Gas System Operator

Gas Ten Year Statement 2020

nationalgrid

Gas Ten Year Statement 2020

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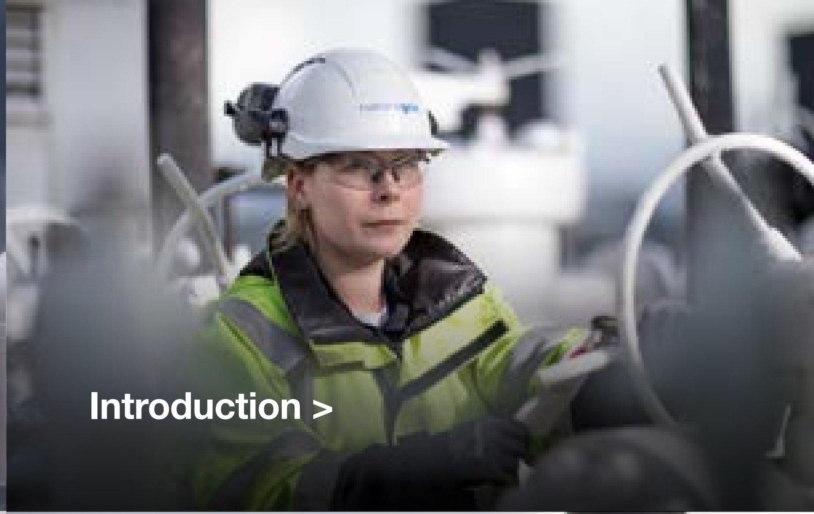

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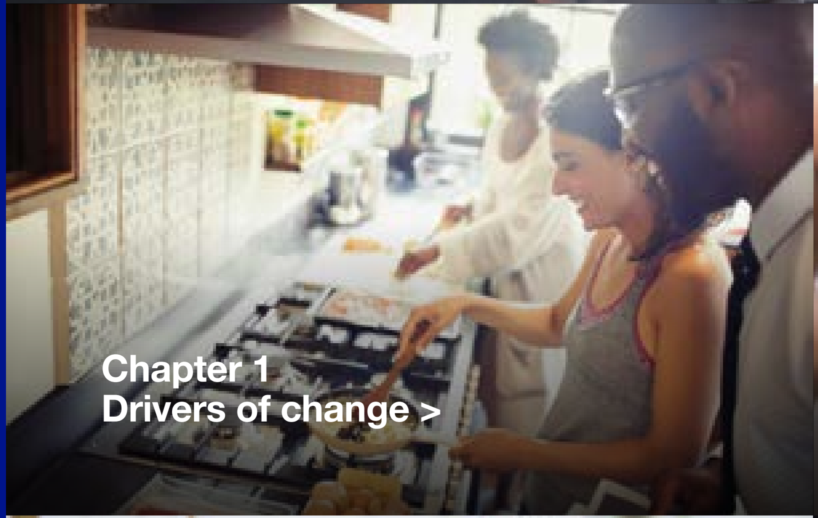

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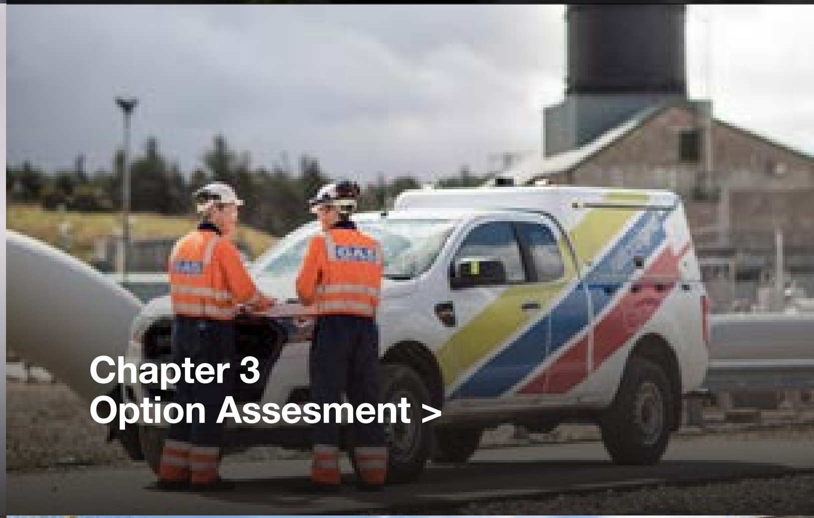

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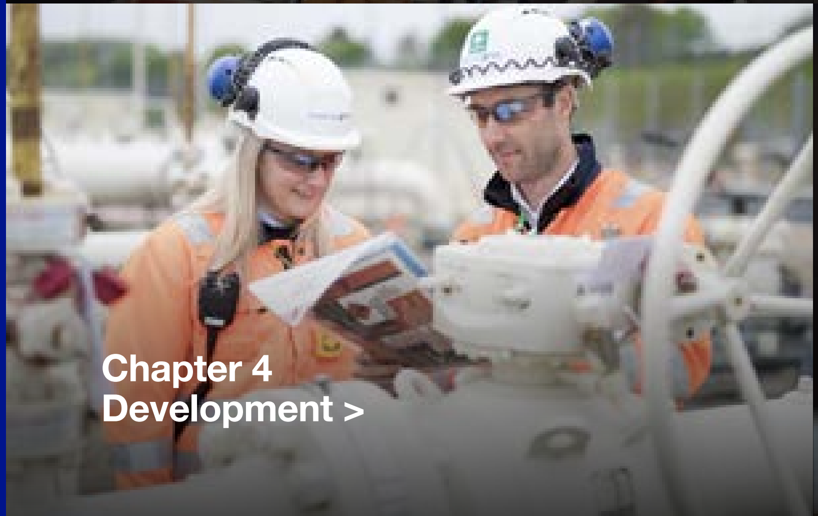

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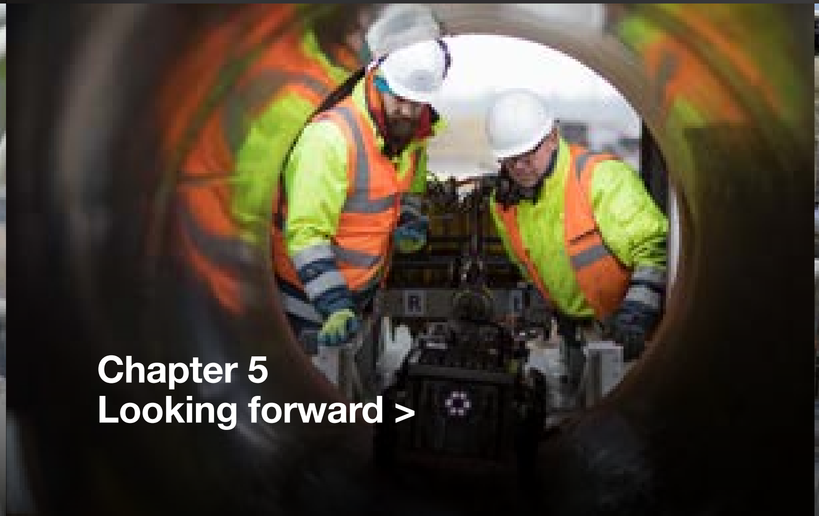

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Gas Ten Year Statement 2020

Welcome
How to use this document

We have published the 2020 *Gas Ten Year Statement (GTYS)* as an interactive document.

Home
This will take you to the home page.

Arrows
Click on the arrows to move backwards or forwards a page.

Enlarge/reduce
Hover over the magnifying icon to make charts bigger or smaller.

Glossary
Defined words and additional information (indicated by) can be viewed by clicking the yellow book symbol in the left-hand navigation bar.

'Linked' content
Words in light blue and underlined have links to other pages in this document, or are URLs. The URLs have an additional superscript number next to them, These are listed in 'Index of links' at the back of the book and give you the URLs in full.

Welcome
to our 2020 *Gas Ten Year Statement*

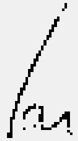
We are in the midst of an energy revolution. The economic landscape, developments in technology and consumer behaviour are changing at a remarkable rate, creating more opportunities than ever before for our industry. Our 2020 *Gas Ten Year Statement*, along with our other Gas Transmission publications, aims to encourage and inform debate, leading to changes that ensure a secure, sustainable and affordable energy future.

Although the key themes have remained unchanged over the past 12 months, their importance remains crucial to us, in particular how we respond to the changing needs of our customers, the impact of EU legislation and the effect of the United Kingdom's net zero ambitions.

As the pace of the energy transformation accelerates, we will continue to enhance our approach to how we foresee usage of the gas network evolving. This document provides a medium for us to engage with you and capture your changing requirements. In doing so, we will make sure we have the right tools and capabilities in place to maximise market efficiency, whilst maintaining a safe and secure network.

In 2020, we are in a position where we need to transform the National Transmission System (NTS) from transporting natural gas and work towards a net zero future by switching to low-carbon gases such as hydrogen and biomethane. However, at the same time, we are met with the challenge of meeting today's customers' needs which includes providing a safe, efficient and reliable natural gas network. This creates a challenge between providing the needs of today and preparing for a lower carbon future.

I hope you find this document useful. Please share your views with us to help shape the future of the National Transmission System. You can find details of how to contact us on our website.



Ian Radley
Head of Gas System Operations

Welcome
to our 2020 *Gas Ten Year Statement*

As part of the *GTYS* publication we produce a huge amount of analysis and data. For ease of use, we have not included all of this data within this *GTYS* publication. Instead, our workbook is available online and contains the following:

- All graphs and tables contained in *GTYS 2020*.
- Actual demand for 2019 (TWh).
- Peak day, maximum and minimum physical NTS entry flows for Gas Year 2019/20.
- Peak day, maximum and minimum physical NTS exit flows for Gas Year 2019/20.
- Gas demand and supply volumes per scenario out to 2050.
- 1-in-20 peak day diversified demand per scenario out to 2030.
- 1-in-20 peak day undiversified demand per scenario out to 2030.
- 1-in-50 peak day diversified demand per scenario out to 2030.
- 1-in-50 peak day undiversified demand per scenario out to 2030.
- Peak and annual supply by terminal out to 2050.

Introduction

Introduction

We write the *Gas Ten Year Statement (GTYS)* to provide you with a better understanding of how we intend to plan and operate the National Transmission System (NTS) over the next ten years.

The *GTYS* is published at the end of our annual planning cycle. We use the *GTYS* to provide you with updated information to help you identify connection and capacity opportunities on the NTS. We summarise key projects, changes to our internal processes that may impact you, as well as highlighting key developments that provide further information on our Gas Transmission activities.

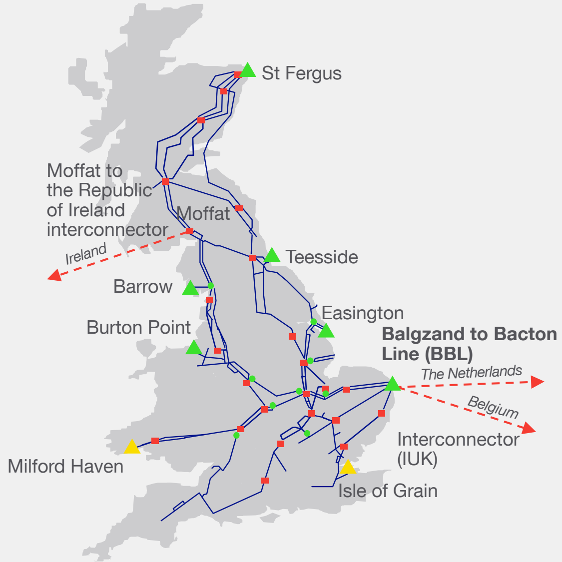
What do we do?

We are the owner and operator of the gas NTS in Great Britain. Our primary responsibility is to transport gas from supply points to exit offtake points safely, efficiently and reliably. We manage the day-to-day operation of the network. This includes balancing supply and demand, maintaining system pressures and ensuring gas quality standards are met. We are also responsible for identifying the long-term needs of the network. We must make sure our assets on the NTS are fit for purpose and safe to operate. We develop and deliver effective maintenance plans and asset replacement schedules to keep the gas flowing.

Our network

The NTS plays a vital role in the secure transportation of gas and the facilitation of a competitive gas market. Our network includes approximately 7,660 km of pipelines, presently operated at pressures of up to 94 bar (see appendix 1 for a detailed view of NTS maps). Our network transports gas from entry terminals and storage facilities to exit offtake points from the network. At exit offtake points, gas is transferred to four distribution networks (DNs) for onward transportation to domestic and industrial customers, or to directly connected customers including storage sites, power stations, large industrial consumers and interconnectors.

Figure 0.1
The National Transmission System



Key:
- NTS pipeline
- Liquified natural gas (LNG) import terminals
- Natural gas entry terminals
- Interconnectors
- NTS compressor sites

Introduction
Key themes

The 2020 *Gas Ten Year Statement (GTYS)* provides an update on the current way we plan and operate the National Transmission System (NTS). In addition, the *GTYS* outlines what we are doing to address them.

The key drivers of change that impact how we plan and operate the NTS include:

- Customer needs
- Asset management
- Legislative change
- Net zero by 2050.

These drivers of change can trigger our Network Development Process, the process we use for decision making, optioneering, and delivering all our projects.

Introduction
Key themes

Customers' needs

Our customers' needs are continually evolving. That includes both their immediate and long-term needs as reflected in the *Future Energy Scenarios (FES)*. In our role, we need to ensure we continually adapt our planning and operation to safely accommodate these needs on the National Transmission System (NTS). In addition to this document, we use the *Gas Future Operability Planning* documents as a vehicle for our customers to assess the future needs of the NTS.

We have seen how our customers' needs have been evolving. As a result of this, in this year's *GTYS*, we are sharing more about our Network Capability process and make it more accessible to our readers. We needed to refine this process in order to share it with our stakeholders so that they may benefit from the insights it may bring.

Asset management

It is vital that we comply with all safety legislation that applies to operating the NTS, while also maintaining the current level of network risk through maintenance and replacement. With so many assets on our network, including many that are ageing, we are continuously investing in, and maintaining, our assets. An ageing network needs more maintenance, and we have to balance this with our customers' changing needs of our network.

Net zero

In June 2019, the UK Government set a new target requiring the UK to bring all greenhouse gas emissions to net zero by 2050. As the owner and operator of the NTS, we are uniquely placed to facilitate and support the transition to net zero, while maintaining the reliability of our network and meeting the needs of consumers.

We submitted our RIIO-2 business plan to Ofgem in December 2019 for the price control period 2021–2026. In this, we made some key commitments as part of our road map to net zero within our Environmental Action Plan. This plan spans five key areas with approximately 28 objectives to deliver for RIIO-2 and prepare us for RIIO-3. Specifically for net zero, it is decarbonising our operations through several initiatives. Our commitments fall into two categories for decarbonising; understanding our emissions better and acting in the areas we have already identified.

In July 2020, National Grid Gas Transmission submitted the FutureGrid project as part of the Network Innovation Competition (NIC) process. The FutureGrid project will build a hydrogen test facility from a representative range of decommissioned assets. Flows of hydrogen and natural gas blends (up to 100% hydrogen) will be tested at transmission pressures to better understand how hydrogen interacts with the assets.

Introduction
Our regulatory framework

The RIIO (Revenue = Incentives + Innovation + Outputs) regulatory framework was implemented by the Office of Gas and Electricity Markets (Ofgem) in 2013/14. In RIIO-1 (2013–2021), Ofgem set us an output and incentives framework. We are delivering against these outputs and incentives in return for an agreed revenue allowance from Ofgem. You can find more information on our delivered outputs for RIIO-1 in Our Performance publication.

RIIO-2

Spotlight

We submitted our business plan for the RIIO-2 period (2021–2026) in December 2019 and received Ofgem's draft determination (DD) response in July 2020. We have built our plan by listening and incorporating feedback from our stakeholders and consumers.

In the next RIIO period we are looking forward to working on our major asset investment projects and making progress to ensure the UK is hydrogen ready by 2026 as set out in our journey to net zero road map published with our business plan. These projects include:

- Starting work on redesigning the Bacton Terminal to meet future requirements of the site.
- Starting work to ensure compliance with emissions legislation on five compressor sites in RIIO2 as well as completing works at Peterborough and Huntingdon.
- Undertaking asset health works across our network to ensure that UK energy consumers continue to benefit from a reliable and safe gas transmission network.
- Our response to the DD is published here. Ofgem had their open hearings in October 2020 and their final determination is due in December 2020.

Our key gas SO publications

Gas Ten Year Statement – Annual publication

The *Gas Ten Year Statement (GTYS)* details how we will plan and operate the gas network, with a ten year view.

The *GTYS* is published at the end of the annual planning process and provides the platform on which the next annual planning process is built.

Gas Future Operability Planning – Ad-hoc

The *Gas Future Operability Planning (GFOP)* describes how our changing customer and stakeholder needs may affect the future operability of the National Transmission System (NTS). The *GFOP* acts as a vehicle for our customers and stakeholders to engage with us on topics exploring future operability challenges.

The *Gas Summer Outlook* and *Gas Winter Outlook* provide our view of the gas security of supply for the forthcoming summer and winter respectively. They are informed by insight received from stakeholders across the energy industry via responses to our Gas Winter Review and Consultation and through regular conversations with industry participants.

