

Cadent

Your Gas Network

Developing networks for the future

Long-Term Development Plan 2019



Table of Contents

We are Cadent. Your gas network.....	4
Welcome to the Long-Term Development Plan 2019.....	5
How we engage with our customers and stakeholders.....	8
Our ambition	8
Our customers' priorities.....	9
A new approach and new voices	9
Customer Engagement Group.....	10
Centrally defined, regionally delivered.....	10
Your feedback.....	10
Energy networks in transition – the critical role of gas in decarbonisation.....	11
Short-term emissions reduction	12
Low-carbon gas supply	13
Biomethane connections	14
Transport – reducing emissions from freight	14
Off-gas grid decarbonisation	15
Demand.....	16
Appraisal of scenarios	16
Demand overview	16
Forecast demand.....	16
Forecast comparison and accuracy.....	18
Future demand factors.....	18
Facilitating connections to our networks	20
Entry connections	20
A changing network	21
Exit connections.....	21
Supporting customers in multi occupancy buildings.....	22
Facilitating timely network reinforcement	22
Commercial operation of the network.....	22
Facilitating distributed entry gas	23
Investing in our networks	24
Investment implications	24

Maintaining the integrity of our networks	24
Monetised risk.....	24
Asset data	24
Growing capacity of our networks	24
Low pressure reinforcements	25
Medium and intermediate pressure reinforcements	25
Upgrading our networks for the long term	25
Case study: putting safety first in North London.....	26
Driving change through innovation	28
Innovating for today	28
Bringing robotic technology to life: CISBOT	29
A quick, smart solution: Bonded Saddle.....	29
Learning from our London peers: Microstop.....	29
Delivering Net Zero.....	30
Hydrogen in our homes: HyDeploy.....	30
Ensuring accurate billing in a low carbon world: Future Billing Methodology.....	31
Networked hydrogen to remove CO2 emissions from heavy transport.....	31
Closing statement.....	33
Further reading	34
Regulatory basis for document	35

We are Cadent. Your gas network.

We own, operate and maintain the largest gas distribution network in the UK, providing our customers with the energy they need to stay safe, warm and connected.

Our networks

- 1** North West
- 2** West Midlands
- 3** East of England
- 4** North London



Welcome to the Long-Term Development Plan 2019

This report provides you with the information you need if you have plans to interact with or connect to our gas networks.

Our vision is to set the standards that all of our customers love and others aspire to. This means that our long-term plans are shaped by our customers and stakeholders. This annual publication is an important opportunity to share our latest long-term plan and our strategic thinking, and seek feedback so we can continue to adapt our activities going forward. We want to make it as easy and efficient as possible for you to interact with us.

This year, we have undertaken an unprecedented level of engagement with our customers and stakeholders across our regions to understand your priorities, and we are using this insight to develop a business which meets your expectations. We have a very experienced Board, and have established a highly skilled, independent Customer Engagement Group to challenge us on the ambition of our plans and bring experience from different business sectors into our thinking.

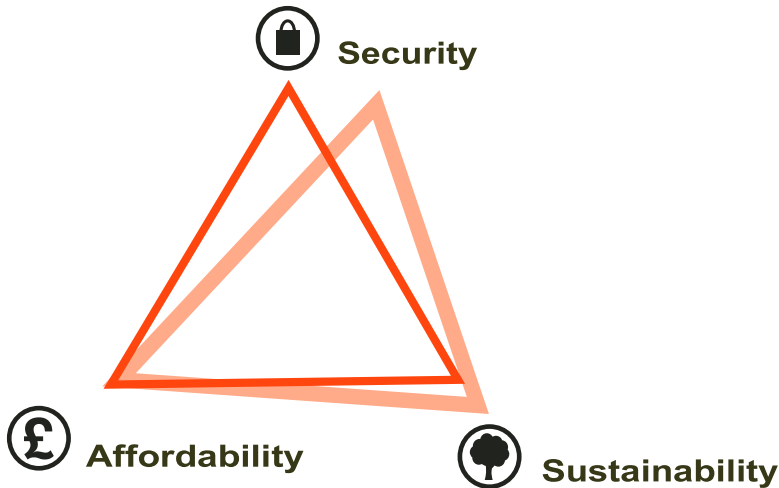


We've had a clear and structured Stakeholder Engagement Strategy for a number of years now, but this year we have significantly increased our efforts. We have become far more regionally focused and created a direct link between our Engagement Strategy and the actions that we take. This has involved a range of regional events and workshops, and building relationships with key organisations across our networks, including central and regional government, local authorities, Local Enterprise Partnerships, trade organisations, businesses, industry and academia. We have listened to a range of concerns, issues and ideas, and are using them to actively shape our business plans to present solutions and services that meet these needs. We share a number of our plans in this report, including:

- How we will support a step change in levels of green gas connecting to our network, by making the required network capacity available – this is a critical barrier our customers have raised with us
- How we will support off-gas grid communities near our gas networks to connect to low-carbon gas
- How our plans will provide the necessary flexibility to respond to new uses of our networks at scale, such as gas-fired, small scale power generation and combined heat and power schemes to reduce thermal energy waste.

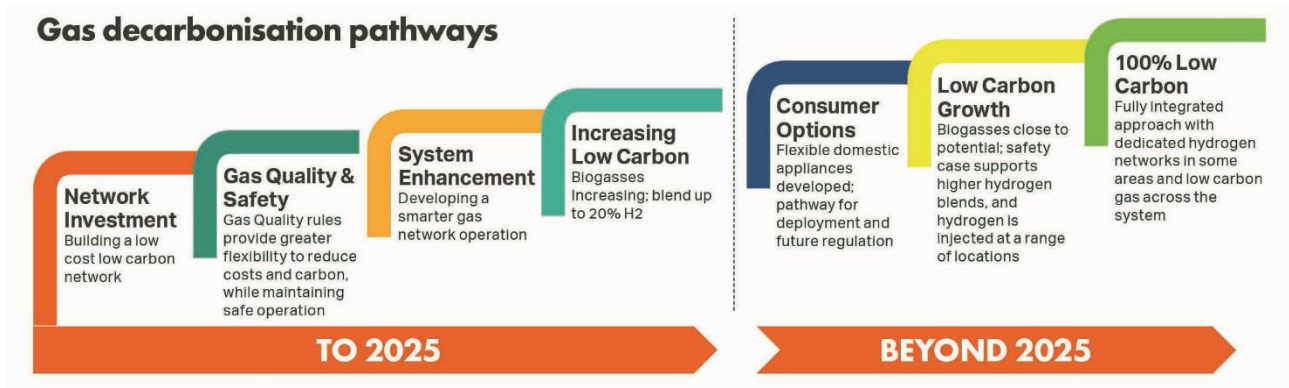
Government and public interest in the future direction of the energy industry continues to rise. Energy supply in the future, including both gas and electricity, will need to meet the ‘energy trilemma’, by being:

- **Secure** – continuing to operate safely and reliably, 365 days a year
- **Sustainable** – facilitating the decarbonisation of heat and power
- **Affordable** – reducing the number of families living in fuel poverty and keeping prices fair for all consumers.



We continue to engage with a broad range of stakeholders, supported by robust research and carefully focused demonstration projects, to ensure the importance of gas to society now, and into the future, is fully understood. Our gas networks are at the centre of this energy transition, and we must play a leading role through our own activities as we move towards a low-carbon future.

We support the Energy Networks Association’s (‘ENA’) Gas Decarbonisation Pathways Project, a major industry initiative to build a low-cost, low-carbon network and develop new technologies that make the most of renewable gas and hydrogen. The Project will help coordinate network activity and support policy-making for decarbonised gas. We are also taking action by developing projects and partnerships at scale to demonstrate that this future is realistic and deliverable, and provides a route to decarbonisation, at lower cost and with less disruption to customers and communities.



