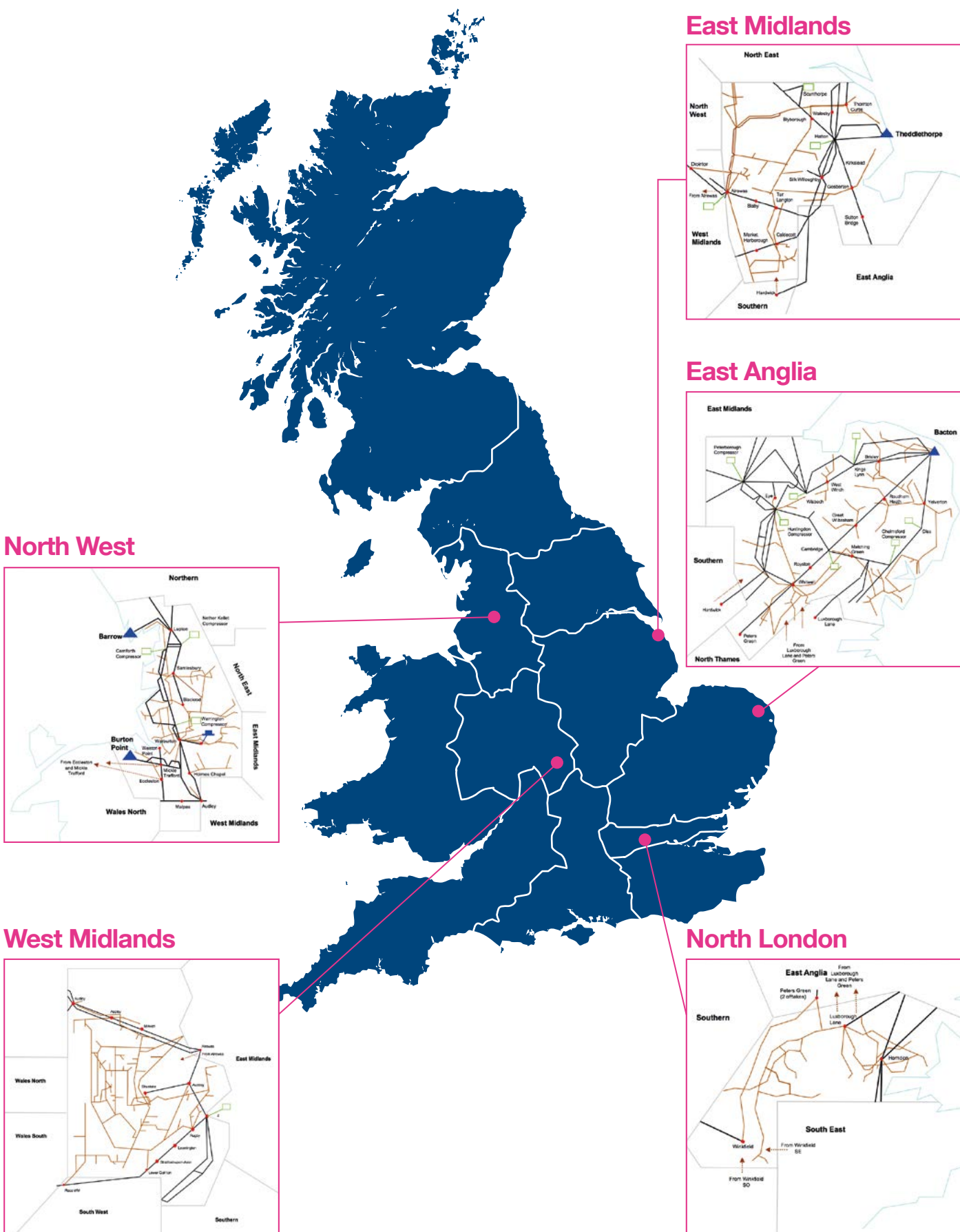
LDZ	Maximum Day	Demand	1-in-20 Forecast Peak for 2015/16
East Anglia	19-Jan-16	22.69	29.39
East Midlands	14-Jan-16	27.45	35.31
North London	20-Jan-16	27.92	37.39
North West	16-Jan-16	31.92	43.04
West Midlands	20-Jan-16	23.53	31.16

Table A2.2A – Actual GD UK Input Flows on Maximum Demand Day of Gas Year 2015/16 (mcmd)

LDZ	Minimum Day	Demand
East Anglia	07-Aug-16	3.44
East Midlands	06-Aug-16	4.34
North London	27-Aug-16	4.06
North West	06-Aug-16	6.32
West Midlands	06-Aug-16	3.36

Table A2.2B – Actual GD UK Input Flows on the Minimum Demand Day of Gas Year 2015/16 (mcmd)

A3 – High pressure distribution system



Key contacts and links

If you have an enquiry about our service or would like to give feedback on anything in our 2016 LTDP, here is a list of industry and business contacts.

Ofgem www.ofgem.gov.uk

The agency responsible for regulating Great Britain's gas and electricity markets.

Office for Low Emission Vehicles www.gov.uk/government/organisations/office-for-low-emission-vehicles

The Office for Low Emission Vehicles works across Government to support the early market development, manufacture and use for ultra-low emission vehicles. Read how their work helps to reduce greenhouse gas emissions and air pollution on our roads.

Joint Office of Gas Transporters www.gasgovernance.co.uk

Read about the Uniform Network Code on the Joint Office website. This site also contains details of live modifications to the UNC document and details of the technical committees.

BEIS www.gov.uk/government/organisations/department-for-business-energy-and-industrial-strategy

The Department for Business, Energy & Industrial Strategy is a Government department bringing together responsibilities for business, industrial strategy, science, and innovation with energy and climate change policy.

xoserve www.xoserve.com

Organisation responsible for the information management of all the gas supply points in Britain and gas meters database.

Energy Networks Association www.energynetworks.org

Organisation that represents electricity and gas network operators. They influence decision makers about regulation, cost and safety matters and facilitate best practice and collaboration across energy industries.

National Grid www.nationalgrid.com

The main National Grid corporate website, where you will find details of services for Gas Distribution, Gas and Electricity Transmission as well as our non-regulated business.

Gas Distribution Exit Connections www2.nationalgrid.com/UK/Services/Gas-distribution-connections

Website that provides information and process details for Exit connections and capacity enquiries to the National Grid Gas Distribution network.

Gas Distribution Biomethane Connections www2.nationalgrid.com/UK/Our-company/Gas/Sustainable-Gas

Webpage that provides details for sustainable gas Entry connections to the National Grid Gas Distribution network.

Gas Distribution Innovation Team www2.nationalgrid.com/UK/Our-company/Innovation/Gas-Distribution-Innovation

Webpages explaining the different types of funding available for innovation projects and showcases new technologies for Gas Distribution.

Alternatively, contact the team by emailing:
.box.GD.Innovation@nationalgrid.com

National Grid Gas Distribution Talking Networks www.talkingnetworksngd.com

Web portal for our stakeholders to share views and feedback throughout the year to help us plan and develop our business and the wider industry.

Website that provides details of National Grid's view on UK energy use into the future.

Smell gas? Contact the National Gas Emergency Service if you have any concerns about gas safety on:
0800 111 999



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⁸ Special Condition D3 requires that a statement, published annually, shall provide a ten-year forecast of Distribution Network Transportation Activity concerning likely use of the pipeline network and system developments that can be used by companies, who are contemplating connecting to our system or entering into transport arrangements, to identify and evaluate opportunities.

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