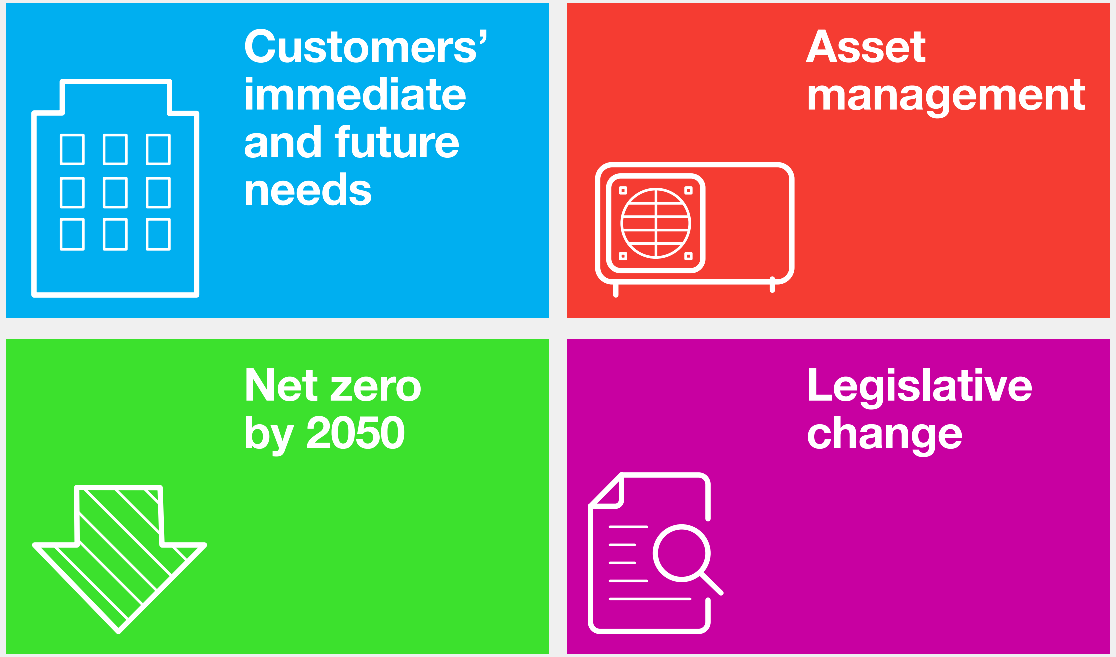
1 Drivers of change

Drivers of change

1.1 Introduction

This chapter describes the drivers of change that can trigger stage one of our Network Development Process (NDP), please see figure 1.1.

Figure 1.1
Drivers of change that can trigger our Network Development Process



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Drivers of change

1.2 Customer needs

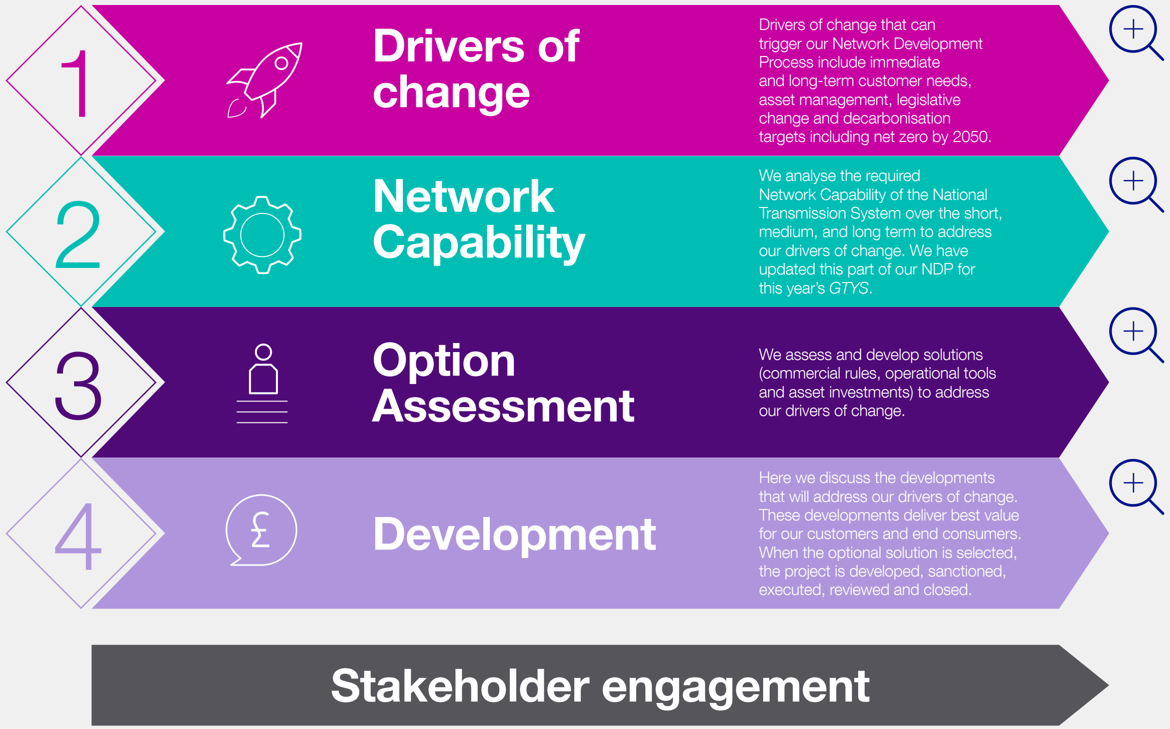
In the *GTYS* we aim to make our investment decision process as transparent as possible by outlining the initial stages of our Network Development Process (NDP) (figure 1.2).

The NDP defines our method for optioneering, developing, sanctioning, delivering and closing projects that address our drivers of change. Our goal is to deliver projects to have the lowest whole-life cost, be fit for purpose and meet our customer, stakeholder and RIIO requirements.

In the *GTYS* we focus on all four of the NDP sections. The Drivers of Change chapter focuses on the external stimuli that trigger the beginning of the NDP process. Network Capability looks into how we analyse and assess the network to address these drivers. The third chapter, Option Assessment, describes how we aim to develop solutions looking at rules, tools and asset solutions. The final stage of the NDP details solutions that have been identified as the preferred option to meet our stakeholders' needs and these are discussed in the Development chapter.

In this chapter, we explore the drivers of change that can trigger stage one of our NDP.

Figure 1.2
Our Network Development Process



Drivers of change
1.2 Customer needs

Our immediate customer needs include the connection and capacity processes. When these are initiated by our customers, they are a key driver of change that triggers our Network Development Process (NDP). We need to assess what impact a connection or capacity change will have on our current Network Capability and our operational strategies.

Anyone wishing to connect to the NTS can arrange for a connection directly with us and we can reserve capacity for you. However, you must be aware that a shipper must buy and hold your capacity. Our Gas Transporter Licence stipulates we can only enter transportation arrangements with shippers and Gas Distribution Network Operators, as detailed in the Uniform Network Code (UNC).

In addition, for any new entry connection to our system, the connecting party should tell us as soon as possible what the gas composition is likely to be. We will then determine whether gas of this composition would be compliant with our statutory obligations and our existing contractual obligations. Please see appendix 2 for further information on network entry gas quality specifications and the latest gas quality developments in Great Britain.

1.2.1 Connection and capacity application process

If you need a new connection or a modification to an existing NTS connection, you will need to go through the application to offer (A2O) process. Our connection (A2O) and capacity processes (Planning and Advanced Reservation of Capacity Agreement – (PARCA)) are separate. You can find a detailed description of our connection and capacity application processes in appendix 3 and appendix 6.

If you have any queries about our connections or capacity processes please contact the Gas Connection Contracts team directly, you can find their contact details in appendix 4.

Facilitating flexible connections for gas customers

Spotlight

We are constantly evolving the connection process to the National Transmission System (NTS) for a new generation of gas customers with the objective of reducing the cost and time to connect.

In *GTYS* 2019 we reported on a proposed NTS connection at Somerset Farm, a biomethane site which is located near Wisbech in Cambridgeshire on feeder 7. The site was successfully commissioned and had its first flow of gas on 22 July 2020. The connection used the learning outputs from 2018 as part of the innovation funded Project CLoCC (Customer Low Cost Connections), and was chosen when we invited expressions of interest from potential pilot customers. We are now seeking to learn from the implementation of the project and further review our policies and procedures and apply this to future smaller flow sites wishing to connect. Looking to the future this connection underlines our support for the UK's Clean Growth Strategy and is one example of how the NTS can be used on the journey towards net zero.

Biocow – first biomethane connection

Fordoun – first compressed natural gas (CNG) connection

The future for gas connections

The gas connections portal enables customers to generate cost estimates and apply for a gas connection online. We currently have over 100 companies registered to use the portal.

We have a number of new connections in discussion and are looking to continually evolve our processes and learn from these projects to make further improvements for customers. This will include reviewing the costs and the services we offer to our increasingly diverse customer base on a regular basis.

For more information on gas connections, please get in touch with the Gas Contract Management team at Box.UKT.customerlifecycle@nationalgrid.com or via our website through accessing the online gas connections portal.

Drivers of change
1.2 Customer needs

1.2.2 Future Energy Scenarios

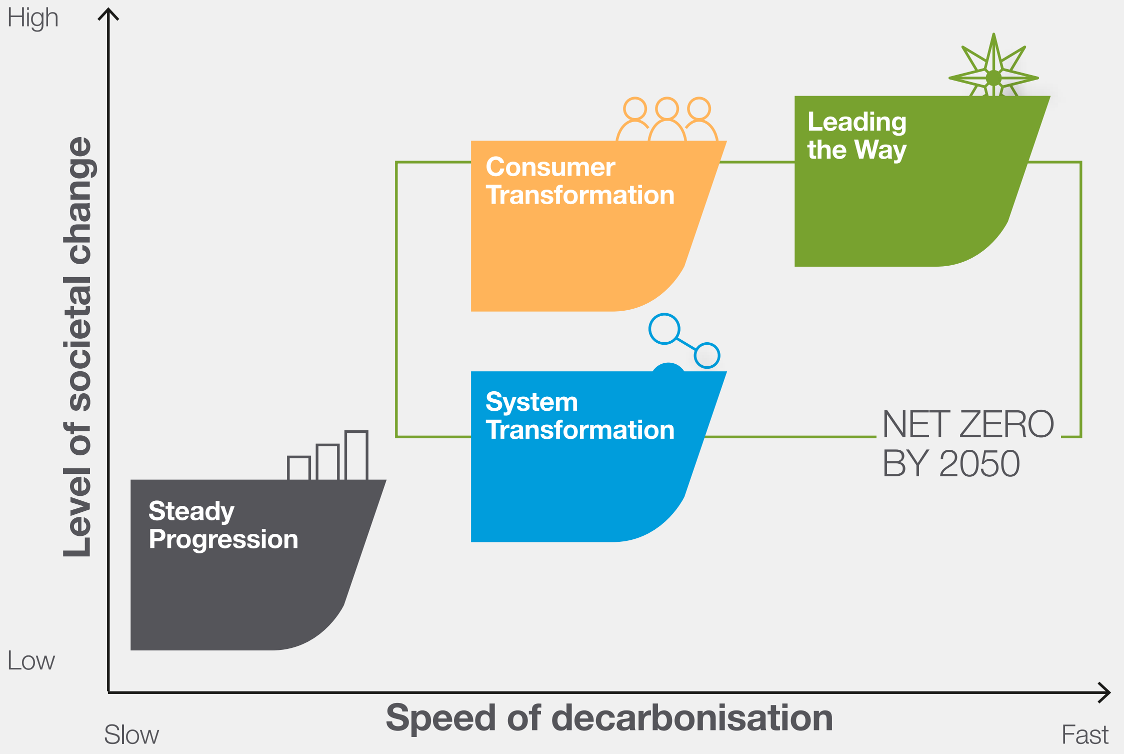
Our long-term customer needs are articulated within National Grid ESO's *Future Energy Scenarios (FES)*. We use the latest *Future Energy Scenarios* as the starting point for all our future network planning.

The Future Energy Scenarios are produced each year to identify a range of credible scenarios for the next 30 years and beyond (figure 1.3). These scenarios consider how much energy might be needed and where it could come from. They look at what the potential changes over this time period might mean for the industry and for its customers.

As a result of the new legislated 2050 net zero target, FES 2020 has a new scenario framework with axes of 'Speed of decarbonisation' and 'Level of societal change'.

In the document we only show data out to 2030 but within the data sheet we will share out to 2050, as this period is of the greatest relevance to decisions that need to be taken on the gas network today. The *GTYS* does not repeat the *FES*, it instead shows a comparison between now and 2030 to highlight key potential changes to gas supply and demand over the next decade.

Figure 1.3
The *FES* 2020 scenario matrix



Drivers of change
1.2 Customer needs

1.2.3 Gas demand

Figure 1.4 shows a comparison of gas demand by scenario between 2020 and 2030. The following paragraphs detail the consumer choices and technological developments that influence the composition of UK gas demand for each future energy scenario for 2030.

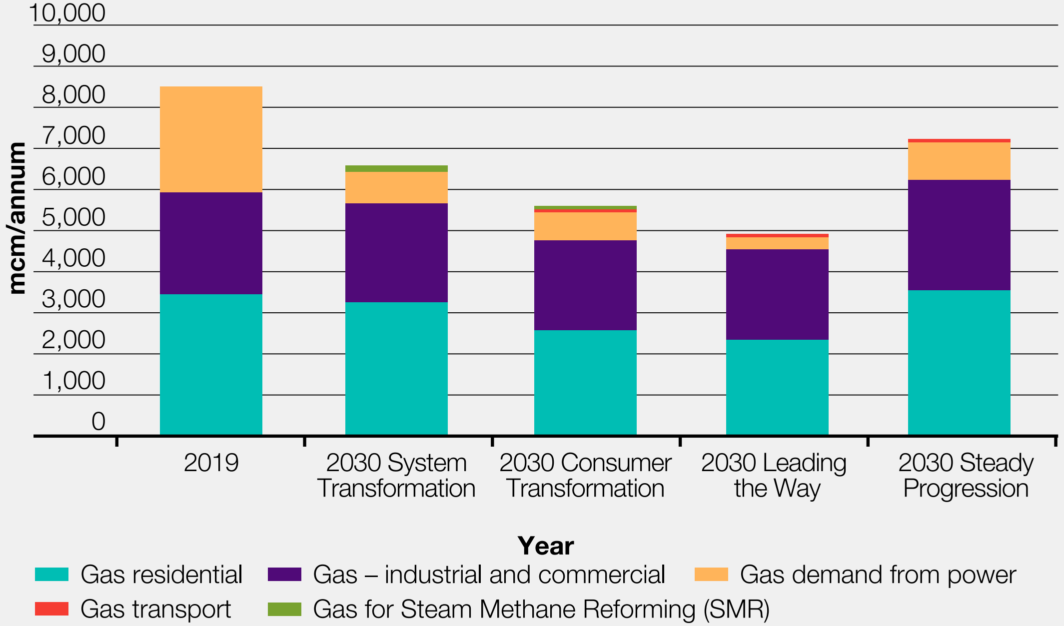
System Transformation, which focuses more on hydrogen for decarbonisation, has a slower increase in energy efficiency and sees gas boilers retained ahead of a move to hydrogen. The hydrogen is produced from methane reformation (i.e. from natural gas) with carbon capture.

Consumer Transformation, a more electrified scenario, sees residential natural gas demand decline as homes become more thermally efficient and electric heat pumps start to replace gas boilers. This is alongside increased levels of energy efficiency and electrification in the Industrial and Commercial (I&C) sector. In the power sector, gas-fired power stations increasingly operate as peaking plant to support renewable output.

Leading the Way sees the quickest and largest reduction in natural gas demand of the four scenarios. This scenario will move to more hybrid solutions for heating (e.g. electric and hydrogen hybrids) in the years beyond 2030 with any hydrogen used being produced from electrolysis.

Steady Progression has the slowest decarbonisation and does not follow a pathway that meets the 2050 net zero target. Natural gas boilers remain the primary heat source and use of gas-fired electricity generation remains high.

Figure 1.4
Comparison of gas demand by future energy scenario between 2019 and 2030



Drivers of change
1.2 Customer needs

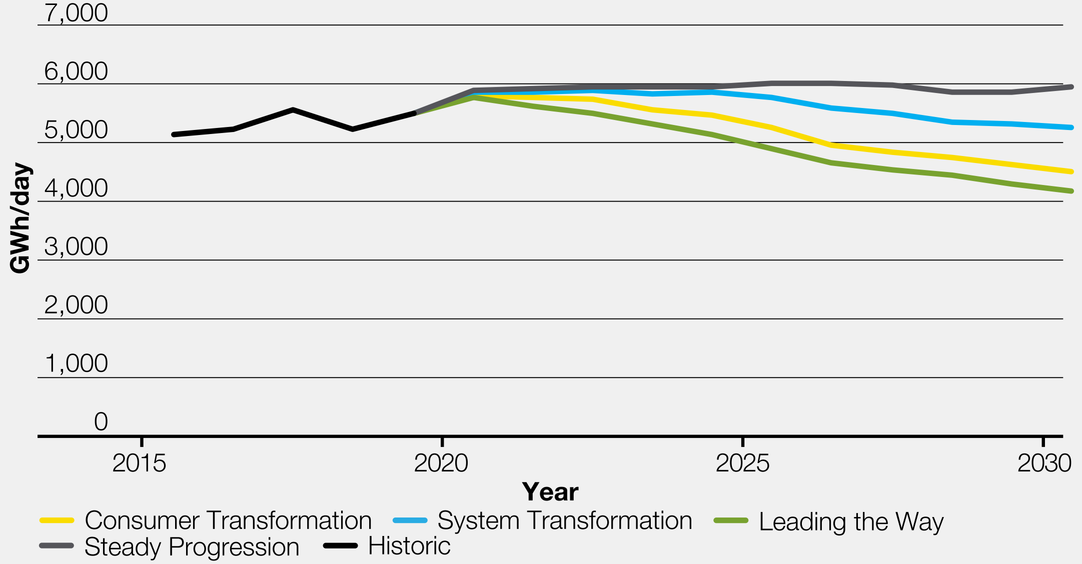
1.2.4 Peak daily demand

Gas peak day (1-in-20) demand is illustrated in figure 1.5.

Trends in peak natural gas demand generally mirror annual natural gas demand in each scenario as many of the factors which influence annual demand also influence peak demand, but the declines are not as rapid.

Gas is still required as a supporting electricity generation source when intermittent power generation is producing less. It is also used for heating in gas boilers, hybrid heating systems (electric heat pumps with gas boilers for peak load) or hydrogen production, depending on the scenario.

Figure 1.5
Peak demand 1-in-20



Drivers of change

1.2 Customer needs

1.2.5 Gas supply

On the NTS, we have eight gas supply terminals (figure 1.6). These deliver gas from the UK Continental Shelf (UKCS), the Norwegian Continental Shelf (NCS), Europe, and the world market delivered as liquefied natural gas (LNG).