We are maintaining our focus on reducing emissions in the short term, with new sources and uses 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.

Our drive to decarbonise now and into the future is supported by our continued investment in our existing networks. Since 2012/13, we have replaced over 10,000 kilometres of our networks with durable plastic under our gas mains replacement programme. The new plastic pipes will result in lower emissions from our networks, and ensure their continued safety, reliability and efficiency. We continue to develop our plans to achieve our targets as quickly as practicable. We have also expanded our programme of improvements to our wider range of assets, to ensure we provide a reliable network for the future.

Efficient and innovative investment is critical to enable the substantial activity we expect to see in new sources of distributed gas connecting to our network; particularly biomethane. It is equally necessary to support the increasing volume of connections to our networks of new gas-fuelled electricity production, which is vital to secure the electricity grid.

I hope you find this report both interesting and informative. We welcome any views you have on the plan, including ideas for improvement. Please share your feedback with us at cadentgas.com/ltdp.

Ed Syson
Chief Safety and Strategy Officer
Cadent

How we engage with our customers and stakeholders

Our customers' and stakeholders' views, feedback and recommendations are vital to continuously improving the services we provide, and shaping the way we develop our network.

During 2018/19, we introduced a new enhanced engagement approach across the organisation to increase our reach and establish a more tailored and targeted process of engagement with customers and stakeholders.

In total we engaged with over 25,000 customers and stakeholders through face-to-face workshops and meetings, online forums, surveys, regional roadshows and webinars. Through our Customer Insights Forum, we have continuously used this feedback to identify priority areas for improvement. For instance, we have used feedback to reshape our household connections delivery approach, establishing a single point of customer contact and simplifying the end-to-end process. This has resulted in our North London network moving from an average customer satisfaction score of below 8/10 to over 9.3/10, the highest of all gas distribution networks.

Our ambition

Our vision is to set the standards that all of our customers love and others aspire to. The feedback we have received from our engagement activities has provided us with an array of ideas for improvement, which we are refining and sense-checking with our customers.

Our customers tell us that they cannot love the standards that we set unless they trust us to deliver them; they tell us that ongoing, two-way engagement is a critical factor in establishing this trust. We have made firm customer commitments against our current business plan and into the future and we must continue to engage with customers, communities and other stakeholders to enable our delivery. From our Board all the way through our organisation, we understand the strategic importance of ongoing engagement and we are committed to using increasingly innovative ways to ensure we deliver the best possible outcomes to our customers.



Our customers' priorities

From the feedback we have received, we have identified four clear customer outcome areas, which are underpinned by 17 customer priorities. These are summarised below:

Outcome	Delivering a resilient network to keep the energy flowing safely and reliably	Providing a quality experience to all of our customers, stakeholders & communities	Tackling climate change and improving the environment	Trusted to act for our communities
Priorities	Managing network asset risk for now and the future - Mains replacement - Asset health risk - Emergency service	Setting standards that all of our customers and stakeholders love	Decarbonising our business operations	Building trust through every action
	Cyber resilience	Keeping the energy flowing	Reducing our wider environmental impact	Making a positive difference for our communities
	Physical security	Minimising the disruption from our works	Facilitating the low emissions energy systems transition: - Green Gas - Hydrogen - Peaking and Storage - Decommissioning	Sustainable engagement to drive better customer outcomes
	Workforce planning	Supporting customers in vulnerable situations - Identifying needs - Carbon monoxide awareness - Fuel poverty - Going beyond		Creating an environment for our employees to thrive and be proud of the service we deliver
	Data strategy			Transparency in how we operate

A new approach and new voices



Earlier this year, we travelled across our regions to hold community-based roadshows. We visited Liverpool, Leicester, Birmingham, Norwich and London with our tour bus, packed with family games, information and numerous volunteers, to engage with customers and communities in their own city centres. We spoke with thousands of customers, informing them of who we are, what we do and asking them to undertake a short survey to help us shape the commitments we make in our forward-looking business plan. Over 2,500 survey responses were received and the roadshows were a resounding success, bringing together people from across communities to have fun, hold engaging conversations and contribute to our business planning process.

Some of the key insights we took from the roadshows were:

- Customers generally have a low awareness of Cadent, the gas industry, climate change and the role we have to play in this
- Customers value the work that we do to support customers in vulnerable situations and are generally willing to pay more for us to go further in this area
- Providing a safe and reliable network is by far the most important factor to customers across the country
- Customers and other stakeholders support the work we do with local communities and believe that we should do more.

Customer Engagement Group

Our Customer Engagement Group is made up of 13 professional and experienced individuals from a variety of industries, including private sector and third-party organisations, to challenge us on our ongoing engagement approach and business plan commitments. Our first meeting was in September 2018 and we have met over 30 times since.

Our engagement approach has become far more robust and inclusive as we act on the feedback from the group. We have improved the way that we identify different customer and stakeholder groups to ensure that we have a truly accessible and representative approach to engagement. We have received over 100 challenges from the group, many of which are now closed, while others are being worked on.

Centrally defined, regionally delivered

Our engagement strategy works on the principle of being centrally defined and regionally delivered. This ensures our engagement focus and activities across the whole company are aligned, but gives local management teams clear accountability for their own engagement plans, which can be tailored to the requirements of their regions and the communities and customers they serve.

From our Board, right through to the front line of our organisation, the strategic importance of high-quality engagement with our customers and stakeholders is fundamental to reaching our vision. To demonstrate our commitment to this, we have made stakeholder engagement a key factor in how our employees' performance is rewarded.

Each of our networks is very different geographically and demographically, and this leads to intrinsically different requirements in each. The best way for us to learn about our customers and what they want and expect from their energy network is to embed ourselves within the communities in which they live; to be both visible and available at a local level, to be known and trusted by them and those who represent them. We also recognise that we need to work with our counterparts across the whole energy system – in both electricity and gas – to better serve UK energy customers.

Your feedback

We want to deliver what's important to you, so please let us know your views. You can share your feedback with us at cadentgas.com/ltdp.

Energy networks in transition – the critical role of gas in decarbonisation

The gas networks are critical to the decarbonisation of UK energy. Gas provides scale and seasonal storage which other technologies cannot match, at a significantly lower overall cost to customers.

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

Demand for gas remains significant given the role it plays across the energy system, and the continued drive for cost-effective steps towards decarbonisation. This will be supported by the continuation or replacement of Renewable Heat Incentive (‘RHI’) funding for new biomethane production plants.

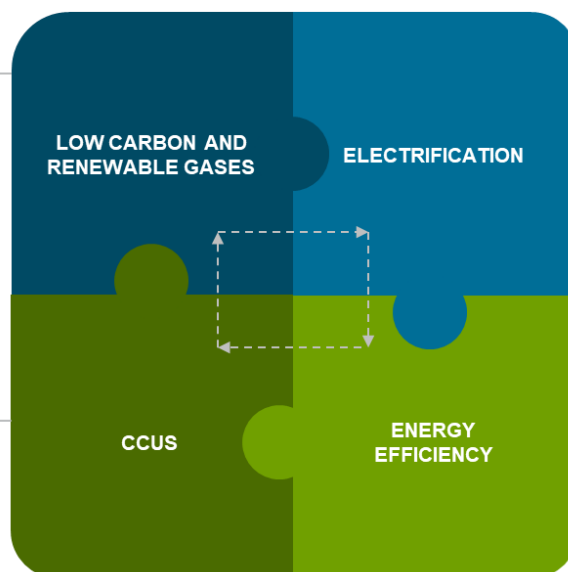
The evidence for the longer-term role that gas can play in a decarbonised system is clear, as we are demonstrating with HyNet and HyDeploy (see **Driving change through innovation**, p.28). Compared to alternative ways of reducing greenhouse gas emissions, such as the large-scale electrification of heat and transport, evolving our gas supply chain towards a low-carbon future is more affordable and secure, and will help deliver our emissions goals with less disruption. In order to define a clear pathway to Net Zero, the Energy Networks Association commissioned a **report by Navigant**, which was published in October 2019. Navigant’s work is based around four core elements:

LOW CARBON AND RENEWABLE GASES

will be fully integrated into the GB energy system. By 2050, all gas end-users will be supplied with hydrogen and/or biomethane. Hydrogen will be produced by natural gas reforming, creating the basis for hydrogen clusters, and by electrolysis using renewable power (both dedicated and curtailed generation). Biomethane will be produced by anaerobic digestion and thermal gasification.