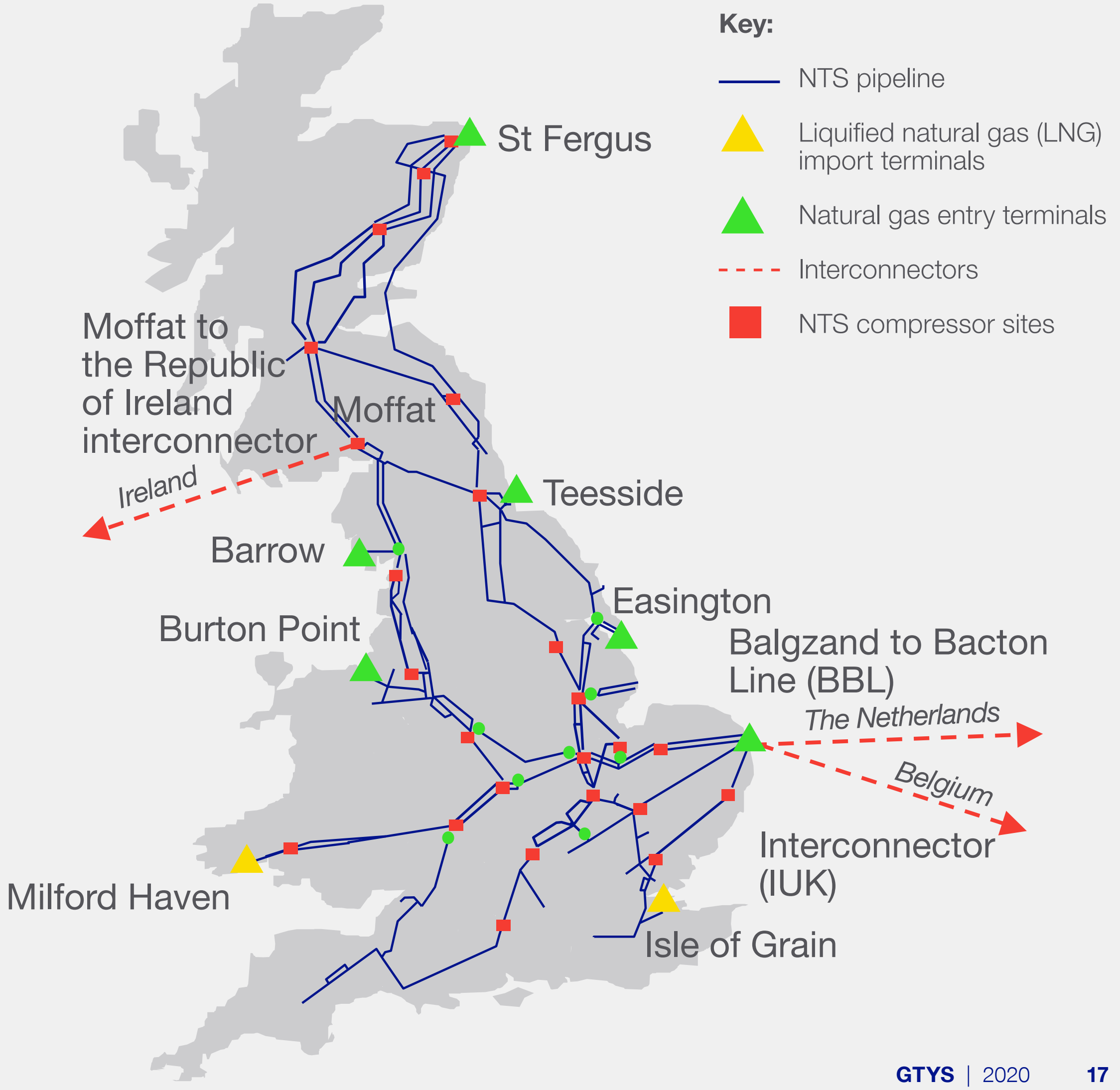
Over the past two decades, the UK has transitioned from being self-sufficient in gas (delivered from the UKCS) in 2000, to being dependent on imported gas for 58% of our gas demand by 2020. Due to the decline of the UKCS, there is potential for the UK to reach 74% dependency on imported gas by 2030. The current and potential sources of indigenous gas in the UK include:

- UK Continental Shelf (UKCS)
- shale
- biomethane.

Imported gas provides greater flexibility for us to manage the operational challenges of a rapidly-changing gas system.

On the following page, figure 1.7 shows a comparison of the UK's gas supply composition between 2019 and 2030 for each future energy scenario.

Figure 1.6
NTS gas supply terminals



Drivers of change

1.2 Customer needs

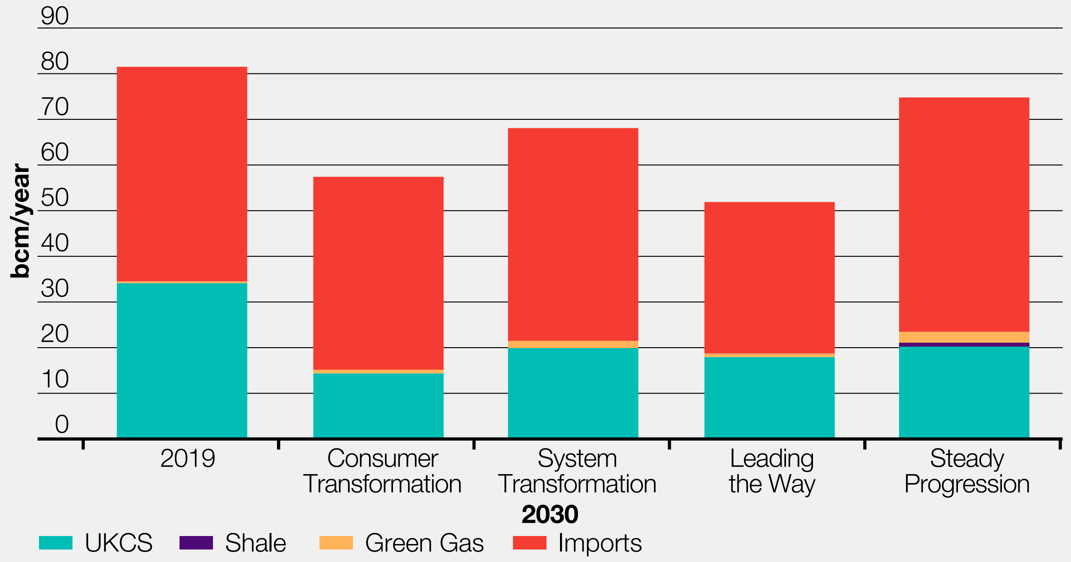
In **System Transformation,** whilst demand for natural gas reduces slightly in the early years, it levels off in the late 2020s as hydrogen production from natural gas begins to develop. Green gas supplies start to increase in the early 2020s but start to be displaced as hydrogen develops.

In **Consumer Transformation,** the lower demands for natural gas start to necessitate more flexible supply and so this scenario sees the lowest level of supply from UKCS. This also corresponds to the highest percentage of import dependency across the scenarios (although the absolute level is lower than in **System Transformation**).

Leading the Way has the lowest natural gas demand in 2030 of the four scenarios due to earlier decarbonisation and any hydrogen being produced from electrolysis rather than methane reforming. However, it sees a relatively slower UKCS decline than **Consumer Transformation** and so the import dependency is less.

Steady Progression has the highest demand for natural gas across the scenarios due to slower decarbonisation and the supply mix is the closest to today. UKCS supplies at 2030 are also highest in this scenario and there is a higher proportion of green gas supplied than the net zero scenarios where bio-resources are valuable for meeting hard-to-decarbonise demand and for use in negative emissions technologies. Indigenous shale gas enters the supply mix in the early 2030s which helps to mitigate the risk of import dependency.

Figure 1.7
Comparison of gas supply by scenario between 2019 and 2030



Drivers of change
1.2 Customer needs

1.2.6 Peak supply

In all our scenarios we assess whether there will be enough gas to supply peak demand. To make sure that demand can be met even if there is a failure in the network, we carry out an assessment assuming that the single largest piece of infrastructure is not available. This is known as the N-1 test and is used by the Government in assessing the security of gas supply.

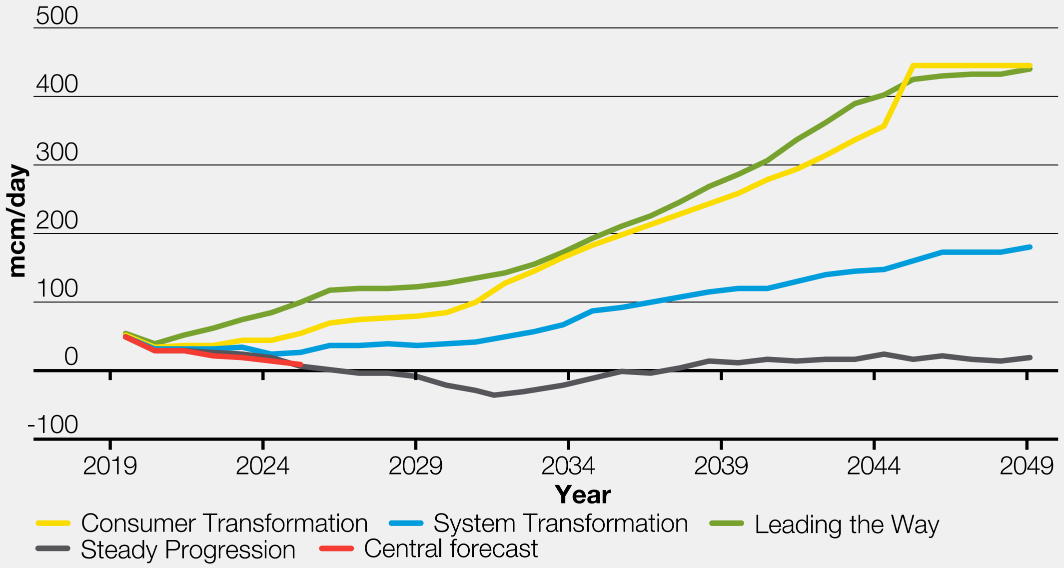
In figure 1.8 we show the margin of supply over peak demand under N-1 conditions. The figure shows that supply capacity exceeds peak demand in all scenarios but **Steady Progression** out to 2030. In **Steady Progression**, under the N-1 conditions, it shows that demand exceeds supply in the year 2027.

We will re-assess this again next year given that the risk of losing the single largest piece of infrastructure is extremely low and there are a number of uncertainties which may evolve over the 12 months and change this scenario, including:

- government policy in relation to net zero
- the future supply mix is an evolving picture.

We are confident that re-assessing next year is the most pragmatic approach, and should it be deemed that action is required, we will assess the full range of options available to us (rules, tools and assets). Given that any solution would only be required for a relatively short period of time, we would envisage that a contract solution would be favourable. In the unlikely event that we need an asset solution, we would have sufficient time to develop this as the lead time is six years.

Figure 1.8
Peak supply margin under N-1 conditions



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Drivers of change
1.2 Customer needs

1.2.7 *Gas Future Operability Planning (GFOP)*

In addition to using the *FES* data as the starting point for all of our network analysis, we also use the *FES* to explore how our customers long-term needs (out to 2050) may affect the future operability of the National Transmission System (NTS). We document potential operability challenges within our *Gas Future Operability Planning (GFOP)* publications to share with our customers and stakeholders.

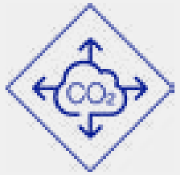
Engage with us

Regular engagement with our customers and stakeholders allows us to better understand your changing needs. This helps us to ensure that we can continue to deliver your requirements going into the future, whilst meeting our statutory and commercial obligations.

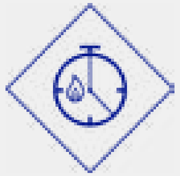
The GFOP acts as a vehicle for our customers and stakeholders to:

- challenge our assumptions about future operability challenges
- share their views on the changes they envisage and what they require from the gas transmission network going into the future.

We recently published our latest *GFOP* discussing how increasing low-carbon gases in the gas networks could enable net zero carbon emissions, please click here to view it online. For the purpose of this document, there was a focus on two potential roles the NTS could play in a net zero future:



Natural gas NTS that enables a net zero 2050.



Hydrogen NTS that enables a net zero 2050.

We want to continue to focus on what you, our customers and stakeholders, believe are the most important elements of the future energy landscape. We are therefore keen to get your input. Visit our website and get in touch with us at Box.OperationalLiaison@nationalgrid.com to become part of the future energy debate.

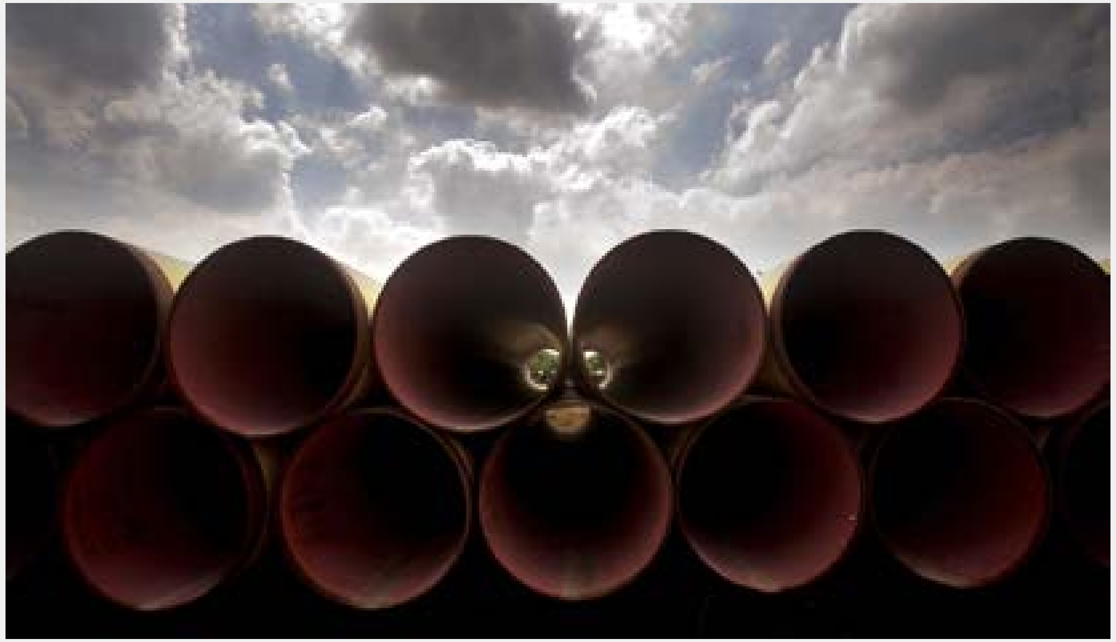
Drivers of change
1.3 Asset management

The NTS is ageing, and this means that managing our asset health is becoming an increasingly important driver of change and trigger for our Network Development Process.

Asset health driven work accounts for over 50% of our capital plan. Over the RIIO-1 period, we will have invested a total of £89m per year to maintain the health of our assets to continue to deliver a safe and reliable network for our customers. Our RIIO-2 business plan includes proposals to invest a further £167m per year on asset health, almost doubling our annual asset health investment.

The NTS comprises of approximately 7,660 km of pipeline, 24 compressor sites with 75 compressor units, 20 control valves and 530 above-ground installations. The network was built quite rapidly from the late 1960s with the majority of the network as we know it today in place by 1990. With a typical asset design life of 40 years, over 70% of our network will be beyond its original life expectancy by the end of RIIO-1. This isn’t to say that all our assets beyond their design life need replacing, but it does mean that careful management of these ageing assets is required. Our current asset health strategy is to first consider whether the asset is still required on the NTS. Once the need is established, we will consider all options and adopt an appropriate intervention type (maintain, re-life, replace, remove).

We have developed asset maintenance and asset health programmes to maintain the health of the NTS. Our asset maintenance programme focuses on delivering routine maintenance and monitoring the health of our assets versus our expected asset life cycles. The asset health programme addresses assets that are either end of life or have failed, typically through invasive works such as replacement or refurbishment. These programmes ensure that we can consistently deliver a safe and reliable system to meet the needs of our customers and stakeholders.



Drivers of change
1.3 Asset management

1.3.1 Developing our asset management approach

We manage our assets as efficiently as possible, however, through our ISO55001 accreditation, we are continuously improving our asset management processes to ensure we effectively manage network risk and deliver value for our customers. During 2019/20 we have continued to improve our approach by integrating asset strategy, portfolio planning, investment governance, and investment delivery, within an end-to-end Asset Investment Planning and Management (AIPM) process. We have also implemented a Decision Analytics solution to optimise the investment that we undertake across our network.

A key aspect of the solution is the use of a monetised risk-based approach to the planning and targeting of investments and the reporting of investment outcomes to Ofgem. Through improved understanding of our asset base, how our assets can fail, their probability and consequence of failure, we can better understand risk across our network. With this improved understanding, we can target our investments to deliver further value to our customers and stakeholders.

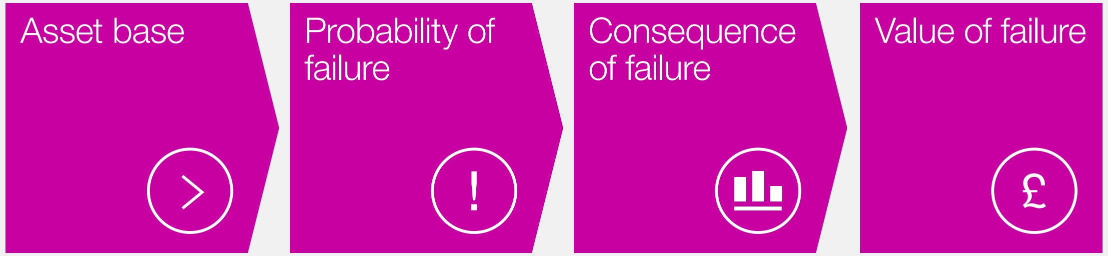
Figure 1.9
Developing our asset management approach

Drivers of change

1.3 Asset management

We reported last year that Ofgem had provisionally accepted our new NOMs methodology and a proposed rebased asset health target for RIIO-1 had been submitted, using a monetised risk approach (see figure 1.10). We are now pleased to report that following industry consultation, Ofgem have approved our rebased Network Replacement Outputs for RIIO-1 and will update our Gas Transporter Licence accordingly.

Figure 1.10
Network Output Measures methodology



To provide further information, figure 1.11 describes the measures of risk that comprise our new monetised risk-based asset management approach. This framework, now call Network Asset Risk Metrics (NARMs), is being used to consistently assess all investment on the gas transmission network and ensure that we deliver work that is beneficial to our customers and stakeholders.