CARBON CAPTURE, UTILISATION AND STORAGE (CCUS)

will be needed to reduce emissions from hydrogen production and industrial processes. It will also provide “negative emissions” when combined with certain bio-energy technologies.



ELECTRIFICATION

will occur across the demand sectors. Most road transport will be electrified, as well as short-distance shipping. There will be electrification of low-temperature industrial processes. According to our analysis, hybrid heat systems – an electric heat pump paired with a low carbon or renewable gas boiler – will be a key technology for decarbonising the buildings sector in a cost-optimal way.





ENERGY EFFICIENCY

will need to improve across GB, particularly in the buildings sector as a complement to electrification. Renovation measures such as loft insulation and high-performance glazing will be deployed to bring the majority of buildings up to a moderate level of energy efficiency.

Navigant suggest that their Balanced Scenario, summarised below, represents the least cost pathway for the energy networks to achieve Net Zero by 2050.

Balanced Scenario

Renewable and low carbon gas are used in a balanced combination with low carbon electricity

 BUILDINGS	<ul style="list-style-type: none"> • Heat supply mostly by hydrogen and biomethane • Deployment of hybrid heat systems with limited all-electric heat pumps and district heating • Moderate renovation in existing buildings
 INDUSTRY	<ul style="list-style-type: none"> • Hydrogen and electricity replace natural gas in most applications • Hydrogen can be produced on site, but also centrally from dedicated renewable electricity
 TRANSPORT	<ul style="list-style-type: none"> • Energy supply mostly by hydrogen and bio-LNG • Road transport largely on electricity and hydrogen • Shipping mostly on Bio-LNG
 POWER	<ul style="list-style-type: none"> • Dispatchable power generation using <ul style="list-style-type: none"> • Gas power plants (biomethane and hydrogen-fired) • Biomass power plants

This report confirms that the actions we are already undertaking, such as supporting green gas and trials and demonstrations with hydrogen, are all consistent and support this least cost pathway. Further work is now underway with the other gas networks to address the additional areas where the report suggests action is required, either by the energy networks or other stakeholders.

Short-term emissions reduction

In the immediate future, the gas networks will play a leading role in reducing emissions. There are several areas where we support immediate, cost-effective actions to deliver emissions reductions, such as the growth of green biomethane plants and the use of gas in the transport sector. We support and facilitate green fuels connecting to our networks, and work with the industry to remove barriers to their continued growth.

Introducing new sources of gas into the existing gas network represents a relatively low-cost decarbonisation option, allowing us to improve the reliability of the UK's energy infrastructure. It is not credible to rely on renewables such as solar and wind to support the decarbonisation of the massive winter demand for heat.



Furthermore, we can enhance the security of the energy network by using the electricity and gas networks together, and not relying on one source to supply all of our energy needs.

We are considering demand, supply of renewable gas, domestic heat and transport in an effort to decarbonise the UK and meet emissions reduction targets and energy efficiency ambitions. We have highlighted the possibilities in this area in our 'Future role of gas' series of publications. In this series, we aim to promote discussions with our stakeholders and inform debate across the industry. You can read the full series at cadentgas.com/innovation/future-gas-documents.

Low-carbon gas supply

Renewable gas, such as biomethane, will play an important part in the decarbonisation of domestic heat, transport and power generation. It does not require significant investment in new network infrastructure: renewable gas 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.



Whilst renewable gases contain the same methane molecules as natural gas, they contribute a significant overall reduction in greenhouse gas emissions due to their sustainable production, along with the avoidance of methane emissions from waste feedstock. In the future, we can offset the minor emissions produced by renewable gas using carbon capture.

We sponsored a **study by Anthesis Consulting Group PLC and E4tech UK Ltd**, looking at the potential scale of bioreources available within the UK to make low-carbon gas. The study showed that the potential for renewable gas from waste and biomass feedstocks

could be as high as 174TWh by 2050, with a central estimate of 108TWh. This is enough renewable gas to meet over 50% of domestic gas demand or to supply all the homes in the south of England. This could be supported further by energy efficiency, imported waste and biomass, and government policy to encourage growth in the appropriate feedstocks.

This is achievable with continued support and longer-term certainty for government incentives such as the continuation or replacement of the RHI. We will work closely with government to communicate clearly the vital role gas plays in the energy mix, so that investors and the supply chain can have confidence for the long term. We will play a full role in supporting increasing flow on our network by investing to provide capacity where it is required, and working with our colleagues across the gas networks to share best practice.

Looking further ahead, there is increasing confidence in the role of hydrogen to transform the energy market, establishing a hydrogen economy. This would involve using the existing gas distribution network to transport hydrogen for domestic heat and transport. The gas industry, working with government, is assessing the impact this would have, including exploring the use of hydrogen blending, and understanding the implications of transporting a different gas in the pipeline system. You can read more about this, in the context of our HyDeploy project, on p.30.

Biomethane connections

We have now successfully connected 32 biomethane sites to our network, which have the potential to heat up to 200,000 homes. In the graphic to the right, you can see the breakdown of where our biomethane connections lie across our networks.

Government review of the RHI and the delay to implementing the revised mechanism has resulted in many projects being put on hold, creating a queue. With the new policy confirmed earlier this year, the queue has been released with a consequential rush to connect in time to qualify for the funding support. We are working with our customers and the supply chain to manage this process as efficiently as possible.

Since our first connection in 2013, we have sought and responded to customer feedback to help drive down costs, and improve our processes and commercial frameworks. Making the connection process as straightforward as possible and providing customer choice will help us increase the numbers of renewable gas connections, and reduce our reliance on the transmission system to supply gas safely, reliably and affordably to our customers.

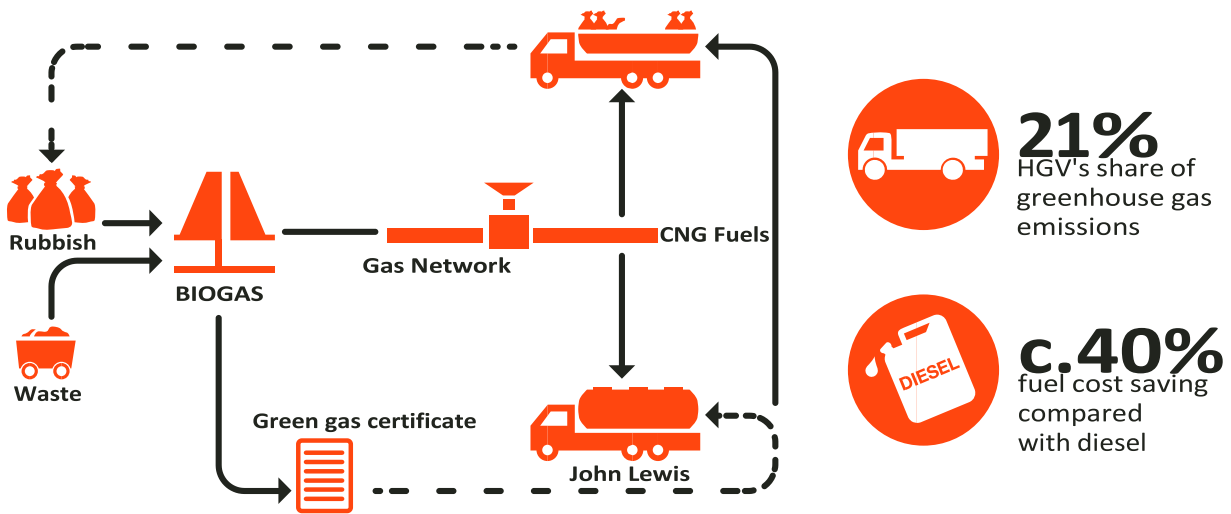


Transport – reducing emissions from freight

We recognise the government and industry focus on replacing UK cars with electric vehicles as a positive step. However, around 21% of transport emissions come from buses, heavy goods vehicles and the other vehicles involved in delivering the goods and raw materials needed by our economy. Air quality continues to be a concern, particularly in our cities, so addressing emissions from freight will make a real difference. We have been exploring a range of options to achieve this, including hydrogen fuel cells and using natural gas to power vehicles.

Heavy goods vehicles, lorries and buses can all be fuelled using natural gas, using the existing gas network to create the network of filling stations to make this a reality. Gas is a clean, quiet and cheap alternative to diesel, so a good choice to reduce emissions from transport. Looking ahead, using certified **renewable** gas for transport could deliver CO₂ emissions savings of up to 84%. As an example of our commitment to decarbonising transport, we supported Nottingham City Council to launch the world's largest gas-fuelled double decker bus fleet with 120 buses, saving 3,500 tonnes of CO₂.

As we predicted last year, the number of natural gas filling stations for heavy goods vehicles has started to grow, with eight now fully operational including Hatfield (in partnership with GasRec) which is supporting Ocado's growing fleet of 29 gas-powered vehicles. We are developing four more stations in partnership with CNG Fuels, including one in Warrington, which will be the largest refuelling station in Europe. Finally, we are pleased to announce that we are actively supporting the development of CNG Fuels' large-scale, public access refuelling station at our National Distribution Centre in Birmingham, to reduce emissions from our own vehicles and other fleet operators in the area.



The benefits from leveraging our gas networks to support the transport sector include:

- Supporting UK CO₂ emissions reduction and cleaner air in cities
- Maximising the use and benefit of our gas networks
- The potential for our gas networks to form the backbone of a national filling station infrastructure.

Off-gas grid decarbonisation

Government is considering how to reduce carbon emissions from high-carbon domestic heating systems such as oil and coal. We believe that in some circumstances, where the gas network is nearby, extending the gas grid to a community represents the lowest cost pathway for the residents. Gas is an attractive option which minimises disruption compared to the alternatives. We commissioned a report from NERA to assess wider socio-economic benefits of switching from oil or coal to gas, and this showed a minimum net present value of over £6,000, with a much higher amount when switching from the more polluting fuels.

There is therefore strong evidence that switching from oil or coal to natural gas achieves significant benefits, including carbon emissions reductions, and these would be further improved by renewable gases. Indeed, the new heating systems could be futureproofed to accommodate a future switch to hydrogen.

With this clear benefit, our future plans include stepping up the support we can provide for off-gas grid communities seeking to connect to our network. We are also trialling gas network extension, to demonstrate the added value and provide the evidence needed to influence regulatory changes and ensure such extensions become business as usual.

We would welcome feedback on such an approach, particularly from any off-gas grid areas where extending the main gas network may be supported. You can share your feedback with us at cadentgas.com/ltdp.

Demand

In this section, we look at demand forecast across our four gas distribution networks for the next ten years. For a more detailed breakdown of our demand forecast including supporting graphs, see [Appendix A](#).

Appraisal of scenarios

Demand scenarios are based on planning assumptions we have derived from market observations and stakeholder engagement. The scenarios take into account the need to reduce our carbon emissions, which is critical to meeting the UK's decarbonisation targets by 2050. They also include the views of specialist consultancies and data collected from National Grid's **Future Energy Scenarios ('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.

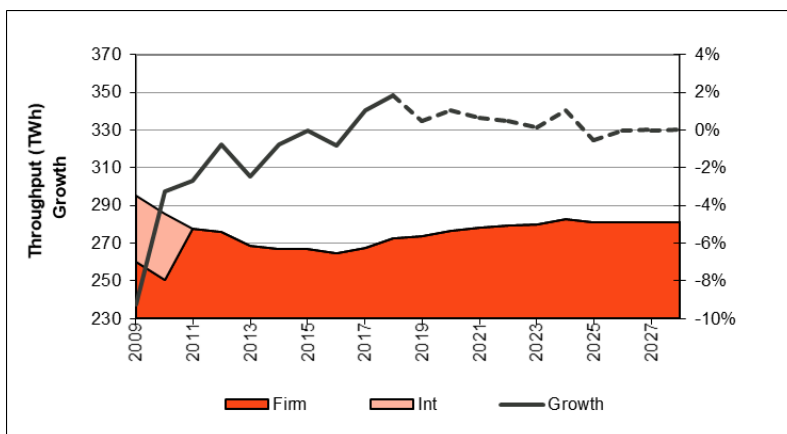
Demand overview

The latest peak gas demand forecast shows minimal change over the next ten years. All forecasts are based on annual demands, which are then converted into peak demands. These are established through analysis of historical behaviour.

In a world that is constantly changing, we are continually challenging and reviewing the way we forecast to ensure it remains appropriately robust and accurate.

Forecast demand

This year's projections for future demand reflect a change from previous years' projections of a harsh decline in demand. This has seen an increase in peak demand, with a slight overall reduction over the ten-year period. The increase is partly due to additional peaking electricity generation plants connecting to our network, requiring capacity at peak gas demand times. Other factors include the change in how peaks have been calculated, incorporating experience from March 2018.



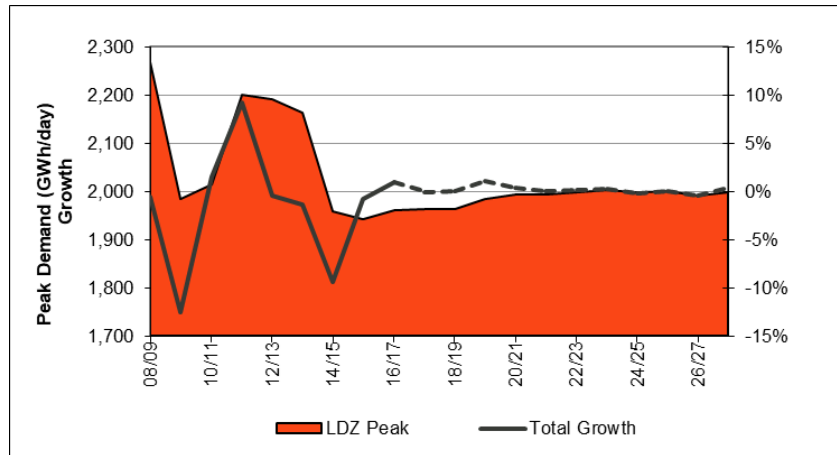
In 2018, The Office for Gas and Electricity Markets ('Ofgem') requested that networks across transmission, distribution, gas and electricity agree a common set of factors and assumptions for developing their core view of the future.

As part of this review, we debated the key areas that will affect and drive behaviours in gas demand over the next ten years.

The outcome was an unprecedented level of collaboration and knowledge sharing, which has resulted in greater understanding and agreement on the common factors and assumptions affecting each network's demand forecast.