Figure 1.11
Measures of risk

Category	Service risk measure
Safety	Health and safety of the general public and employees
	Compliance with Health and Safety legislation
Environment	Environmental incidents
	Compliance with environmental legislation and permits
	Volume of emissions
	Noise pollution
Availability and reliability	Impact of network constraints
	Compensation for failure to supply
Financial	Shrinkage
	Impact on operating costs
Societal and company	Property damage
	Transport disruption
	Reputation

Our new monetised risk-based approach to investment planning has been central to the development of our business plan for the next regulatory period, RIIO-2. Our RIIO-2 business plan submission identifies an increase in asset investment expenditure from our RIIO-1 levels of spend, driven by an increased volume of work to maintain current levels of network risk (as measured by NARMs) on our ageing asset base. You can find out more information on our RIIO-2 submission online.

Drivers of change

1.4 Legislative change

This chapter outlines the key legislative changes that can trigger our Network Development Process, as these changes will impact how we plan and operate the National Transmission System (NTS) over the next ten years.

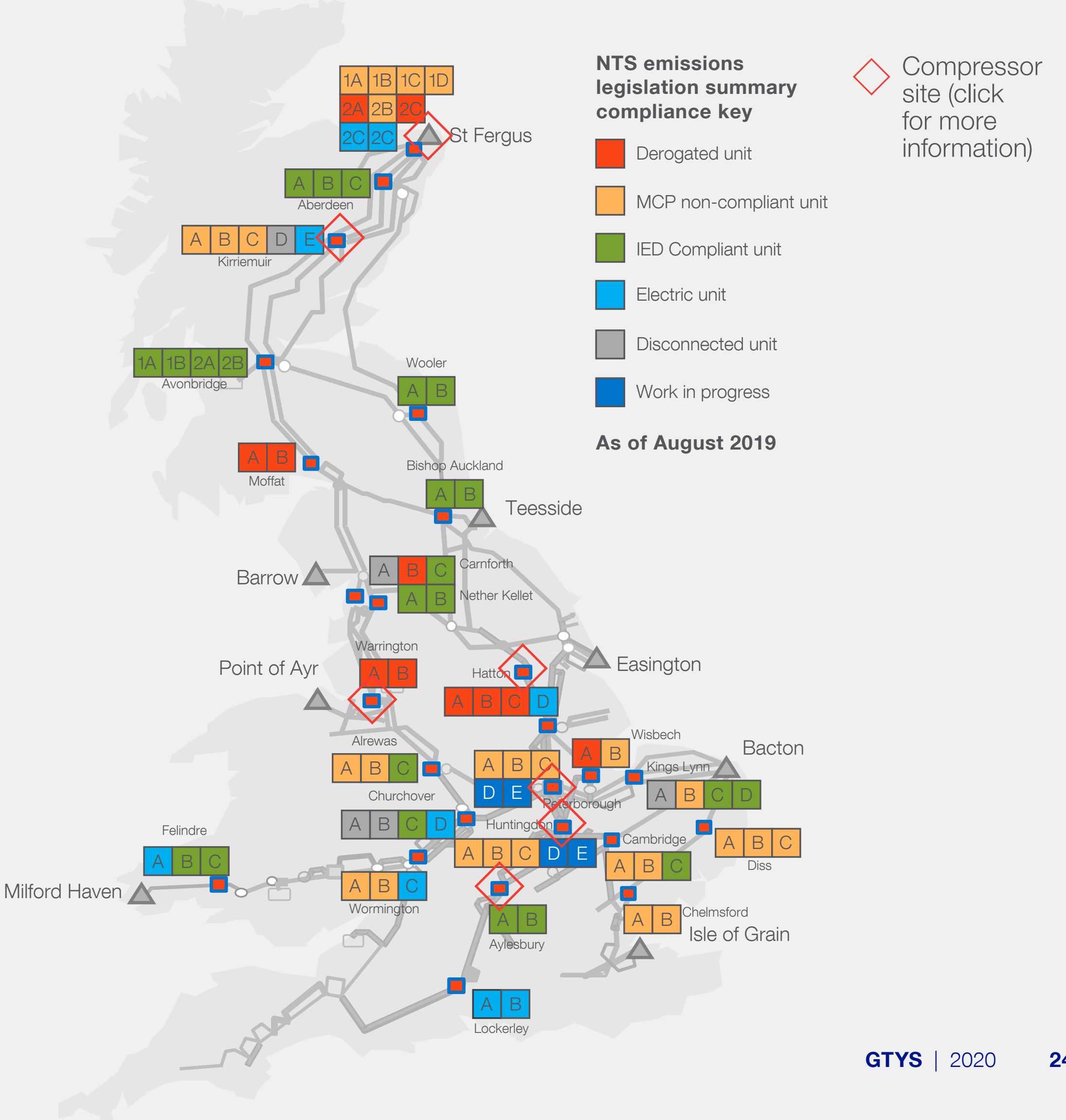
1.4.1 Industrial Emissions Directive (IED)

The Industrial Emissions Directive (IED) is the biggest change to environmental legislation in over a decade, and consolidates several European emissions-related directives. These include the Integrated Pollution Prevention and Control Directive (IPPCD) and the Large Combustion Plant Directive (LCPD). These European Union (EU) agreed targets and directives determine how we must control our emissions.

The IED forms the new mandatory minimum emission standards that all European countries must comply with by 2023 and came into force on 6 January 2013. The IED heavily impacts our current compressor fleet (figure 1.12) with implications for everyone who relies on the NTS.

We remain committed to reducing emissions from our compressor operations, as we continue to transport gas in the direction of a decarbonised world in order to meet the UK's decarbonisation targets. Works to achieve IED compliance at our compressor sites have been submitted as part of our RIIO-2 business proposal. You can read our RIIO-2 business proposal online.

Figure 1.12
Impact of the IED on our current compressor fleet



Drivers of change
1.4 Legislative change

Industrial Emissions Directive – Chapter II

Chapter II of the IED applies to 23 of our 24 NTS compressor sites. This chapter details an integrated environmental approach to the regulation of certain industrial activities as well as requirements based on the use of best available techniques (BAT).

Chapter II of the IED also incorporates requirements from the Integrated Pollution Prevention and Control Directive (IPPCD) that was implemented in 2008. The IPPCD requires progressive pollution reduction and applies at a fleet level across the NTS. We have to ensure that all of our compressor installations covered by the IPPC regime have a permit.

To obtain the obligatory IPPCD permits, we must demonstrate that BAT has been employed on the permitted installation to prevent/reduce emitting pollutants by means of an assessment. The IPPCD permits will specify the maximum emission limit values (ELVs) to the air for each unit, along with other operating conditions.

The utilisation of National Grid's compressor installations varies greatly across the fleet. Consequently, environmental benefits can be maximised if a network-wide approach is employed, focusing on high utilisation installations (in order, for example, to maximise reduction of total mass emissions within the UK) with due consideration given to potential local environmental impacts.

A network-wide approach is described in the annual Network Review carried out by National Grid NTS to review all emissions from compressor sites.

The findings are discussed and agreed with the Environmental Agency (EA), Natural Resources Wales (NRW) and the Scottish Environment Agency (SEPA). Further information and a copy of the Network Review may be obtained from the environment agencies.

Drivers of change
1.4 Legislative change

Industrial Emissions Directive – Chapter III

IED Chapter III details the regulation of large industrial installations and incorporates requirements of the obsolete Large Combustion Plant Directive (LCPD) that was implemented in 2001. Chapter III of the IED also affects a significant number of our compressor units in operation on the NTS, impacting in total 16 of our 64 gas turbine driven compressor units. It sets clear emission targets for pollutants such as nitrogen oxides (NOx) and carbon monoxide (CO) at a combustion unit level and applies to industrial emissions for units with a thermal input 50 MW and above.

All of our compressor units that fall within the IED Chapter III directive must meet the ELVs defined in the directive. ELVs set out in the directive can be met in one of two ways:

1. **Choose to opt in** – must comply with the ELV or plan to upgrade to comply by a pre-determined date.
2. **Choose to opt out** – must comply with restrictions defined in the derogation including Limited Lifetime Derogation or the Emergency Use Derogation.

Significant works to ensure compliance by 31 December 2023 have been completed, with more works planned.

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Drivers of change
1.4 Legislative change

Medium Combustion Plant Directive (MCPD)

This directive fills the regulatory gap at EU level between large combustion plants (>50 MWth), covered by the Industrial Emissions Directive (IED), and smaller appliances (heaters and boilers <1 MWth), covered by the Ecodesign Directive.

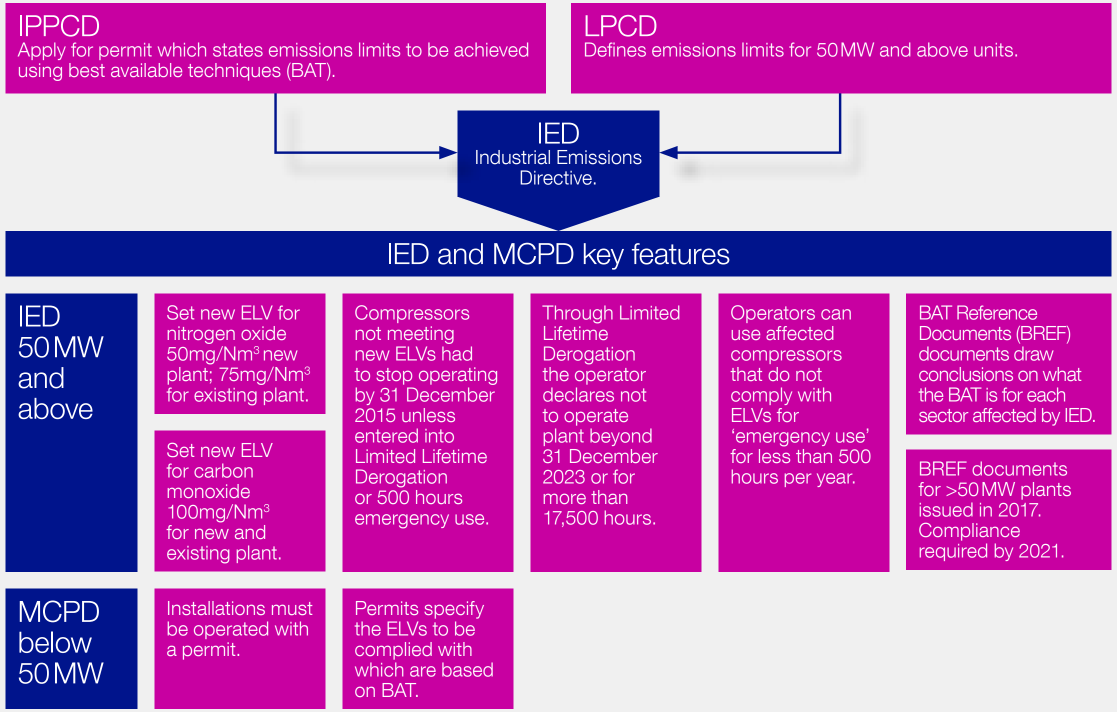
MCPD was transposed into UK legislation in December 2017. The emissions compliance deadline for gas driven compressors was originally 2025, however National Grid has secured a longer derogation for gas compressors required to ensure the safety and security of a national gas transmission system, and now have a further five years (to 2030) to comply with the requirements. The MCPD also applies to further emissions targets from 1 January 2030 onwards.

The MCPD applies to smaller gas compressors and will affect a further 41 of the NTS compressor units. Other combustion plants, such as pre-heat systems, are also captured as part of this directive. The impact assessment that we completed in 2016/17 is now being used to develop mitigation plans.

The impacted units include some of the oldest compressors we operate, many of which are beyond their design life. There are four main methods for us to achieve MCPD compliance: replacement of units with compliant ones, modification, derogation (i.e. limited/emergency use) or decommissioning. Works to achieve MCPD compliance at our compressor sites have been submitted as part of our RIIO-2 business proposal. You can read our RIIO-2 business proposal online.

Please see figure 1.13 for an overall summary of the Industrial Emissions Directive (IED) legislation.

Figure 1.13
Industrial Emissions Directive legislation key features



Drivers of change

1.4 Legislative change

1.4.2 Additional EU legislation

Following the UK's referendum result on EU membership in June 2016, the UK will formally leave the EU at the end of the transition period (the end of December 2020).

We will continue to take forward the implementation of EU requirements whilst the terms of the future EU UK energy relationship and arrangements are defined as part of the political Free Trade Agreement. As part of this process, we will engage with both the UK Government and Ofgem to understand the impact of the UK's exit from the EU on the implementation of future EU energy market requirements.

We engage on gas policy matters at a European level within the European Network for Transmission System Operators for Gas (ENTSOG), Gas Infrastructure Europe (GIE) and with other EU stakeholders. We will work closely with the Department of Business, Energy and Industrial Strategy (BEIS) and Ofgem to consider the gas aspects of the new EU legislative package as part of its Green Deal, focused on decarbonisation in the context of post-COVID 19 economic recovery.

European Union Third Energy Package

The Third Energy Package comprises several EU regulations which establish harmonised arrangements for EU gas markets and the establishment of pan-European organisations to support its detailed development and implementation. The Third Energy Package creates a framework to promote cross-border trade and requires several legally binding guidelines and network codes to be established and implemented with the aim of promoting market liquidity, improving integration between Member States' gas markets, and promoting the efficient use of interconnectors to ensure that gas flows in response to price signals (i.e. to where it is valued most).

These EU legislative requirements take priority over GB domestic legislation and associated regulations and codes, including the Uniform Network Code (UNC). Over recent years, a series of UNC modifications have been raised and implemented to ensure the UNC arrangements are consistent with the EU legislation (see appendix 5).

Preparations for the end of the Brexit transition period are likely to contemplate the requirements of a 'no deal' scenario. Contingency arrangements planned to address the potential 'no deal' Brexit in January 2020, principally in the form of the European Union (Withdrawal) Act 2018, would have incorporated into domestic law the EU regulations that were in place on the day prior to exit. A series of statutory instruments (SIs) were also placed to address any inoperabilities that would arise from application of this broad approach. The same approach could be taken in the event no agreement is reached between the UK and the EU at the end of the transition period.

Drivers of change
1.4 Legislative change

The energy market arrangements between the UK and the EU that will apply following the end of the transition period may also require further modification of the UNC to ensure consistency with such arrangements.

Over the last year we have continued to focus on the Revision of the Regulation on Gas Security of Supply ((EU) 2017/1938 of 25 October 2017). This replaces Regulation (EU) 2010/994 and mandates a greater level of cooperation between Member States. It came into effect on 1 November 2017 with a phased implementation timetable. The solidarity principle is the last element to be implemented and work is ongoing with BEIS and Ofgem in conjunction with the Commission for BEIS to fulfil its obligation.

Further details on UNC change proposals and implemented modifications can be found on the Joint Office website.

For more information on EU legislative activity, please refer to appendix 5.

Drivers of change

1.5 Net zero

In June 2019, the UK Government committed to a legally-binding target of net zero greenhouse gas emissions by 2050. This was a vital step needed in a bid to limit global temperature rises to well below 2 degrees Celsius set out under the Paris Agreement. Decarbonising the energy system is a challenge of both scale and pace. A mixture of technologies will be required to meet the net zero commitment and we must work collaboratively to develop a whole energy system approach.

The Gas NTS will play a key role in achieving net zero by 2050. As the owner and operator of the NTS, we are uniquely placed to facilitate and support the transition to net zero, while maintaining the reliability of our network and meeting the needs of consumers.

1.5.1 Our net zero commitments in RIIO-2

We submitted our RIIO-2 business plan to Ofgem in December 2019 for the price control period 2021–2026. In our submission, we made some key commitments as part of our road map to net zero. These included:

- providing resilience to renewable generation
- taking a consumer-first approach to ensure that no-one gets left behind
- delivering the transition as a responsible business
- facilitating the use of green gas
- reducing our business carbon footprint
- being ready to start the conversion to hydrogen by 2026.

Drivers of change
1.5 Net zero

1.5.2 Facilitating the use of green gas

In July, Somerset Farm, owned by Biocow Ltd, began injecting biomethane into the NTS, the first biomethane producer to connect to the high-pressure National Transmission System. With the establishment of Project CLoCC (Customer Low Cost Connections), we will continue to facilitate these connections to support the decarbonisation of our network.

1.5.3 Reducing our business carbon footprint

Within our RIIO-2 business plan, we outlined our commitments to environmental performance within our Environmental Action Plan. This plan spans five key areas with approximately 28 objectives to deliver for RIIO-2 and prepare us for RIIO-3. Specifically for net zero, we are decarbonising our operations through several initiatives. Our commitments fall into two specific categories for decarbonising; understanding our emissions and acting in the areas we have already identified.

One of our key commitments is to develop a robust science-based target, which will review all our emissions and develop a high-level engineering road map to address those emissions on the journey to net zero 2050. One activity that has been agreed in the Draft Determination is our innovation project, MoRFE (Monitoring of Real-time Fugitive Emissions), which will install live monitoring equipment to detect and quantify methane leaks from our compressor stations – further reducing our emissions by enabling quick detection.

Drivers of change
1.5 Net zero

Methane emissions are of significant focus in our RIIO-2 plans, with further funding requests for pipeline recompression equipment to address the low-pressure emissions associated with pipeline isolations – moving us close to net zero for pipeline decompression. We intend to install renewable generation on our sites to provide baseline electricity for our operations, along with the adoption of alternative fuel vehicles in the form of electric vehicles. Together, we expect these activities to reduce our emissions by 5% by the end of RIIO-2 on the baseline year of FY20 – this may not seem significant, but >80% of our emissions are directly linked to compressing gas and are associated with the legacy running of the network whilst trying to balance supply and demand scenarios. As hydrogen technology becomes more mature, we believe that we will be able to address the more significant proportions of our emissions.

1.5.4 Being ready to start the conversion to hydrogen by 2026

As we transition to net zero, we must look for alternatives to methane or natural gas, such as hydrogen. Currently, 85% of homes use gas for heat, and 40% of the UK's electricity relies on gas, but when this gas is burned, harmful carbon emissions are released into the atmosphere contributing to global warming.

Hydrogen can provide a credible pathway towards decarbonising domestic heat, power, transport and industry as no greenhouse gases are released at the point of use. The next 5 years will be key in building the evidence base for hydrogen to inform decisions for the future of the NTS and its ability to transport hydrogen safely.

Drivers of change
1.5 Net zero

Our Hydrogen in the NTS (HyNTS) programme that was launched during 2018–2019 looks to explore some of the opportunities and challenges with transporting hydrogen in the NTS.