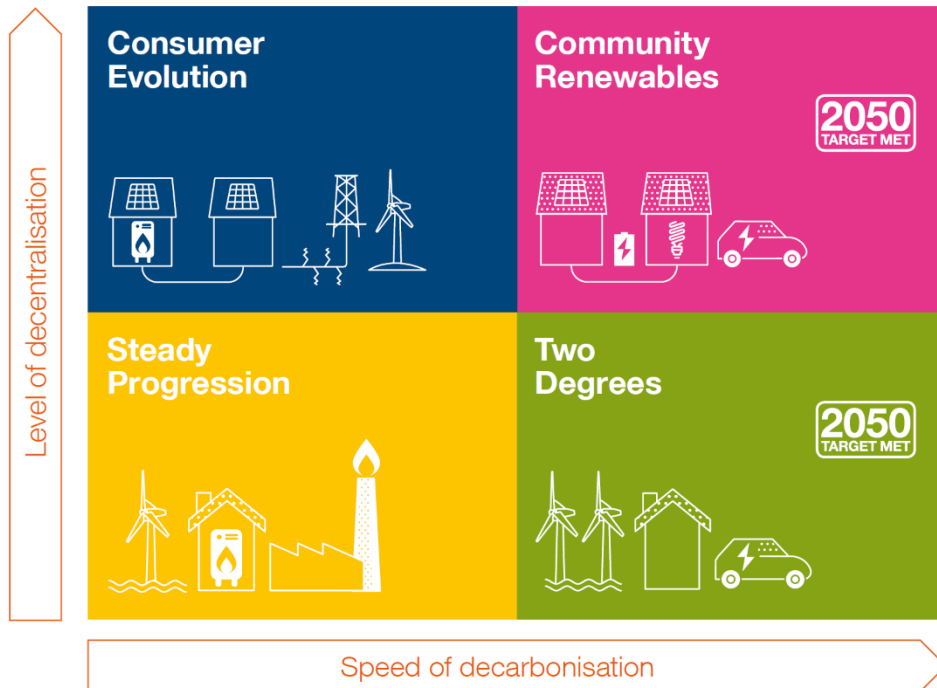
This has reinforced the stance we take in all key areas, providing a strong basis on which to review and agree the position for our demand forecast.

The FES 2019 document provides four scenarios in total, with a five-year forecast. The scenarios provide guidance based on the underlying assumptions for each scenario, whereas the forecast indicates the expected demand based on these assumptions.



This year, we have used the five-year demand forecast provided as we believe this represents the most realistic view of the shorter-term evolution of the energy system, and is influenced less by the modelling assumptions regarding the longer term decarbonisation choices.

The four FES scenarios and the five-year demand forecast are summarised below:



FES scenario key comparison chart

● CR Community Renewables
 ● TD Two Degrees
 ● SP Steady Progression
 ● CE Consumer Evolution
 ● UK Government target

	2018	By 2025	By 2030	By 2035	By 2040	By 2045	By 2050	Maximum potential by 2050
Transport	Approximately 75% of vehicles are electric	<1%			● CR ● TD			● CR 99% 36m vehicles
	Exceeds 1 GW of vehicle-to-grid capacity	N/A						● CR 20.4 GW 3m vehicles
	Over 300,000 gas or hydrogen vehicles	1,900			● TD	● SP ● CE	● CR	● TD 1.2m vehicles
Heating	10% of homes using low carbon heating	2%		● CR ● TD	● CE		● SP	● CR 88%
	Majority of homes rated EPC C or higher	38% of homes	● CR	● TD	● CE	● SP		● CR 85% of homes
Electricity generation	25% electricity output from distributed sources ²	19%	● CR ● TD ● CE				● TD Falls below 25% in the late 2040s ● SP Does not reach 25%	● CR 38%
	60% renewable generation	43%	● CR ● TD		● SP ● CE			● CR 84%
	Carbon intensity of electricity generation below 100g CO ₂ /kWh	248g CO ₂ /kWh	● CR ● TD	● SP	● CE			● TD 7g CO ₂ /kWh
Electricity storage	Exceeds 6GW electricity storage technologies	3.6GW	● CR ● TD	● SP ● CE				● CR 28.1GW
Gas supplies	10% of supplies from onshore production (e.g. biogas)	< 1%		● CE	● CR ● SP		● TD	● CE 51%
Hydrogen	Over 10TWh hydrogen demand	<1TWh		● TD		● CR ● SP		● TD 312 TWh

Forecast comparison and accuracy

You can read our full forecast data in **Appendix A**.

- Appendix A1 contains demand forecast information at a local level through to 2028/29.
- Appendix A2 splits demand forecast by load categories.
- Appendix A3 includes:
 - A comparison of the actual demands during 2018 with the forecasts published in our 2018 Long-Term Development Plan
 - Maximum and minimum demand days and forecasts for winter and summer 2019.

Future demand factors

To meet our carbon emissions reduction targets and ensure the future of UK energy is sustainable, affordable and secure, the way in which energy is produced and used needs to change. Almost half the energy consumed in the UK is used to provide heat for buildings and industry, of which two thirds comes from natural gas.

We have seen demand fall because of energy efficiency measures employed in homes and industry. The assumptions made about the impact of energy efficiency measures on gas demand continues to be reviewed as the easier measures are completed, which leaves the more costly and difficult ones to address.

We know there will be some 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, and with increasingly significant contributions from small, decentralised, gas-fired power generation.

Our forecast demand includes alternative technologies such as air source heat pumps, which will reduce customers' use of gas. We also include gas-efficient appliance technologies like gas-sourced heat pumps and combined heat and power, which reduce carbon intensity. These new and emerging technologies can help us be flexible as we meet our domestic peak heat demand, and reduce pressure on the electricity grid. New hybrid appliances powered by renewable electricity could 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 funded.

New technology and the way gas is used across the year and at peak times is changing, and this will continue as new technologies become the norm and behaviours evolve. This is leading to a clear distinction between our view on annual demands versus peak demand. Gas used across the seasons is likely to continue to decline, but the original relationships that the gas industry has built from experience are beginning to be less relevant. Through numerous innovation projects run by the gas networks, we are looking to understand the evolving relationships between peak and annual demands, and to consider whether we take a whole new approach to how we forecast future demand.

Facilitating connections to our networks

We're continually assessing the service we provide to customers who want to connect new sources of gas to our networks (entry connections), and those who want to connect to the gas grid to receive a safe and reliable gas supply (exit connections). In this section we provide an overview of our recent activities and our forward-thinking plans for connections customers.

Entry connections

We welcome the connection of new sources of gas to our networks, and will continue to add to the 32 biomethane plants we have now connected to our networks. Biomethane is produced by fermenting organic matter, with feedstocks ranging from farm and animal waste to food and sewage waste, crops and silage. Biomethane producers can export their energy securely and recognise the associated revenues, and the production process affords a green and sustainable solution to waste management for industrial, commercial and domestic users.

Renewable gases such as biomethane will have an increasingly positive impact on the UK energy mix and help to address the energy trilemma (security, affordability, sustainability). These alternative gases can deliver:

- A meaningful contribution to the UK's decarbonisation targets
- Economies of scale, by better using a reliable network to supply heat and power
- Cost efficiencies in comparison to other renewable sources such as solar.