1.5.5 Funding net zero

Ofgem have proposed a range of funding mechanisms as part of the Draft Determinations to enable us to carry out our net zero commitments. We will maximise the use of these mechanisms throughout the RIIO-2 price control period as well as exploring other funding mechanisms outside of the regulatory framework to achieve net zero.

1.5.6 Collaborating across the industry

The Energy Networks Association's (ENA) Gas Goes Green programme brings together the UK's gas network operators to deliver the world's first zero-carbon gas grid by 2050. The programme will incorporate the engineering expertise within the gas network operators, with the know-how and experience of a wide range of other experts, allowing gas network operators to co-ordinate and deliver major operational and technical changes to achieve net zero in the most cost-effective and least disruptive way.

We are also working with the Department for Business, Energy and Industrial Strategy (BEIS), along with ENA, the gas distribution networks, and wider industrial partners to define a collaborative and costed programme of work to assess the impacts of converting the gas systems to hydrogen. The programme builds the case for how the system will need to transition from the natural gas networks we have today to the gas system of the future.

HyNTS National Grid

Spotlight

HyNTS nationalgrid

HyNTS is a programme of work that seeks to identify the opportunities and address the challenges that transporting hydrogen within the National Transmission System (NTS) presents. This will unlock the potential of hydrogen to deliver the UK's 2050 net zero targets.

On the right we have a list of some of the projects that HyNTS has incorporated.

Project Cavendish

A review of the potential of the Isle of Grain region to use existing infrastructure to supply hydrogen to London and the South East including generation, storage, transport and CCS.

Hydrogen Flow Loop

Offline test loop to evaluate metallurgy changes on existing NTS steel pipe and new Mobile Automated Spiral Interlocking Pipe (MASIP) when exposed to 30% hydrogen, identifying next steps to assess the NTS' suitability to transport hydrogen.

NTS Hydrogen Injection

To identify the requirements to enable a physical trial of hydrogen injection into the NTS, identifying the gaps in the safety case and indicating the most suitable NTS location for a live small-scale trial.

Hydrogen Deblending

To assess a variety of hydrogen recovery technologies and develop concept designs for selected options including a techno-economic review and identify the requirements for a demonstration project.

Project Union

Project Union will review the potential phased repurposing of NTS feeders to carry hydrogen and provide a new hydrogen transmission 'backbone' for the UK.

FutureGrid

The FutureGrid project will build a hydrogen test facility from a representative range of decommissioned assets. Flows of hydrogen and natural gas blends (up to 100% hydrogen) will be tested at transmission pressures, to better understand how hydrogen interacts with the assets. The project will increase understanding of the characteristics of hydrogen in the NTS and builds on the HyNTS programme of work carried out so far, demonstrating what is required for hydrogen to be safely transported within the NTS.

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2 Network Capability

Network Capability

2.1 Executive summary

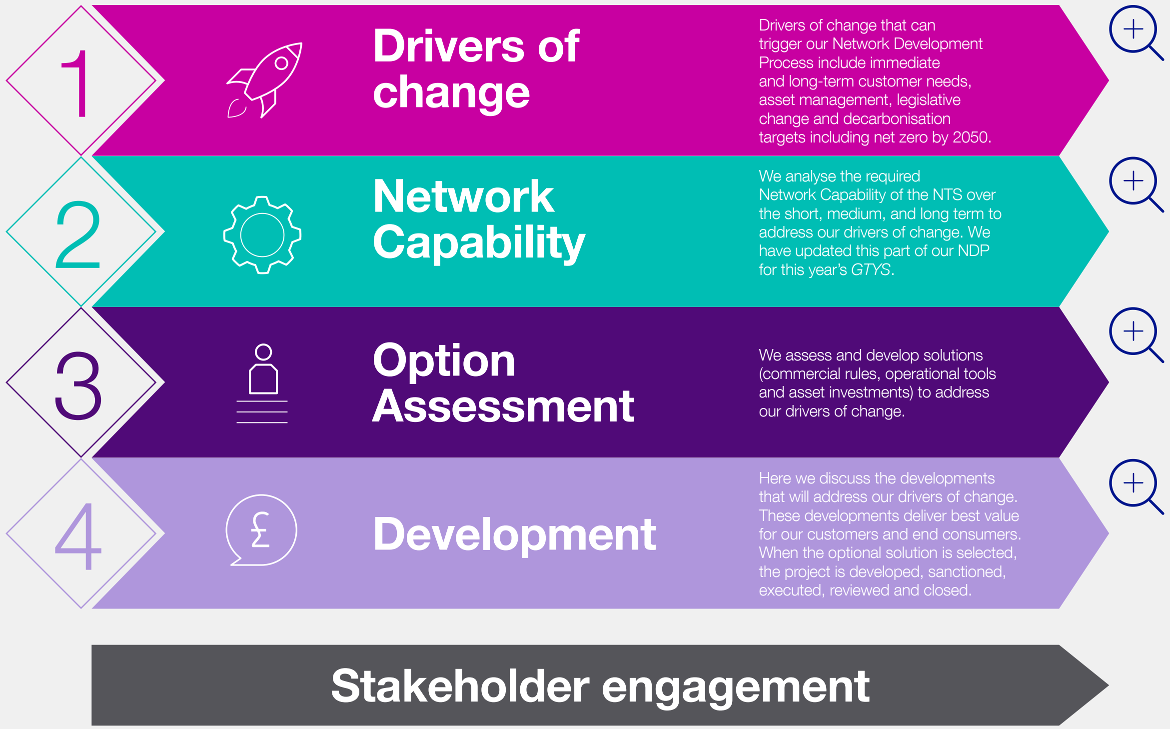
This chapter explores the second stage of our Network Development Process (NDP) (figure 2.1). Here, we analyse the required capability of our National Transmission System (NTS) to address drivers of change.

The capability, and the development, of the NTS is managed through the Network Development Process. This chapter describes how we analyse and assess the required capability of the NTS to address drivers of change.

This year we have introduced a new way of sharing our Network Capability metric, aiming to increase the visibility and transparency of this process. We describe this change and what it means for our stakeholders, customers and the consumer. We summarise some of the new ways we will showcase how our Network Capability assessment is evolving and how this will affect some of the outputs that are produced.

In chapter three, we discuss how we develop options once we have determined the capability that is required to fulfil the drivers of change.

Figure 2.1
Our Network Development Process



Network Capability

2.2 Introduction

Providing the right level of Network Capability underpins all of our investment decisions, business cases and business plans. It is a forward-looking process that allows efficient decisions to be made. This part of the process has not previously been widely shared with our readers and stakeholders.

From this year onwards, we intend to describe the process in more detail and make it much more accessible to all. To do this, we had to refine the process and develop new means of sharing complex ideas so that our customers and stakeholders can benefit from the insights it may bring. With these insights available to all parties it improves our ability to arrive at solutions which will best benefit the consumer.

We will publish an Annual Network Capability Assessment Report (ANCAR) in June of each year. The document will include information at entry and exit zone level, such as:

- flow forecasts
- the level of physical Network Capability
- the level of Network Capability that can be delivered using commercial tools
- an explanation of the changes to the level of physical Network Capability levels resulting from changes to the installed operational assets; a view of the required level of Network Capability in 10 years' time.

This will provide the reader with details of how decisions on investments made in the NDP are impacting the Network Capability and provide opportunities to allow feedback.

We have undertaken extensive engagement with many individuals and businesses to arrive at the present process, but this is only the first step. We will continue to discuss with all interested stakeholders how we can improve what we do and how we can better articulate the outputs from the process.

As part of this continual engagement, we are presenting some early analysis, based on the most recent *Future Energy Scenarios (FES)* as an annex to the *Gas Ten Year Statement*. This interim analysis is intended as an area for discussion that will set the framework for the ANCAR in June.

The rest of this chapter will explain our Network Capability process.

Network Capability

2.3 What is Network Capability?

The National Transmission System (NTS) is a complex system of physical assets such as pipes, compressors, valves, supply points and offtakes. In order to simplify this, the analysis of the NTS has been partitioned into zones that correspond to the way in which gas flows through it. Figure 2.2 gives a simplified view of the NTS and the zones.

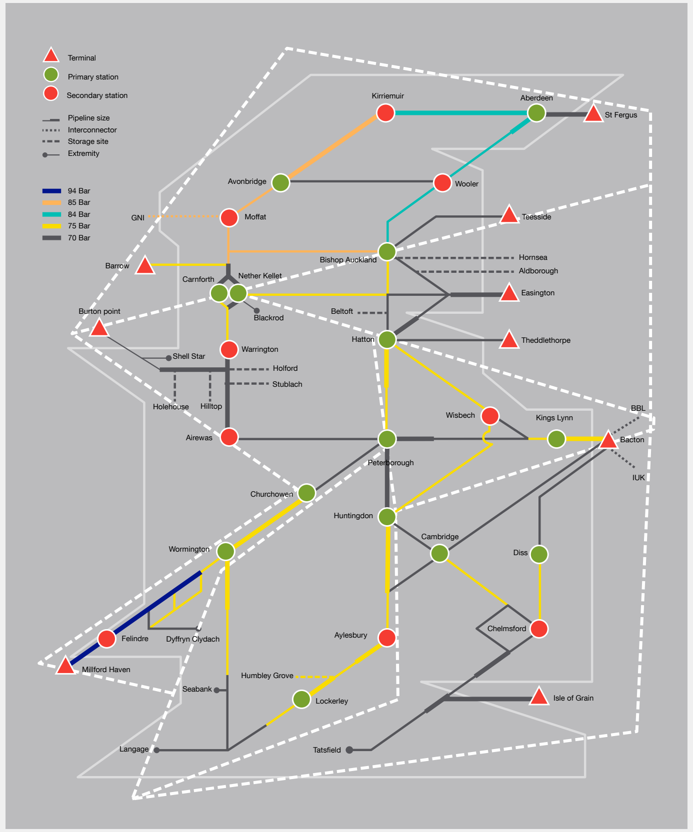
To assess both entry and exit capability the NTS has been divided into seven zones:

- Scotland and the North
- North East
- North West
- East Midlands
- Wales
- South West
- South East.

East Midlands and South West do not have sufficient entry points to include these in the entry capability assessment, so are omitted.

The Network Capability process comprises a series of sub-processes and figure 2.3 illustrates them and their interactions. The section numbers adjacent to some of the boxes refer to the sections within this chapter that expand upon the description of the process.

Figure 2.2
NTS simplified with zones



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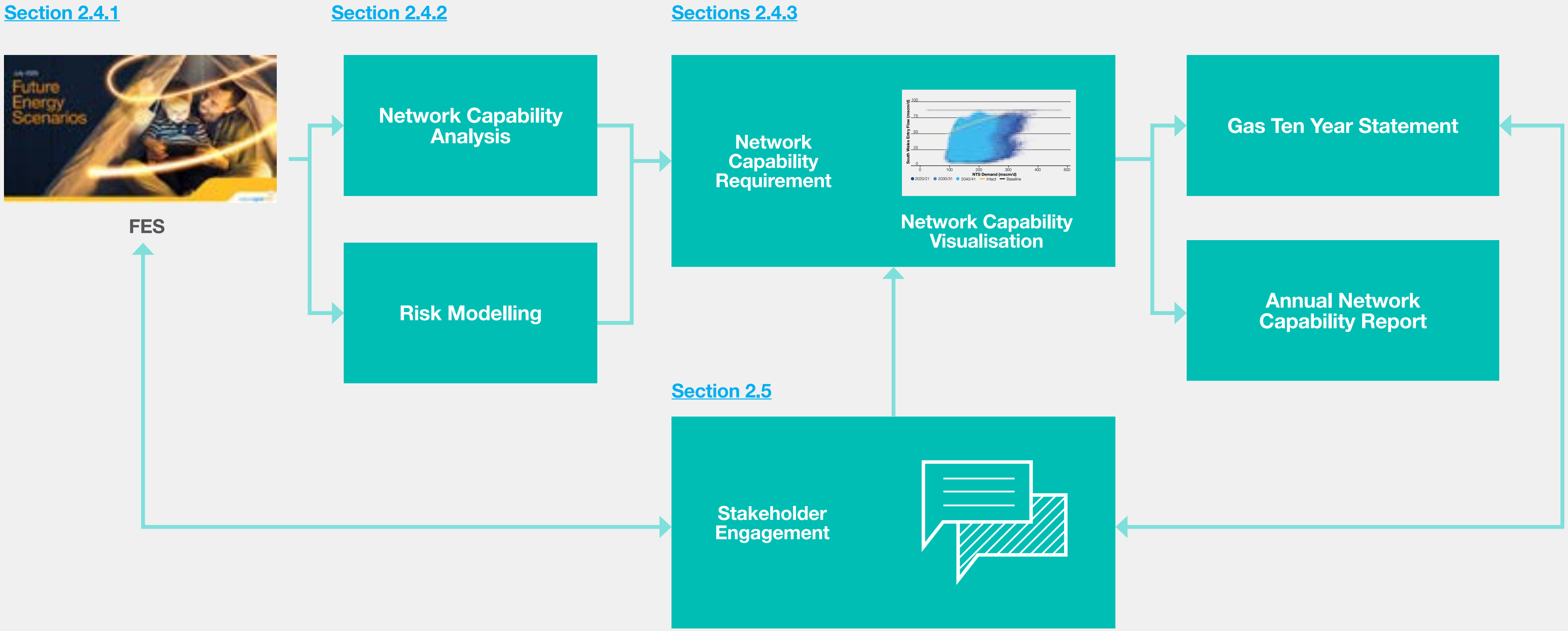
Network Capability

2.4 The Network Capability process

Figure 2.3
The Network Capability process (with references to text)



Network Capability

2.4 The Network Capability process

2.4.1 *Future Energy Scenarios*

Future Energy Scenarios (FES) is created by National Grid's Electricity System Operator (ESO). It maps plausible energy pathways out to 2050. Four scenarios are created for gas demand and supply.

The starting point in scenario creation is talking to customers and stakeholders and seeking their views on the latest forecasts and on how the energy landscape might change in the near future. The full engagement process is described in detail in the Stakeholder Feedback document.

The ESO begins their analysis of future demand and supply, using economic forecasts, information from stakeholders and market intelligence from a range of sources. The process is described in *Future Energy Scenarios*, with full details of the modelling for each component in the Modelling Methods summary.

The *FES* publication gives us the annual data set for the scenarios for gas demand and gas supply. All the FES data outputs that are included in *GTYS* can be found in the Data workbook. This data forms the basis for our assessment.

2.4.2 Network Capability analysis

The Network Capability analysis process defines the physical capability of the network to flow gas. To determine the Network Capability of each zone we calculate the maximum capability at a minimum of three national demand levels.

The supply capability is calculated by increasing the supplies in the zone until a constraint is found. The supply and demand remains in balance by reducing the supply at the least interacting supply points.

The demand capability is calculated by first reducing the supplies in the zone being assessed to the appropriate minimum for the demand level being assessed. If no constraint is found the demand in the zone is increased by moving demand from the least interacting zones to the zone being assessed until a constraint is found.

Network Capability

2.4 The Network Capability process

2.4.3 Network Capability visualisation – Entry

The visualisation of Network Capability is an evolving attempt to explain Network Capability and its future requirements.

We analyse capability at a minimum of three different demand levels, summer (low demand), winter (high demand) and a mid-point demand. By interpolating these points we create Network Capability curves. Figure 2.4 illustrates and explains the principles of the entry Network Capability diagrams. Network Capability curves are intended to also facilitate conversations with stakeholders about baselines. The vertical axis reflects the absolute level of entry flow for the zone under consideration. The horizontal axis reflects the assumed pattern of national demand.

These boundary curves are combined with the risk modelling data to allow comparison of Network Capability to forecasts of customers' flows.

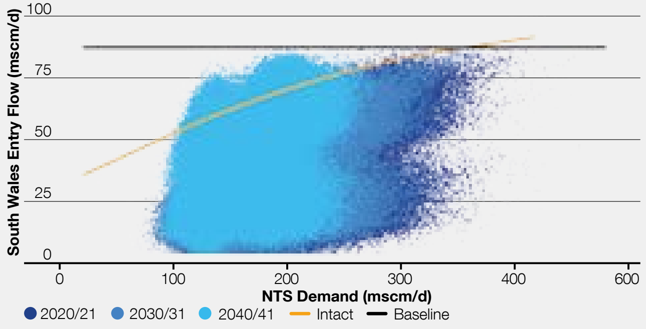
For each of the five entry zones we produce four charts, one for each FES scenario.

Figure 2.4
Entry Network Capability visualisation

The black lines show our obligated (baseline) entry level for the relevant zone.

Dots above the orange line indicate a potential constraint.

The orange line shows the level of capability that can be delivered by the assets in our business plan.



Each zone of the network will have four graphs. These graphs show the projected supply and demand for each of the four future energy scenarios (FES).

The cluster of dots show the projected supply and demand scenarios in the future. Dark blue = 20/21 through to Pale blue = 2049/50.

Network Capability

2.5 Stakeholder engagement

Stakeholder engagement is central to the Network Capability process. Throughout the entire process there is extensive gleaning of views and information from a wide selection of the industry and interested parties. It commences with all the FES interactions (see section 2.3.1), through the business as usual activities around customers' needs and requirements from the network and, more recently, to numerous meetings where we have sought insight into how we should frame this new Network Capability process and how it should develop. For the near future we have set ourselves three objectives:

- To further develop and enhance the process and articulation of Network Capability with stakeholders.
- Using the measures, illustrate stakeholders' needs of the transmission system against the current capability, identify implications, challenges and opportunities ahead and feed them into the network development processes.
- Articulate to stakeholders how the outputs of this work inform our decisions.

As stated at the start of this chapter we publish an interim Network Capability analysis as an annex to this *GTYS*. We will be seeking industry views on the annex but we would also welcome any thoughts and comments, especially prior to the full ANCAR publication in June 2021.