Whilst the form of renewable gas we are connecting to our networks is currently biomethane, in the future we expect to see other sources of gas connecting, such as:

- **Synthetic Natural Gas from biomass ('BioSNG')**

Substitute natural gas, which is produced from drier waste or biomass – typically, but not exclusively, black bag waste

- **Shale and coal bed methane**

Shale and coal bed methane are accessed through hydraulic fracturing, horizontal drilling and dewatering. Shale is a significant uncertainty over the next ten years

- **Hydrogen**

Subject to confirming that hydrogen can be transported and used safely, it is a medium and longer term low carbon option, and a huge potential clean energy source for the 2030s and beyond. You can read more about our HyDeploy project on p.30, which explores the potential to use blended hydrogen in the gas distribution networks.

A changing network

The renewable gases we are connecting to our networks are changing the role and nature of the UK energy system. To help support the growth of green energy, we are leading a project with the other gas distribution networks to standardise elements of the design and commissioning process for biomethane projects. We've set up a working group through the Energy Networks Association to ensure that value-adding initiatives to improve connection processes receive the funding they require.

We are actively consulting our internal and external stakeholders to create a strategy that will allow renewable gas producers to connect lower calorific value gas to our networks as quickly and easily as possible, significantly reducing costs.

In response to customer feedback, we have developed 'heat maps' of our medium pressure, intermediate pressure and high pressure pipes to highlight areas where we have capacity available in our network to connect gas. If you would like to view a copy of our latest heat maps, please email: box.sustainableconnectionsteam@cadentgas.com

In addition to biomethane, we continue to facilitate the connection of new sources of gas to our networks. We are working closely with our stakeholders to ensure our processes are flexible, and evolving quickly to recognise any new challenges and share best practice.

To find further information on our entry gas connection services for biomethane, or other forms of distributed gas, please visit cadentgas.com/services/gas-producers/biomethane.

Exit connections

In 2018-19, we facilitated 18,000 new connections. We envisage this figure continuing to rise significantly in the short term, due to the number of new domestic sites and commercial and industrial incentives within the UK.

We offer a variety of services to our exit connections customers, including:

- Household connections and alterations
- Business-to-business connections and alterations, including more complex projects.

Our service extends beyond connecting paying customers; we recognise the importance of supporting fuel poor customers. Living in a cold home can have much wider impacts than just financial ones, affecting areas such as the physical and mental health of families, and educational attainment of children. We offer free and discounted connections under the Fuel Poor Network Extension Scheme (subject to eligibility criteria), and connected over 4,500 households at risk of fuel poverty in 2018-19. By offering this service, we reduce fuel poor customers' energy costs and improve their quality of life.

We have seen an increase in the number of enquiries and quotation applications for power generation plants across our networks. We work with developers to understand their plans and actively support them to identify the best places on our network to connect. We currently have 64 power generation sites connected to our network, generating 884MW of electricity, and a further 105 sites in progress.

We are undertaking regular workshops with the other gas distribution networks to understand the implications of and requirements for power generation, and to consider the appropriate supporting frameworks.

This year, we formally launched a new service for power generation customers, the Detailed Analysis Study. You can find out more at cadentgas.com/services/business-customers.

We also process competitive exit connections within the industry, such as:

- Connections to Independent Gas Transporter ('iGT') networks. These independent networks are connected to ours, but the iGT owns and operates the network
- Utility Infrastructure Providers ('UIP') connections. A UIP is responsible for designing and constructing the network, which will then be owned and operated by Cadent or an iGT.

Our Connections Team is continuously improving our service to customers. We recognise that understanding our customers' needs better will allow us to evolve our proposition to meet and exceed expectations.

Detailed information on all our connections services, including contact details, incentives for fuel poverty areas, charges, and terms and conditions, can be found at cadentgas.com/get-connected.

Supporting customers in multi occupancy buildings

We support district heating schemes, which can save costs for customers by providing communal heat from a single central heating system. This can be especially effective in low, medium and high rise buildings.

We will continue to help communities in multi occupancy buildings explore the best use of energy, and we are planning further specific stakeholder and consumer engagement on this matter. We would welcome feedback on this proposal, and would be especially interested to hear from anyone involved in regional district heating schemes. You can share your feedback with us at cadentgas.com/ltdp.

Facilitating timely network reinforcement

Working closely with our regional stakeholders, we have identified the need to support timely network reinforcements so that the existing energy infrastructure is not a barrier to economic growth.

The current regulatory regime set out by Ofgem is low risk, meaning reinforcement works are only undertaken when there is absolute certainty about the longer-term demand. This can result in delays to developments. The current pricing methodology also incentivises developers to leave their applications for connection as late as possible, which can result in delays to the overall process.

In response to this issue, we have developed a proposal whereby in return for a local body underwriting the works, we accept the obligation to complete reinforcements. This approach would enable much more timely reinforcement, and could be used for new housing developments, business parks, transport refuelling stations, or gas-fired district heating schemes.

We welcome feedback from local bodies and developers on whether such an approach would be beneficial, and if it could remove a significant barrier to economic growth. Please share your feedback with us at cadentgas.com/ltdp.

Commercial operation of the network

The gas network is governed by the Uniform Network Code, which is a contract between gas shippers and transporters. This framework is used to manage the commercial arrangements between all parties and underpins the UK gas industry. Any concerned party can propose a modification to the contract, enabling discussion, development and voting on any recommended changes, to be approved by Ofgem.

Facilitating distributed entry gas

From our day-to-day interactions with renewable gas developers, we understand that a primary issue for the networks to address is the availability of network entry capacity. Current commercial arrangements do not facilitate general reinforcements to provide entry capacity, forcing developers to find connection points where there is existing spare capacity.

Earlier this year, at an industry event in Birmingham, we launched a review of the commercial regime supporting distributed entry gas. The feedback we received from this event supported our observations and the need for a review, and we are now designing our next steps in response to this. The final timetable will be governed by the industry framework and associated processes.

In parallel, we are working with Ofgem to ensure appropriate levels of funding are available to support entry capacity reinforcements, if the pricing changes are approved and implemented. This could result in a step change in decentralised, low-carbon gas production.

Investing in our networks

We invest heavily in our networks, both to maintain their integrity and to grow their capacity, ensuring we meet the expanding and evolving needs of our customers.

Investment implications

Our typical annual investment across our four networks, over the current regulatory period set by Ofgem, is expected to be close to £600m. Approximately three quarters of this cost relates to our gas mains replacement activities. Even though overall gas consumption is going down, we are still investing to add exit capacity (the amount of gas available to take off the networks), due to possible local constraints within the networks, and to help meet local authorities' strategic development proposals.

Our networks are designed and operated to meet peak capacity requirements, and while we are seeing action being taken to reduce overall consumption – for instance via more efficient boilers, smart controllers, and building insulation – their impact on peak demand is not so clear or significant.

Maintaining the integrity of our networks

We maintain the integrity of our networks by monitoring performance and targeting those assets whose age, current condition, performance and future expected deterioration or obsolescence pose the greatest risk to the safe and effective operation of our networks.

We ensure that we balance inspection, maintenance and capital expenditure to maximise the efficient operating life of our assets with a focus on enabling a sustainable and future ready gas infrastructure.

Monetised risk

We have been working collaboratively with the industry operators to develop and implement a consistent methodology for measuring risk on our networks. By better understanding the condition of our assets and the impact of their failure, we can make best value investment decisions, targeting the greatest amount of risk removed for money spent.

Asset data

Our ability to make good investment decisions relies on suitable asset data. We are committed to continuously improving our asset data and core systems. In 2018, we initiated a project to review our asset data systems and identify opportunities to leverage advances in machine learning and data analytics.

Growing capacity of our networks

Due to year-on-year growth in housing and the rise in gas-fired power generation sites, our capacity requirements are constantly growing. We model predicted demand growth and reinforce or extend the capacity of our networks accordingly.

Low pressure reinforcements

We are developing our lower pressure distribution system so we can provide capacity to customers who want to connect to our network, along with gas transporters.