3 Option Assessment

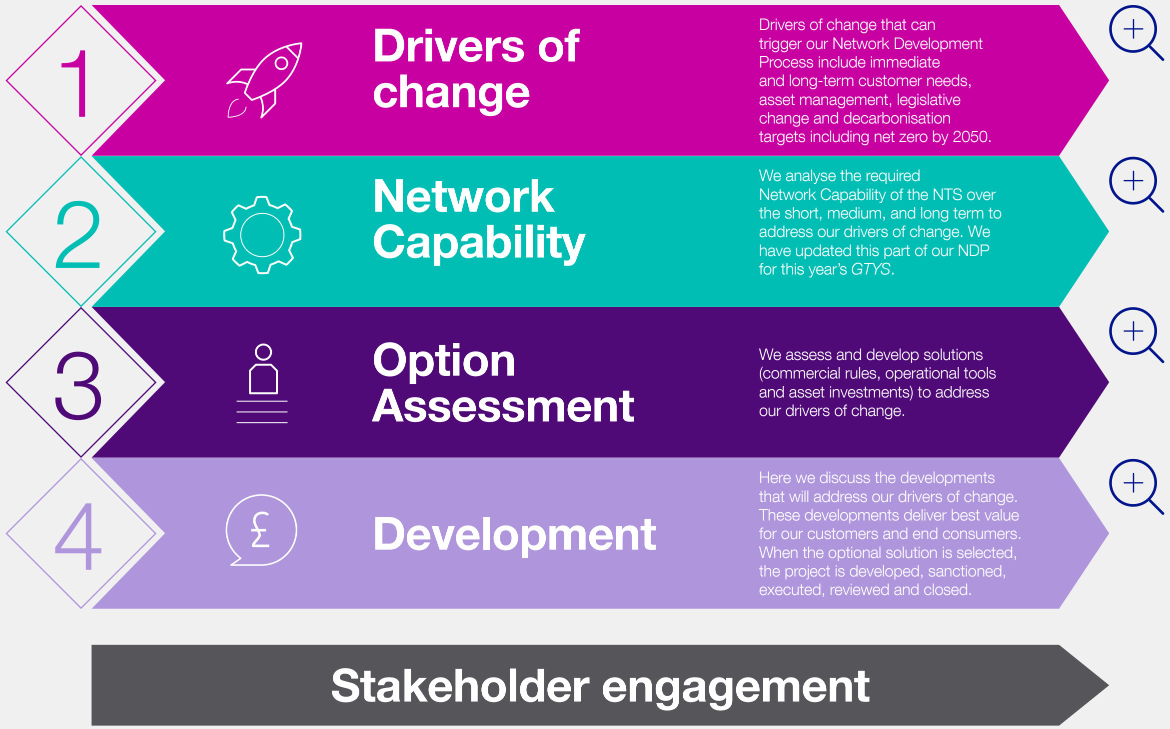
Option Assessment
3.1 Executive summary

This chapter explores the third phase of our Network Development Process (NDP) (figure 3.1). This chapter details how Gas Transmission develops options to deliver the required Network Capability to address our drivers of change.

In this chapter, we describe how we are developing specific options to address shortfalls in the capability of our network.

As the operator and owner of the NTS, we must operate a safe and reliable network. We know that you want to flow gas using within-day profiles that meet your operational, commercial and contractual needs, with minimal restrictions. Here we describe how we make efficient investment decisions that maximise our current Network Capability before we consider building new assets.

Figure 3.1
Our Network Development Process



Option Assessment
3.2 Optioneering

We use our Network Development Process (NDP) to assess the required capability of our network to address our drivers of change. Understanding our Network Capability and our capability as the Gas Transmission owner and operator allows us to determine the rule, tool or asset solutions to address our drivers of change.

This chapter explores how we develop options using a mix of rules (industry frameworks), tools (commercial arrangements and operational strategies) and asset solutions to ensure we retain the required level of Network Capability. Each option will usually have a mixture of solutions, with elements of asset solutions alongside both rules and tools.

To ensure we consider the full range of options, our optioneering is a collaborative process across the SO and TO. This ensures we consider a broad range of options with the potential to address the capability needs. As projects move through our NPD the options under consideration are refined to account for updated information.

3.2.1 Developing rules solutions

With these solutions, we look to alter the industry frameworks and rules which govern how the network is operated. When assessing options to address a specific gap in capability it would not usually be appropriate to consider altering rules which would impact all users of the network, although these could be considered when addressing a network-wide issue.

More targeted local solutions are available which can be a viable solution to specific Network Capability shortfalls. One example would be reducing the Assured Offtake Pressure (AOP) at points on the network as an alternative to investing in increasing capability.

This was considered as a potential solution for our Scotland 1-in-20 needs case. This was seen as possible when combined with investment in the local distribution network (DN), which would have ensured they could operate their system at the reduced AOPs.

Option Assessment
3.2 Optioneering

3.2.2 Developing tools solutions

These solutions may involve either utilising existing commercial tools to manage shortfalls in capability or designing new ones. Commercial solutions are an important consideration when assessing how to meet the network needs. These solutions potentially provide an alternative to investing in additional assets by either utilising constraint management tools or contracts to avoid breaches in Network Capability.

Utilising constraint management techniques can be an effective method of coping with supply/demand patterns which would otherwise exceed the capability of our network. Locational buys and sells allow us to increase supply in one area of the network while reducing it in another. Where these are not viable, capacity buy backs allow us to temporarily reduce capacity at an entry or exit point to ensure flows remain within our capability.

While constraint management tools can be useful to manage short-term issues the costs can quickly escalate if they are required frequently. To reduce these costs contractual solutions can be developed to avoid the need to call on these tools. Bi-lateral contract arrangements at either entry or exit points can be used to manage network flows. For example, to help meet the required pressure level at a distribution network offtake, a turn-up contract could be negotiated with the relevant gas shippers at a particular entry point. Flows through that entry point are then increased on request by National Grid, boosting local pressures. A turn-down contract at a power station can be used in a similar way. As an alternative to asset investment, contracts of this type are likely to be the most effective options when only required for a defined period or when applicable to a limited set of supply and demand scenarios – contracts are only economic if we don't have to use them very often over the short term, and where there is sufficient notice to put these in place.

Contracts may also be developed to ensure we are able to continue to comply with our 1-in-20 obligation. Where demand exceeds our capability it may be necessary to enter into contracts to ensure we are able to meet this obligation. These may involve turning down demand at power stations or industrial sites to bring demand in line with our capability. Alternatively, we could look to turn up supply at nearby entry points to ensure sufficient supply is available in the area and avoid the need to increase the physical capability of the network.

Option Assessment
3.2 Optioneering

3.2.3 Developing asset solutions

Asset solutions are those which involve intervention to our current assets. This could involve incurring asset health costs to maintain or upgrade our current assets, decommissioning current assets or installing new ones.

Table 3.2 shows examples of some of the various asset options which may be considered as part of our optioneering.

Table 3.2
Examples of asset options

Option	Description
Compressor re-wheels	When network analysis results indicate a compressor unit continually breaching its operating envelope, despite mitigating actions, but it is operating within the power limits of the gas or electric drive, it may be that a re-wheel (a redesign of the compressor performance characteristics) is required.
Compressor flow reversal	Where new entry points change the direction of flow in an area, reversal of a compressor site flow configuration is required. Although some sites have been designed to allow flexibility of configuration, others require redesign to allow the compressor to “pump” in the opposite direction.
Regulators	A regulator project may be identified for either pressure protection as a result of an uprating project or to allow a new network configuration (to allow flows to be controlled in a different way). Regulators may also need to be resized to allow for higher flows, or redesigned to allow flow in either direction.
Aftercoolers	Compressor station discharge temperatures are limited to between 45°C and 50°C. Above these temperatures damage is caused to downstream pipeline coatings. If discharge temperatures constrain compressor operation, it may be necessary to fit an aftercooler, which reduces the temperature of the gas leaving the compressor station. This may also improve the downstream pipeline transmission capability. However, aftercoolers induce a pressure drop and require energy (normally electricity) to operate them. So, the overall efficiency of the compression process and contribution to shrinkage must also be considered.
Uprating	It may be possible to add additional capability in the system by identifying uprating projects to test and re-certify pipelines and associated plant to increase their maximum operating pressure (MOP). The ability to uprate a pipeline depends on factors such as the construction of the pipeline, testing level and the pipeline materials minimum specified yield strength. For this reason, pipeline uprating is not suitable for all NTS pipelines. Pipeline uprating may need to be undertaken in conjunction with other projects such as compressor up-rating and re-wheels. It may be affected by safety issues such as proximity to dwellings.
New compressor stations or units	Where Network Capability is limited by available compression power and maximum or minimum system pressures it is sometimes possible to add further compressor units or develop new stations for areas of the network requiring increased compression.
Pipeline reinforcement	Where Network Capability is limited by maximum or minimum system pressures, pipelines may be duplicated (or triplicated) to reduce the pressure drops that are induced by gas flows. The network may also be reinforced by introducing additional pipelines to provide greater interconnection across the system and provide alternative routes for gas to flow from entry to exit points. An example of such an interconnection is the Trans-Pennine pipeline that links the East Coast and West Coast NTS pipelines.
Decommissioning	Where Network Capability analysis suggests the asset is no longer required we will look to decommission it.

Option Assessment

3.3 Assess options

We use a number of tools and techniques to ensure our chosen solution best meets customers' requirements.

3.3.1 Options appraisal

For major infrastructure projects we will apply our options appraisal approach. There are often a number of different ways that we could satisfy the need for a new connection, perhaps involving different locations, technologies or designs. Each time a new connection is needed, we have to identify the most appropriate solution to achieve it. Options appraisal provides information to help inform those decisions.

Options appraisal can be applied at different stages of project development, but mainly in the early stages of strategic options and outline routing and siting. The table opposite shows how we use options appraisal at different stages.

More details of our options appraisal approach can be found in the full report.

Figure 3.3
Our approach to options appraisals

Project stage	Options appraisal normally required?	Purpose of OA work at this stage
Stage 1 **Strategic options** Looking at the range of possible ways that a connection can be achieved	Yes	(i) Comparing technically feasible strategic options to inform the selection of a preferred strategic option(s).
Stage 2 **Outline routing/siting** Looking at broad corridors for linear infrastructure or general locations for other structures	Yes As appropriate	(i) Comparing route corridors/sites to inform the selection of a preferred route corridor I site. (ii) Back-checking and review of the performance of the preferred route corridor or site against the anticipated performance of the preferred strategic option if there have been material changes.
Stage 3 **Detailed routing/siting** Looking at the precise alignment or precise location for infrastructure	As appropriate As appropriate	(i) Comparing alignment options to inform the selection of a proposed alignment (if required). In some cases, only a single alignment will be developed. (ii) Back-checking and review of the performance of the preferred alignment against the anticipated performance of the preferred route corridor if there have been material changes.
Stage 4 **Proposed application** Consulting and preparing an application for development consent	As appropriate As appropriate	(i) Appraisal of the performance of any further technically feasible options that have not previously been considered and which have been identified through formal pre-application consultations. (ii) Back-checking and review of the performance of the proposed scheme in the light of any new information arising through consultation.
Stage 5 **Application for development consent**	N/A	
Stage 6 **Consideration and hearing**	N/A	

Option Assessment

3.3 Assess options

3.3.2 Best available techniques (BAT)

All of National Grid's sites which include a gas turbine driven compressor are subject to regulation under the Environmental Permitting (England & Wales)/Pollution Prevention and Control (Scotland) Regulations, as amended. These regulations place obligations on operators of permitted processes to apply BAT to the way in which an installation is designed, built, maintained, operated and decommissioned.

BAT assessment is the primary selection mechanism for all new and substantially modified or retrofitted compressor machinery trains under the RIIO investment programme.

A detailed justification of any investment decision and how it meets the requirements of BAT is required to support an application to the relevant environmental regulator (the Environment Agency (EA), Scottish Environment Protection Agency (SEPA) or Natural Resources Wales (NRW)) to operate a new or vary an existing facility. Following a successful determination of the application, a legally binding permit will be issued.

National Grid developed a BAT evaluation approach that supports the compressor machinery train selection process for new compressor investment projects and ensures that the relevant considerations relating to potential environmental impact, whole life costs and operating efficiency are taken into account. It also ensures that the selection is consistent with National Grid's corporate objective of ensuring that every project delivers whole life value (WLV).

Given the unique nature of the gas NTS, this approach has been refined to ensure that the operational requirements are considered, including safety, availability, reliability and flexibility and that the selection can be conducted within the constraints of a tendering exercise subject to legally binding EU procurement rules.

3.3.3 Cost benefit analysis

To ensure that identified options for solutions represent the best value for end consumers, we assess the options using cost benefit analysis (CBA). This involves calculating the net present value (NPV) for each option to compare the costs and benefits of a project.

The CBA produces an NPV by considering a wide range of costs for each option, such as purchasing new assets, ongoing asset health, changes to site configuration, compressor fuel usage, constraint management costs, site operation and commercial contracts. We continue to develop our CBA methodology to include real options and wider energy system and environmental impacts.

To ensure a wider range of options are considered, we also perform a qualitative assessment. This will include operational issues, impacts on maintenance and future flexibility. The options for solutions to address drivers of change are progressed based on both their NPV and the qualitative assessment.

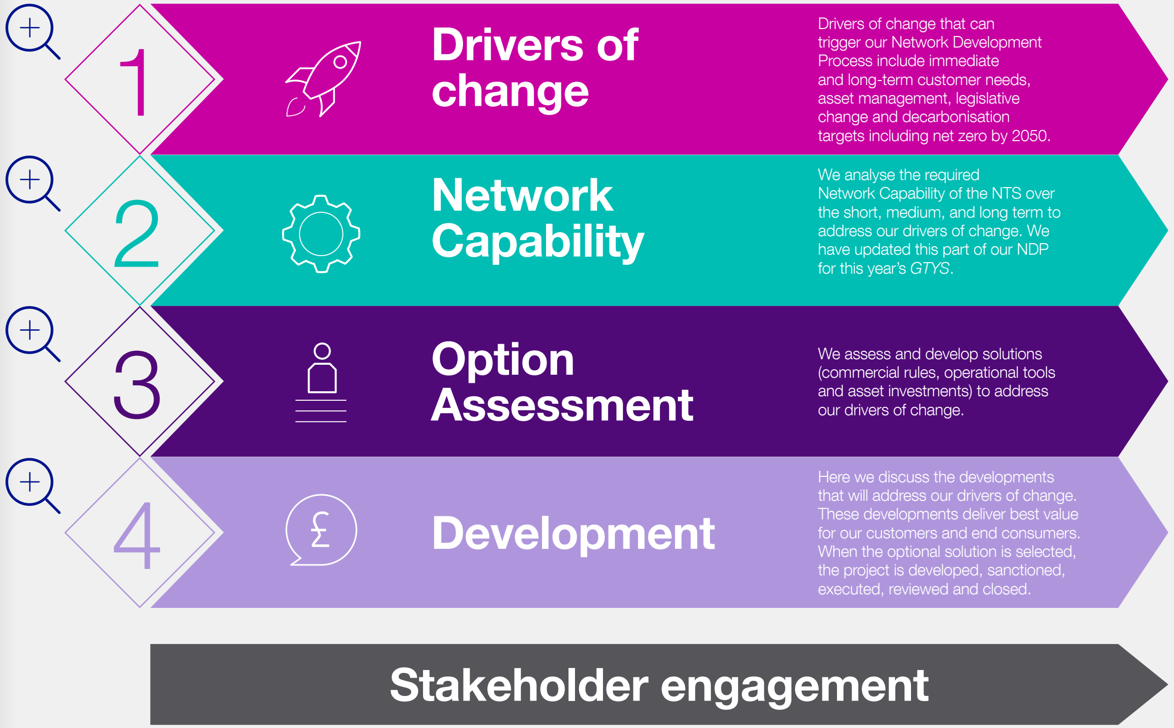
We continue to actively work with our customers and stakeholders to ensure we understand our drivers of change, so that together we can make informed decisions that are right for end consumers. Chapter 4 details some of the current and planned modifications to our networks.

4 Development

Development
4.1 Executive summary

This chapter describes the fourth phase of our Network Development Process (NDP), when the preferred option is progressed to address our drivers of change (figure 4.1).

Figure 4.1
Our Network Development Process



Development
4.1 Executive summary

Stage 4 of our NDP is only reached if the optimal solution to a driver of change cannot be found within our existing Network Capability.

The aim of this stage is to further develop the preferred options based on the direction of travel decided at the previous stage. It may be necessary to progress multiple options at the same time to ensure the optimal final solution is progressed to completion.

We conduct targeted stakeholder engagement with any impacted users to receive feedback on our options. Following this feedback, our options are narrowed down to identify a preferred option and optimal timing of the investment that addresses our drivers of change and delivers a legally compliant solution. We aim to provide the best value for end consumers, as we continue to operate the NTS safely and efficiently in an uncertain energy landscape.

This chapter details the preferred options to address our drivers of change over the next 10 years and encourage feedback on the options being progressed. The developments have been categorised in line with our stakeholder priorities from our RIIO-2 submission. More information on this and the status of funding arrangements through the RIIO-2 process can be found on our website here.

Growing our organisational capability is key to ensuring that we continue to be at the heart of a clean, fair and affordable energy future. Within this chapter, we also highlight some of the specific areas in which we plan to develop our people capability.

Development
4.2 I want to connect to the NTS

The process for applying to either take gas off the system (Exit) or put gas on to the system (Entry) is detailed in appendix 6.

4.2.1 Milford Haven entry PARCA application

We have received a planning and advanced reservation of capacity agreement (PARCA) application in South Wales at the Milford Haven aggregated system entry point. The scheme has reached Phase 2. Network entry capacity has been reserved for 163 GWh/d of funded incremental obligated entry capacity at the Milford Haven aggregated system entry point. The indicative registration date is 1 January 2026. If this scheme proceeds, we expect physical reinforcement of the network to be necessary. Funding for this would be covered by an uncertainty mechanism during the RIIO-2 period. We will begin engagement on the required investment during 2021.

Development

4.3 Gas on and off the system

As the gas transmission system operator, we work hard to balance the system for Great Britain and enable our directly connected customers to move gas on and off the network when and where they want.

In this chapter, we highlight some of the activities we are undertaking to ensure customers and stakeholders can continue to take gas on and off the system.

4.3.1 Scotland 1-in-20

The lower gas supply through St Fergus due to declining UKCS supply is making it increasingly difficult to meet our 1-in-20 winter demand obligations for customers. This is consistent across all *FES* scenarios. To secure Scotland under our 1-in-20 obligation, we have continued to assess our Network Capability for Scotland.

During 2019 the step change in the flows through the St Fergus Terminal continued, but at a reduced level with supplies peaking at 75 mcm/d; 17 mcm/d less than the previous period. The average flow through St Fergus was reduced to 56 mcm/d, from 68 mcm/d in 2018/19.

If the current levels of supply remain or decline further, this could lead to a situation where it is no longer possible to maintain the current Assured Operating Pressures (AOPs) obligation in Scotland.

The worst case credible supply level (35 mcm) at a peak demand (374 mcm) has been assumed based on the 2019 *FES*. This scenario indicates it is not possible to achieve the AOP in 2028/29. With a three-year design and build the project would start in 2025/26.

4.3.2 Developing our capability

We plan to further improve the capability of our processes, people and IT systems. Some examples of this are:

- Improving our ability to develop a robust approach to the treatment of boundary capability between zones.
- Introducing improved visualisation tools by accessing, analysing and displaying our historic data in new ways which will offer greater business insight.
- We will improve and integrate electronic logging tools for the Control Centres to new open platform systems which improve supportability and future enhancements.

Development
4.3 Gas on and off the system

4.3.3 Asset maintenance

Our asset maintenance strategy considers the likely failure modes of each asset type and the consequences should we lose functionality. This consideration leads to decisions on the type of intervention and triggers for maintenance activity. By understanding what our assets are doing and the condition we expect them to be in throughout their lifecycle we can plan, monitor and react to their maintenance requirements.

Examples of the application of the strategy are:

- **Pipelines** – Risk-based inspection driven by considering pipeline condition, criticality, and performance of corrosion prevention.
- **Instrumentation** – Criticality-based, intelligent condition monitoring or performance testing.
- **Electrical** – Scheduled inspections and failure-finding functional checks.
- **Compressors** – Condition monitoring, functional checks, scheduled inspections, and usage-based inspections.
- **Valves** – Criticality-based interval inspection and performance testing.
- **Above-ground installations (AGIs)** – Time based visual inspection and functional checks. We have processes in place to collate asset health issues whether identified through maintenance or identified through performance indicators or observations.

4.3.4 Our investment programme

Where an asset investment is required to address our drivers of change, similar works are bundled together into campaigns to ensure their cost-effective delivery. We simplify scopes of work for our contractors, use standard designs, and streamline project documentation to drive down costs. This approach makes better use of network outages to ensure that our asset delivery isn't constrained, or customers unnecessarily impacted. During 2019–20, we continued to deliver our asset investment programme, investing £66m in the health of our assets to keep our network running safely and reliably. Our current asset health investment campaigns are included in table 4.1.

Table 4.1
Key asset health campaigns

Category	Description
Above-ground installation renovation	Renovation of valves, above-ground pipework and supporting structures at sites across the NTS.
Compressor train	Overhaul of compressor train assets across the fleet.
Pipelines	In-line inspection and remediation of buried pipelines and refurbishment of ancillaries such as corrosion prevention assets.
Pressure systems	Inspection and remediation of pressurised vessels to comply with Pressure Systems Safety Regulations.
Cab infrastructure	Refurbishment of compressor cabs and associated assets such as exhaust stacks and safety systems.
Gas quality, metering and telemetry	Replacement of gas analysers and metering equipment required to comply with Gas Safety Management Regulations.

Development
4.3.5 Key asset investment works

4.3.5.1 Feeder 9 project – Humber crossing

Our river Humber Gas Pipeline Replacement Project to replace an underwater section of the NTS with a tunnelled solution is progressing well. This pipeline section is one of the most critical to UK gas supplies on the NTS and removing the risk associated with both tidal estuary erosion and third-party interference is essential in continuing to provide a reliable and secure gas supply to our customers.

Two hydraulic thrust machines began the epic task of carefully pushing eight 620m long and 850 tonne sections of pipe on rollers into the new tunnel from the Goxhill side of the Humber in June. The pipes were methodically pushed into the tunnel which had been flooded with enough water to fill 16 Olympic swimming pools, to aid the installation. After one pipe section had been installed, the next was moved into position and welded to the one in front. The push continued until all five kilometres of pipeline were fully installed on 9 July 2020, becoming the world's longest hydraulically inserted pipe. You can track the progress of the project on our website.

4.3.5.2 St Fergus

St Fergus Terminal is a key gas entry point into the UK. The terminal was built in 1975 in a coastal environment which accelerates corrosion degradation. Across the site, investment continues to be made across various workstreams focusing on the management of existing issues that may pose a potential safety risk, whilst in parallel retaining appropriate levels of compression availability and capability and meeting environmental targets.

Through 2019/20 we have taken the opportunity to review our asset health programme at St Fergus. A proposal was made as part of our RIIO-2 business plan to carry out major redevelopment work to one of our compressor plants.

4.3.5.3 Bacton campaign

The Bacton Terminal is a key strategic gas entry point into the UK. The site commenced operation in 1968, in a coastal environment which accelerates degradation, and has operated continuously since with no site-wide outages. Examination of the risks and consideration of the needs case work at Bacton has identified issues that should be prioritised in the short term and we are considering options to retain safe operation of the site for the long term, and in consideration of net zero.

We are proposing significant investment at Bacton to deliver service risk benefits and contribute to an improvement in reliability for customers. In RIIO-2 we will be assessing the long-term options for the Bacton Terminal, and whether a continuation of our asset health approach or a terminal redevelopment is the most beneficial approach. At this early stage of development, a terminal redevelopment is the lead option. While this is ongoing, we will also carry out "least regrets" asset health works to maintain the safety and reliability of the current assets.

Development
4.3.6 Network resilience

4.3.6.1 Blackrod

During RIIO-1, we experienced issues along the feeder that supplies Blackrod and these have been addressed without disruption to end consumers. However, under different circumstances, they would have resulted in end consumer disruption. Cadent (the GDN connected at Blackrod) is only able to swap offtake flows away from Blackrod up to 85% of peak winter demand levels. Such flow swaps are also reliant on Cadent having an intact network (i.e. not having assets out for maintenance).

In 2013, a safety inspection of corrosion at various sites was only possible with Cadent undertaking flow swaps on its network. If the pipeline had required isolation, demand had been higher, or if Cadent had been undertaking maintenance on its network, then those flow swaps may not have been possible.

We propose to install approximately 1km of 900mm pipeline with a new AGI.

4.3.6.2 Tirley AGI

During RIIO-1, due to the inability to isolate individual filters for maintenance, we have delayed filter maintenance at Tirley to avoid causing constraints on the network. Safety policy means the filters can only be maintained by isolating the whole site from the network. This results in a flow restriction in South Wales, including reducing entry capacity at the important Milford Haven liquefied natural gas (LNG) terminal to ~20mcm/d (against a contractual capacity of ~86mcm/d). The restriction would also impact gas flows into South Wales to meet demand, should Milford Haven not be exporting LNG to the network.

Continuing to delay maintenance will result in non-compliance with policy, require emergency maintenance and/or result in entry constraints if filters become blocked.

We propose to install new isolation valves that will allow individual filters at the Tirley site to be isolated and maintained.

Development

4.4 I want all the information I need to run my business, and to understand what you do and why

The information we provide supports the efficient functioning of the gas market by allowing market participants to make informed commercial decisions, as well as enabling the efficient physical operation of the network. We provide data, information and knowledge over a multitude of time horizons from as far out as 30 years (e.g. *FES*) right through to medium term (e.g. seasonal outlooks), short terms (e.g. MIPI front page) and after the day (e.g. reconciliation data). We also provide transparent information on the operational and commercial decisions we make for industry to utilise, and through our gas connections portal we provide the ability for our customers to self-serve information on options and costs associated with making a connection to the NTS.

We will continue to invest in our people and IT systems, taking advantage of technology to develop new capabilities allowing us to share information in better ways with our customers and stakeholders. Some of the developments we will undertake include:

- We plan to provide a flexible Gas Operational Forum schedule, bespoke events and in-person and digital attendance.
- We will continue to make updates to our website to ensure the information our customers need to specify a gas connection or to request a network diversion is readily available. Further changes are planned in the next 12 months to improve website navigation and your user experience.
- We plan to commence monthly Gas System Operation information sharing to industry and the public via social media.

Development

4.5 I want you to protect the NTS from cyber and external threats

Our network is subject to a multitude of security threats, which are ever-changing and increasing in sophistication and persistence. These threats include criminality, espionage, activists and extremists, vulnerabilities within systems and vulnerability from insider action. Additionally, there is a rapidly growing threat to Industrial Control Systems from cyber-attacks from a range of hostile forces.

The Physical Security Upgrade Programme (PSUP) was a Department for Business, Energy and Industrial Strategy (BEIS) led national programme to enhance physical site security. The NIS (Network and Information Systems) Directive also came into force in the UK on 10 May 2018 to co-ordinate and raise overall levels of cyber security across the European Union (EU).

As part of the PSUP across RIIO-1 we have continued a programme of physical security enhancements at sites agreed with the Government. In RIIO-2 this programme will continue for sites subsequently agreed with the Government as included in the PSUP.

In RIIO-2 we are also proposing to commence a rolling asset replacement programme at the sites where solutions were installed in the early phases of the PSUP, given the relatively short asset life of these IT hardware and technical assets.

As part of our programme of cyber security investments, we have continual close engagement with OFGEM, BEIS and the National Cyber Security Centre (NCSC). As we are an operator of essential services, we are increasing our cyber resilience in a proportionate manner as part of our RIIO-2 business plan submission. We are consciously competing to bring cyber talent in-house. All our personnel who work with operational technology undertake mandatory cyber security training.

Development

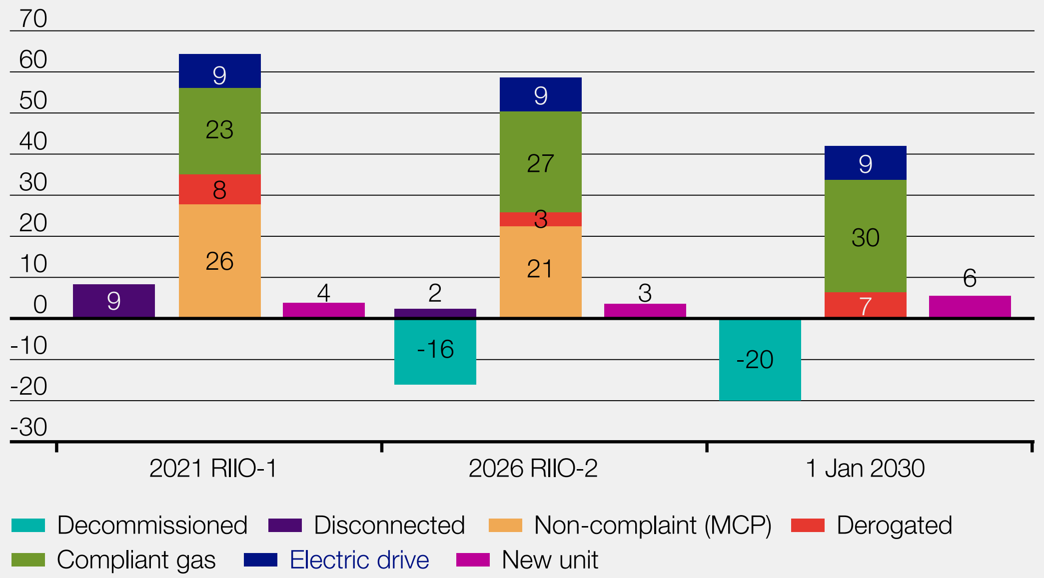
4.6 I want you to care for the environment and communities

4.6.1 IED – Pathway to compliance

To ensure we remain compliant with the IED detailed in section 1.2 and ensure we continue to meet our customer and stakeholder needs we have developed a pathway to compliance for all compression impacted by the legislation. Figure 4.2 shows that at the start of RIIO-2[1] we will have 71 operational compressors. At the point of MCP[2] being implemented our fleet will have reduced to 52 operational units, 13 new compressors will have being installed and 36 compressors will have being decommissioned. These may change as part of our ongoing assessment of Network Capability.

Figure 4.3 shows site by site which compressor units are compliant with emissions legislation, those that are non-compliant (and with which set of regulations), those that are under derogation and units proposed to be decommissioned.

Figure 4.2
State of emissions compliance from RIIO-1 through RIIO-2 and the MCPD compliance date of 1 January 2030



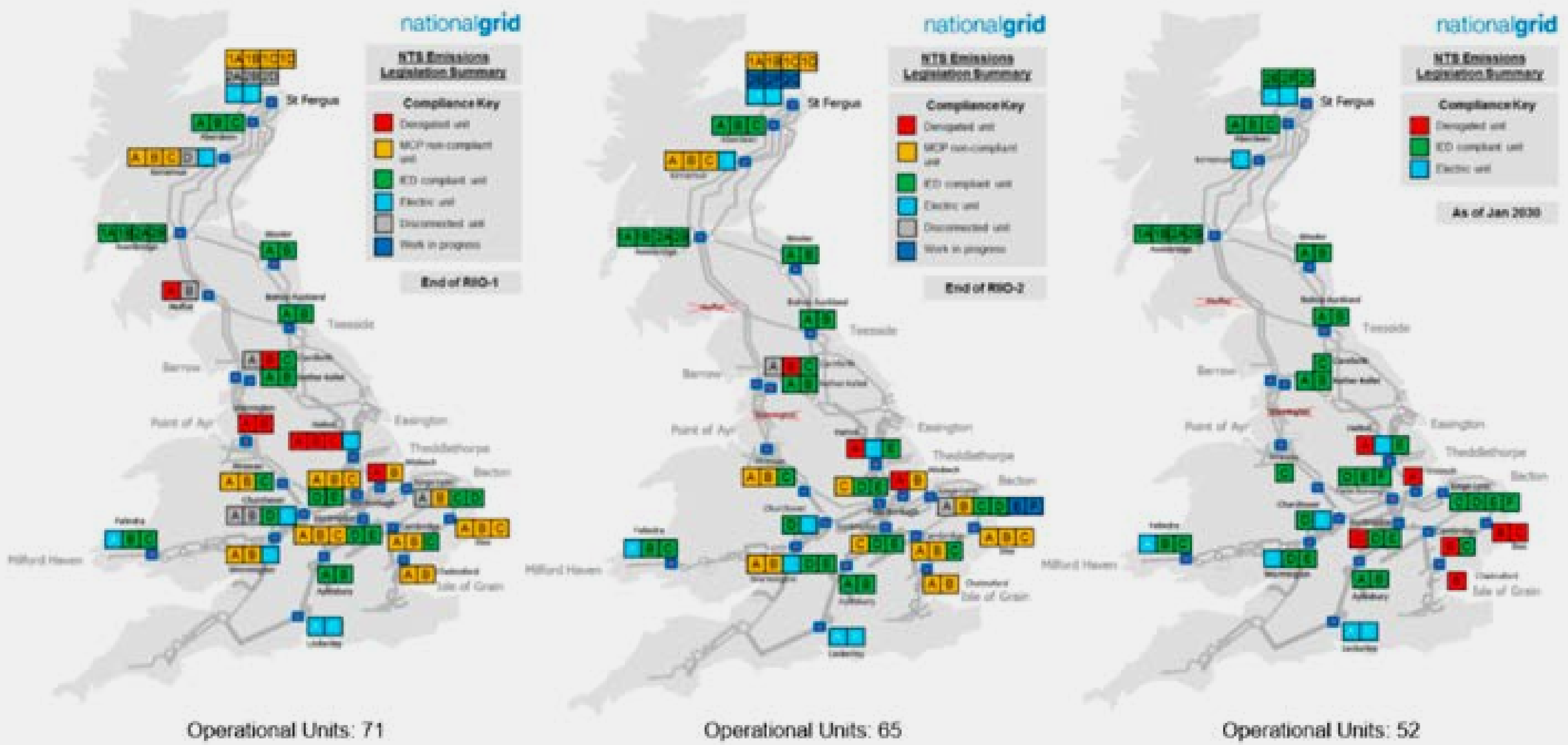
[1] Operational totals include King's Lynn Unit A, an Avon unit disconnected in 2018. It is shown as operational due to the timing of our business plan creation.

[2] Includes two units at Moffat and two units at Warrington subject to employee and trade union consultation.

Development

4.6 I want you to care for the environment and communities

Figure 4.3
Emissions compliance across the NTS at the end of RIIO-1, RIIO-2 and the MCPD compliance date 1 January 2030



Development

4.6 I want you to care for the environment and communities

4.6.2 Peterborough and Huntingdon

We are continuing with works at Huntingdon and Peterborough compressor sites to deliver two new IED compliant gas turbines on each site. The new units, each 15.3 MW in size, are manufactured by Solar Turbines. They are gas turbine driven compressors that use dry low emissions (DLE) technology, recognised as the next generation of low-carbon compressors, and feature computer-controlled combustion systems and low emission burners. Once operational, the compressors will reduce NOx emissions by around 95 per cent over 20 years, with a 16 per cent reduction in CO_2 over the same timeframe.

4.6.3 Hatton

At Hatton compressor station, we are progressing delivery of a new, IED compliant, compressor machinery train following approval of the needs case by Ofgem in 2019. The final funding position will be confirmed in the RIIO-2 Final Determination to be released in December 2020. Detailed design works are currently underway with the construction and commissioning of the new unit in RIIO-2.

4.6.4 MCPD

It is proposed that during RIIO-2 two new MCPD units will be installed at Wormington and that we will begin construction of two new units at King's Lynn but will not be operational until 2027, in RIIO-3. It is also proposed to install three new units at St Fergus as part of the wider asset health investment required at the site detailed in section 4.3.5.2, these will also not be operational until RIIO-3 in 2029. It is also proposed to install a third unit at Peterborough during RIIO-3. Full details of all the business cases can be found here.

All of these proposals are subject to Uncertainty Mechanisms (UM) during RIIO-2 and could change as options are further refined.

4.6.5 Redundant assets

Our network is getting older and we are faced with a challenge about how we should manage redundant assets in a way that is in line with our environmental and sustainability goals, whilst delivering value for consumers.

Assets become redundant for a number of reasons. The needs of stakeholders or individual customers may have changed, legislation changes may mean that assets can no longer be used, or investment in new assets may mean that life-expired assets are no longer required.

We have identified redundant assets, sites and groups of assets that we are proposing to decommission within RIIO-2. Our RIIO-2 plans, based on stakeholder insights, propose to decommission our redundant assets to reduce the environmental and health and safety risk.

This approach is aligned to the polluter pays principles, where customers who have benefited from our redundant assets pay for the decommissioning of them. Deferring these actions would not be in line with strategy set out from government and is not in line with our stakeholder feedback.