Housing developments on the extremities of our networks have continued to rise during recent years, with the fastest growth in East Anglia and the East Midlands. On average, we have carried out 500 reinforcement projects per annum over the last four years, ranging from 1 metre to 20.1 kilometres of new pipe being laid.

Medium and intermediate pressure reinforcements

With the rise of power generation and housing growth, we are increasing investment in our medium pressure and intermediate pressure networks to ensure we can supply towns and cities with the gas required to maintain supplies. Since 2018, we have tripled the number of projects on our medium and intermediate pressure networks, and this theme is set to continue.

Below are some of our key areas of focus across our networks:

East of England: The Silverstone and Towcester development on our medium pressure system is our largest project and will see us laying up to 20.1 kilometres of pipe by 2021.

North London: Due to refurbishment of historical buildings and new large-scale developments, we are carrying out significant reinforcement in our North London network. In particular, we are investing to facilitate the connection of Rayleigh Power Station to our medium pressure system.

North West: We have seen a rise in applications for power generation connections in the North West, and because of this we are reviewing what pressures we realistically need to operate at. We are anticipating some power generation sites driving reinforcement costs in the region of £2 million.

West Midlands: Our main areas for growth in the West Midlands are Warwick and Hinckley, in Leicestershire.

Upgrading our networks for the long term

Between now and 2032, we will continue to invest in our gas mains replacement programme. This work is mandated by the Health and Safety Executive, to improve safety while reducing methane emissions. By the end of the programme, our distribution networks will predominantly consist of plastic pipe, which can carry a wider range of gases including hydrogen. As these pipes also require significantly lower maintenance than existing materials, they will deliver a low-cost, low-carbon network which will play a central role in our energy system. You can see 'heat maps' of our planned gas mains replacement activities from now until the end of the programme in Appendix B – G.

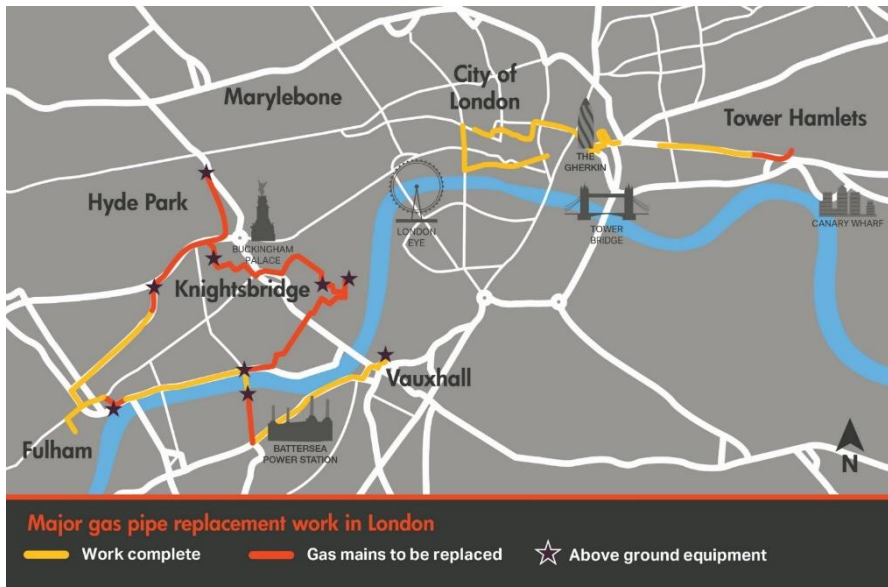
- [Appendix B: East of England network overall](#)
- [Appendix C: North London network overall](#)
- [Appendix D: Greater London](#)
- [Appendix E: North West network overall](#)
- [Appendix F: Greater Manchester](#)
- [Appendix G: West Midlands network overall](#)

Case study: putting safety first in North London

Our London Supply Strategy is a long-term project to make sections of the city's metallic pipelines safer. Subject to regulatory approval, we expect to complete this project by 2029. Most of these large gas mains are over 120 years old, and are in densely populated areas close to nationally important landmarks and buildings.

With this project, we aim to create a robust medium pressure network. Phase 1 of the scheme is valued in the region of £76 million. The map below shows where the mains are being replaced. The scope includes:

- Abandonment of 28 kilometres of metallic mains
- A tunnel under the River Thames for a new gas main
- Replacement of 7 pressure reduction sites (pit governors)
- Remediation of 40 strategic valves along the route of the gas mains replacement.



To date, we have successfully replaced over 16 kilometres of metallic pipelines in key locations including the Fulham Road, Chelsea and London Wall, City of London. Between Royal Chelsea Hospital and Battersea Park, we have also successfully constructed a 30-metre deep tunnel underneath the River Thames, and installed an intermediate pressure pipeline which will serve the Battersea and Nine Elms areas.

We have listened carefully to our stakeholders, who we continue to consult throughout the project. Our engagement has included:

- Talking with the local community and businesses about our 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 Thames Tideway Tunnel project to ensure a coordinated approach to complex diversions at Blackfriars and Victoria Embankment
- Working collaboratively with other utilities to minimise road space and disruption to our customers and the local community
- Working with the Royal Parks to ensure impact to the public and high-profile concerts is minimised
- Presenting all projects and traffic management plans at local authority scrutiny meetings for local and ward councillors to challenge and review prior to approvals.

After the London Supply Strategy project is complete, we plan to replace another 24 kilometres of mains to further reduce risks associated with the Victorian metallic pipelines. This strategic project will provide vital infrastructure to support London's economic growth and help maintain its position as a leading 21st century city.



Driving change through innovation

We strive to put innovation at the heart of what we do, to benefit customers and our environment. By embracing innovation, we are finding the most up-to-date tools and techniques to keep gas flowing safely, reliably and with minimal disruption to customers.

Our innovation projects can be grouped by three key goals which revolve around improving customers' experiences:

1

Transforming our day-to-day operations

2

Finding faster and better ways to upgrade our network

3

Developing a green gas network for future generations

Collaborating with our partners

These areas are underpinned and driven by our collaborative approach to effecting change in the industry.

We work collaboratively with the other gas distribution networks on specific projects, and share learning and best practice from our day-to-day work. We recognise that working together ensures the maximum benefit to customers, by enabling all parties to embrace new, value-adding technology and ways of working. The **Gas Network Innovation Strategy** has been developed by all of the gas distribution networks, and is designed to bring together all of the most important challenges and opportunities facing the UK gas transmission and distribution networks.

We benefit from an extensive community of innovators via **EIC**, which allows us to bring forward new innovations and technologies from small to medium enterprises around the world, which we can apply to the gas networks to transform the way we operate.

Innovating for today

This year, we've taken many ideas to the point where we can use them in our day-to-day operations, while learning from our industry peers and sharing best practice to realise benefits to customers across the UK.

Bringing robotic technology to life: CISBOT



Following successful field trials, we have been using ULC Robotics' Cast Iron Joint Sealing Robot ('CISBOT') to fix, rather than replace, lengths of gas pipe in some of London's most high-profile locations. Our two major trials took place on Oxford Street and The Strand, and the success of these projects led to us deploying CISBOT on Park Lane, Regent Street and Covent Garden.

The robot works by 'crawling' along the inside of a live gas main, sealing any leaks in the joints using a special sealant solution. The CISBOT drastically reduces our impact on local road users

and stakeholders, as the unit can be deployed with just a single excavation which can be made in the footpath rather than the road. From the point of launch, the remote-controlled robot can cover 500m of gas pipe.

In April 2019, we hosted our first Innovative Technology Showcase at City Hall, London. During this event, we took to the stage with ULC Robotics to share the customer benefits of using CISBOT with local stakeholders, including local councils, Transport for London and other utilities.

A quick, smart solution: Bonded Saddle

The Bonded Saddle is a device which gives quick and easy access to large diameter pipes, reducing time and disruption on-site when we are carrying out essential upgrades to our network. This technology allows us to carry out essential work on our gas pipes with greater efficiency, as it means we only need to dig to the top of the gas pipe – as a result, we spend less time digging in the road and reduce our waste.

We are actively sharing the learnings from our Bonded Saddle project across the UK gas industry, and we've seen interest from other utility businesses and internationally.



Learning from our London peers: Microstop



With Microstop technology, we are embracing a new way to bypass the flow of gas in external supply pipes on multi occupancy buildings, isolating a section which we can work on without disrupting customers' gas supply. After our initial research into Microstop, we identified potential trial sites and completed a range of trials. We are now working with our manufacturer to train our engineers to use this technology. Microstop will enable us to maintain security of supply to our customers in multi occupancy buildings, with minimal impact on them and the general public.

Delivering Net Zero

Looking forward, we believe the gas distribution networks will play a major part in the future of energy, delivering a reduction in emissions at a lower cost to alternative options, with less disruption, while maintaining a secure supply and continuing to meet customer demands. Energy efficiency must remain a top priority for the energy industry, as we move towards a decarbonised energy system.

As government policy continues to develop to enable the UK to meet its emissions reduction targets, we are playing a key role alongside the other energy networks in supporting government by:

- **Identifying and filling evidence gaps necessary to enable government to make key policy decisions**

Our projects, alongside those of the other energy networks, include HyDeploy (see below), in which we are researching the potential to blend hydrogen into the existing gas infrastructure.

- **Presenting visions for the future to our national and regional stakeholders, to show the role of the gas network in a low emissions energy system for 2050 and beyond**

The flagship HyNet North West project presents a vision of a hydrogen hub to support the decarbonisation of large industry, demonstrate carbon capture, usage and storage, and provide hydrogen for transport and to reduce the carbon intensity of domestic heating and power.

- **Ensuring a whole energy system approach is considered and the full implications of any policy – both direct and consequential – are properly considered**

We are leading the development of whole system investment planning opportunities via the Open Networks project.

Hydrogen in our homes: HyDeploy

We are in the second year of our pioneering project to demonstrate the steps required to develop a hydrogen fuel network, in which we are testing a blend of up to 20% hydrogen with natural gas in a domestic setting.

Using 100 houses and 30 faculty buildings at Keele University, this is the first ever live trial of hydrogen in the UK. Working with our HyDeploy Consortium partners Northern Gas Networks, Progressive

Energy, ITM Power, the Health and Safety Executive and Keele University, we have safety tested every single gas appliance in all 100 homes. In addition to the gas safety checks, we have also tested all 130 appliances with bottled hydrogen. All appliances passed this test, which is strong initial evidence that customers will not need to replace their gas appliances should a hydrogen blend be made available more widely.

The HyDeploy Consortium has announced the second phase of our HyDeploy programme, which will take place in the North of England from 2020. We will take the learning from HyDeploy at Keele and apply it on a



larger scale – to around 750 households – and to a group of customers who represent a broader cross-section of the UK population. This is a practical example of the gas industry uniting in our commitment to meet the Net Zero carbon challenge.

You can read more at hydeploy.co.uk.

Ensuring accurate billing in a low carbon world: Future Billing Methodology

As the UK prepares for a future where a range of sources provides us with low carbon energy, it's crucial that the way customers are billed keeps pace with this.

With 83% of UK homes currently heated by gas, we want to help customers move to low carbon energy, through hydrogen and other 'green' gases, in a way that's affordable and convenient.

As with all innovation, we have a technical challenge to overcome: each gas has a different calorific value or 'strength', so current regulations mean that the gases must be processed to meet billing standards. This can even include adding carbon back into the process, which is simply not consistent with our low carbon ambition. With the Future Billing Methodology project, we aim to remove the need for this processing by creating a way to measure the blend of gases we are likely to use in the future. If we succeed with this project, we can deliver low carbon gas to customers and pave the way for larger CO₂ reductions.

We have installed over 12 measurement kiosks and started collecting data to share with our industry partners. This will allow us to explore different options for billing and recommend the best solution for customers.

Networked hydrogen to remove CO₂ emissions from heavy transport



Exploring the potential for hydrogen as a fuel for domestic heat and for industry has opened up other opportunities, particularly in transport. Our **HyNet concept**, which proposes an integrated hydrogen economy across the North West of England, with a new hydrogen pipeline at its heart, is a case in point. Once the key elements of HyNet have been installed, namely the pipelines, hydrogen production facility and carbon capture technology, the region

will have access to hydrogen for a range of other uses including transport – particularly heavy or freight transport.

This year we crystallised our thinking on the transport aspects of HyNet by commissioning a report by Progressive Energy and Element Energy called **HyMotion – Network-supplied hydrogen unlocks low carbon transport opportunities**, which we shared across the energy sector. The report provides analysis demonstrating that hydrogen delivered by the gas networks would be more cost-effective and more efficient than any alternatives – especially for larger vehicles.

This means hydrogen trains, boats and ferries, heavy goods vehicles and buses could all become carbon neutral with the help of hydrogen.

As one of the challenges of manufacturing fuel cells is to maintain the purity of the hydrogen used, we have partnered with the National Physics Laboratory to investigate ways of maintaining or restoring this purity when hydrogen is delivered through a pipeline which inevitably contains some contaminants. We hope to share the findings of this project, named **Hydrogen Grid to Vehicle (HG2V)**, next year.

Closing statement

Thank you for reading our Long-Term Development Plan 2019. We hope you found the report interesting and informative.

We've given you an insight into:

- Our enhanced approach to customer and stakeholder engagement
- How we are helping the UK achieve its decarbonisation targets
- Demand forecasts for our networks
- The developments we are making to our connections processes
- The investments we are making to enhance our networks
- How we are driving change through innovation.

Our development plans are driven by our ambition to set the standards that our customers love and others aspire to. We will continue to develop our plans based on customer and stakeholder feedback. Don't forget to share your feedback at cadentgas.com/ltdp if you would like your views to be taken into consideration.

Further reading

Please follow the links below if you would like to find out more:

- cadentgas.com/get-connected

Further information if you are interested in connecting to our network.

- cadentgas.com/digging-safely

How to dig and work safely close to our gas assets.

- cadentgas.com/innovation/future-gas-documents

Information and research, carried out/commissioned by Cadent, about the future role of gas in the UK energy system.

- fes.nationalgrid.com

National Grid's full Future Energy Scenarios documents and supporting information.

- www.ofgem.gov.uk

Homepage for the Office for Gas and Electricity Markets ('Ofgem').

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

The Department for Business, Energy & Industrial Strategy – the government department responsible for business, industrial strategy, science, and innovation with energy and climate change policy.

- www.energynetworks.org

Homepage of the Energy Networks Association ('ENA'), the 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.

- www.eua.org.uk

Energy Utilities Alliance ('EUA'), a not-for-profit trade association that provides a leading industry voice to help shape future policy direction within the energy sector.

- 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.

- www.gasgovernance.co.uk

Home of the Joint Office of Gas Transporters. This site contains information about the Uniform Network Code and its ongoing developments.

Regulatory basis for document

This statement is produced for the purpose of and in accordance with Cadent Gas Ltd obligations in Standard Special Condition D3¹ of its DN Gas Transporters Licence and section O4.1 of the Transportation Principal Document of the Uniform Network Code in reliance on information supplied pursuant to section O of the Transportation Principal Document of the Uniform Network Code. Section O1.3 of the Transportation Principal Document of the Uniform Network Code applies to any estimate, forecast or other information contained in this statement.

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Standard 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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