Development

4.6 I want you to care for the environment and communities

4.6.6 Transitioning to net zero

Climate change is the defining challenge of this generation. The decisions we take now will influence the future of our planet. We know we must make significant changes to curb harmful emissions and we're already a thought leader for the industry on how to make this happen.

In this rapidly changing energy sector we need to keep pace, evolving our organisational capability so that we're set up to deliver against our vision.

Over the next decade, we will continue to anticipate and adapt to changes in faster and smarter ways, remaining at the cutting edge of engineering and asset management, innovating more sustainable energy solutions.

We'll lead the way in the decarbonisation of gas, investing in a range of solutions like renewable natural gas, blending hydrogen in our network and carbon offsetting.

We have already made good progress on reducing our emissions – by 68% since 1990. This is well ahead of our original target of 45% by 2020. But to get to net zero, there's much more to do.

Development
4.7 Innovation

In 2019/20, our ambition was to drive innovation to help deliver a decarbonised network to meet net zero.

Lives, businesses and industry today rely on natural gas. Over time, there will be changes in gas usage as we move to net zero, but one thing remains the same: we need to ensure that the future decarbonised energy system is safe, reliable, efficient and delivers value to our customers. Our innovation activities are at the centre of this challenge.

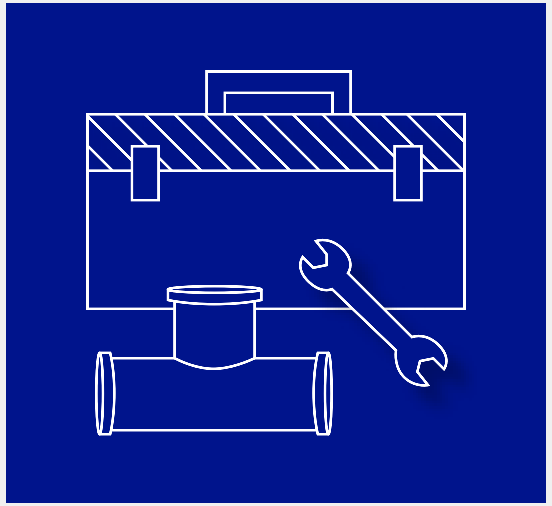
In December 2019, we submitted our Innovation RIIO-2 Strategy, setting out our vision to "innovate to create your network of the future and facilitate UK decarbonisation". Our strategy has three key themes that underpin everything we do:

- Fit for the future
- Ready for decarbonisation
- Decarbonised energy system.

We have also focused on enhancing our engagement with stakeholders through a range of events such as the Gas Innovation Showcase and the Network Innovation Collaboration Event. We've continued to work closely with the other networks to share learning and work collaboratively across several areas.

The team has undertaken 31 NIA projects this year and spent £4.75m. Two of our projects from this year include:

Project 1
Valve Care Toolbox 2



Project 2
GQ sample line assessment and tech watch

Development
4.7 Innovation

More information on our NIA projects is available in our 2019/20 annual summary document.

Building on the progress made in 2019/20, we plan to innovate through business-funded innovation as well as Ofgem's proposed allowances. Our ambitious plans for RIIO-2 aim to develop and deliver innovation to meet our decarbonisation challenges.

174
Network Innovation Allowance (NIA) projects

£27.5m spent

45 collaborative projects

80+ third parties involved

110+ business experts involved

HyNTS FutureGrid

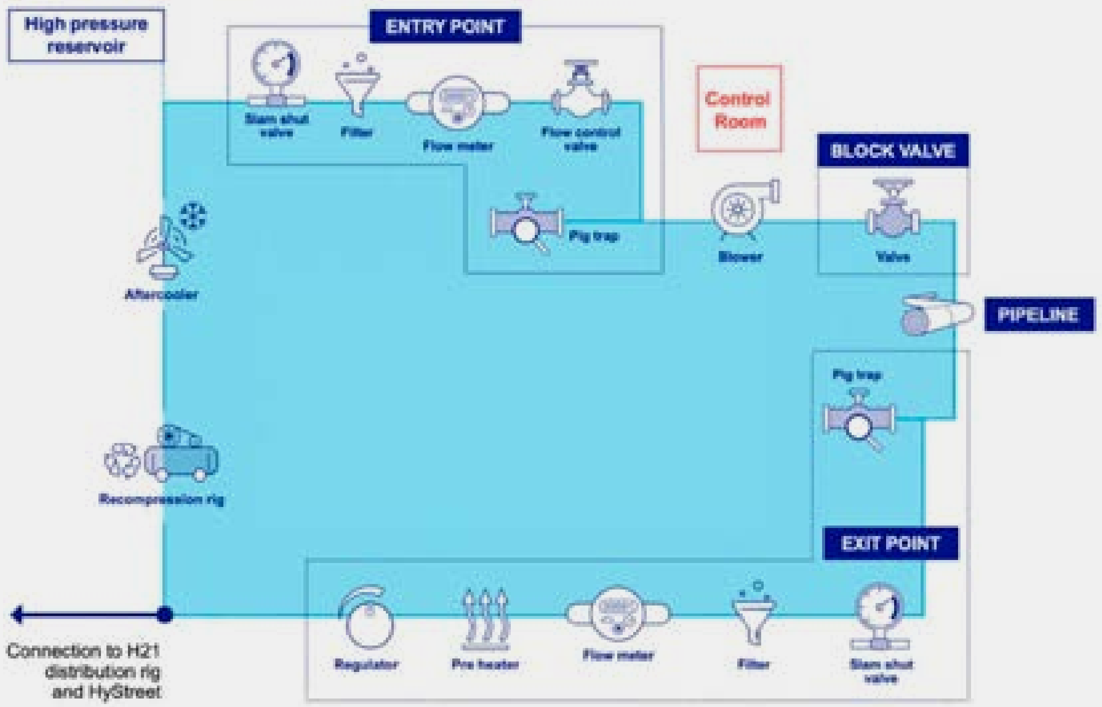
In July 2020, National Grid Gas Transmission submitted the FutureGrid project as part of the Network Innovation Competition (NIC) process.

Achieving the UK's net zero targets will require decarbonisation across the whole energy system. Sectors such as heat are difficult to decarbonise, and the importance of the National Transmission System (NTS) to the UK's current energy supply means we need to consider how to deliver low-carbon energy reliably and safely to all consumers. Existing research suggests that hydrogen could be an alternative to natural gas, but there are several knowledge gaps that need addressing.

The FutureGrid project will build a hydrogen test facility from a representative range of decommissioned assets. Flows of hydrogen and natural gas blends (up to 100% hydrogen) will be tested at transmission pressures to better understand how hydrogen interacts with the assets. The project will increase understanding of the characteristics of hydrogen in the NTS and builds on the HyNTS programme of work carried out so far, demonstrating what is required for hydrogen to be safely transported within the NTS.

For more information, please visit nationalgrid.com/futuregrid

Click here to watch our FutureGrid video



Above is the planned design for the test facility

5 Looking forward

Looking forward

5.1 Introduction

This chapter outlines our plans to continue the development of the *GTYS* and how we propose to engage with you over the coming year.

Key messages:

We want to continue to work with you and involve you in our Network Development Process (NDP) considering the drivers of change that we highlighted in this 2020 *GTYS*.

This chapter includes:

5.2 Your feedback
5.3 Continuous development of the *GTYS*
5.4 Our future engagement.

5.2 Your feedback

We welcome your feedback and comments on this interactive edition of the *GTYS*. It helps us to better tailor the document to include information you value, and to format the document to make it easier for you to navigate. Over 2020/21, we are keen to hear your views on the following areas of our gas transmission business:

- Future system operability challenges
- Asset management
- Network Capability annex
- GB gas quality specifications development
- Network Development Process.

Looking forward

5.3 Continuous development of the *GTYS*

The *GTYS* is an opportunity for us to outline our current operational and asset-based plans for developing the NTS to ensure that we continue to meet your needs. We want to continue to engage with you by involving you in our NDP, providing transparency on our processes, and keeping you informed of our plans.

We have adopted the following principles to ensure the *GTYS* continues to add value for our customers and stakeholders:

- We seek to identify and understand your views and opinions.
- We provide opportunities for engagement throughout the *GTYS* process.
- We create an open and two-way communication process around our NDP.
- We respond to your feedback and demonstrate how this has been considered.

Looking forward
5.4 Future engagement

We welcome your feedback on whether the *GTYS*:

- satisfactorily explains the process we follow in order to develop the NTS
- illustrates future needs and development of the NTS in a coordinated and efficient way
- provides the information you need to assist you in identifying opportunities to connect to the NTS.

We also welcome your feedback on:

- which areas of the *GTYS* are of most value to you
- which areas of the *GTYS* we can improve
- whether there is any additional information you would like to see included in the *GTYS*
- whether *FES* provides a sufficient breadth of scenarios on which to plan the gas network.

If you would like to provide feedback, please contact us. We look forward to hearing from you.

Appendix

Appendix 1
National Transmission System maps

This appendix includes maps of the NTS that indicate the current network.

Figure A1.1
Scotland (SC) – NTS

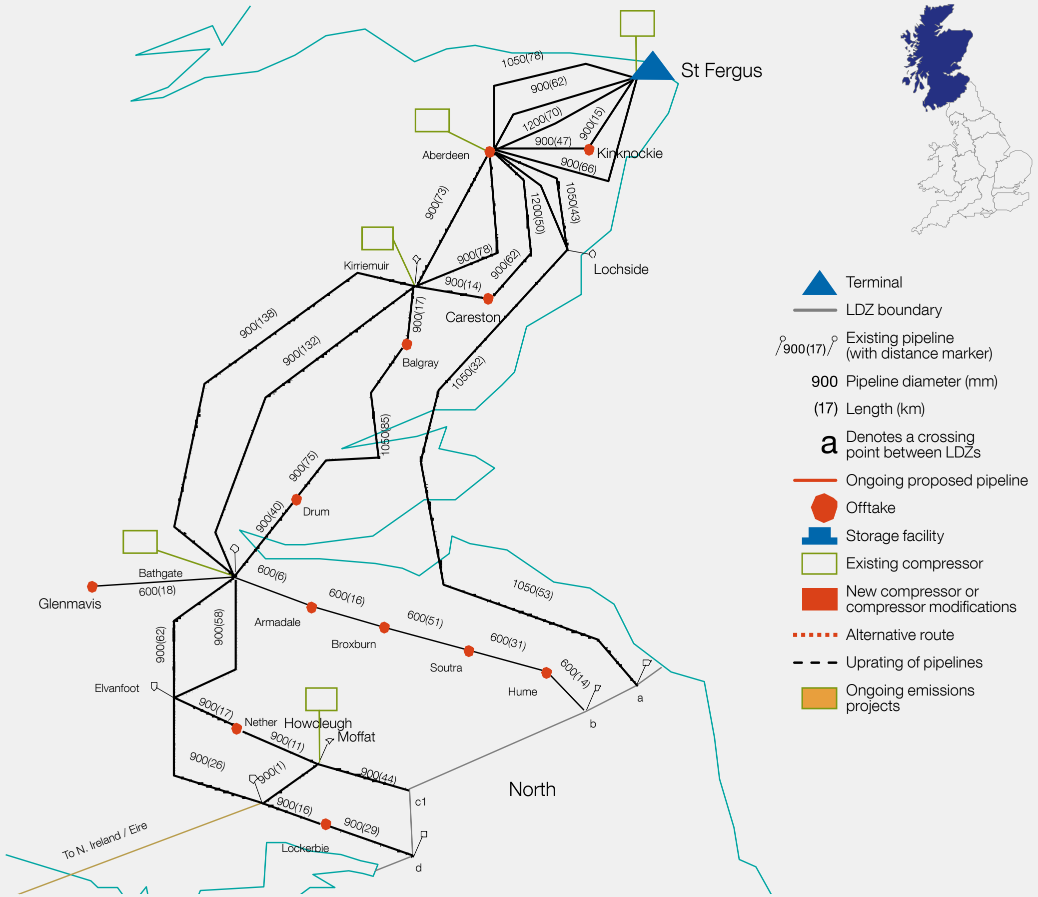
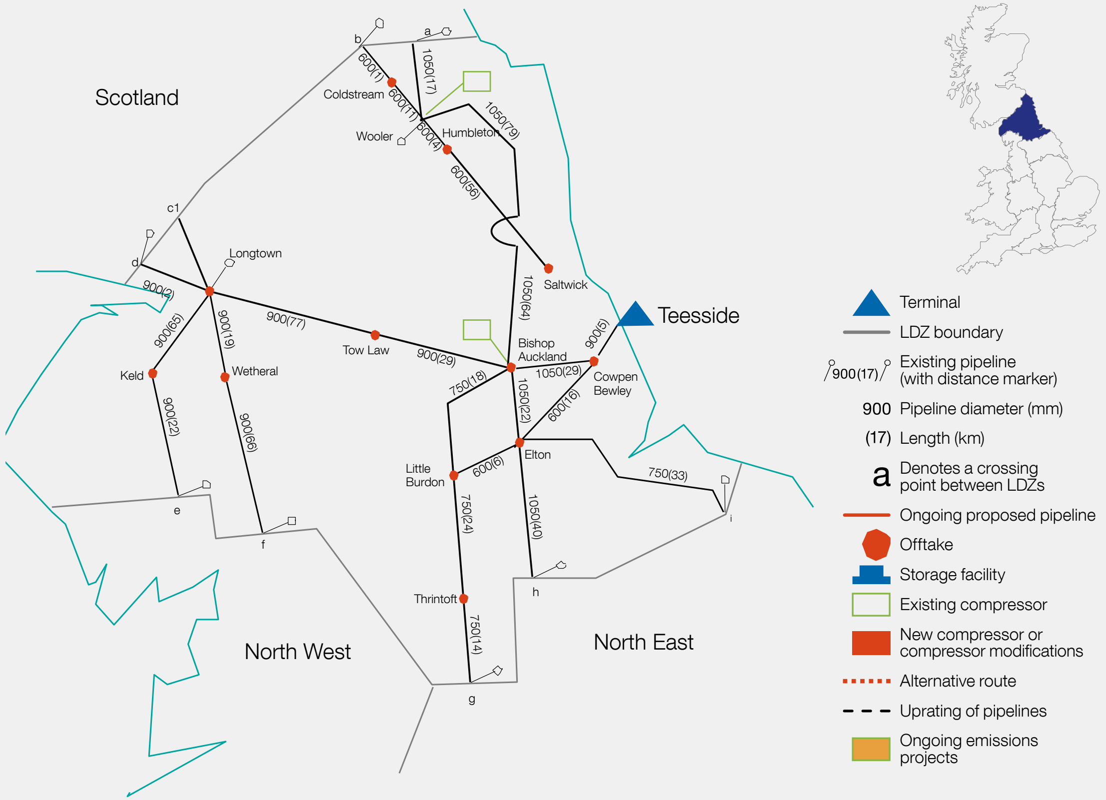


Figure A1.2
North (NO) – NTS



Appendix 1
National Transmission System maps

Figure A1.3
North West (NW) – NTS

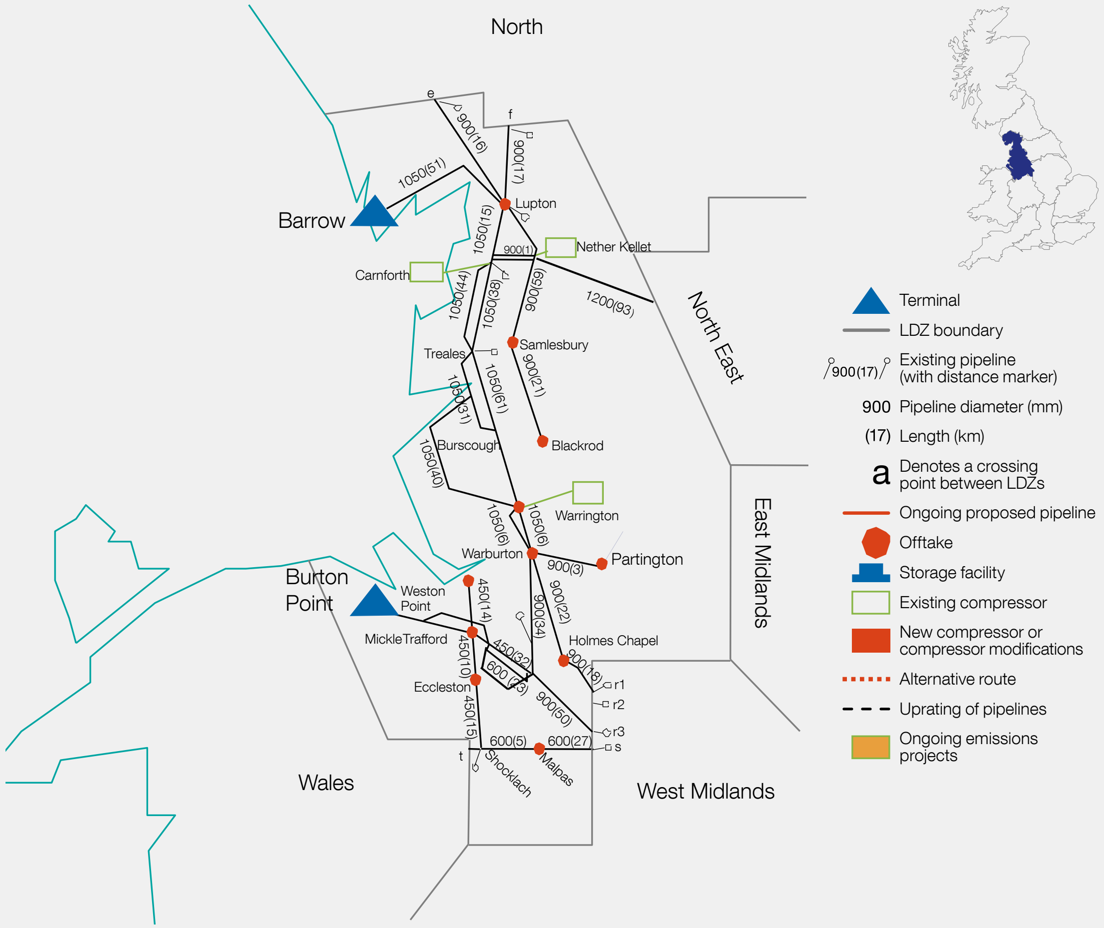
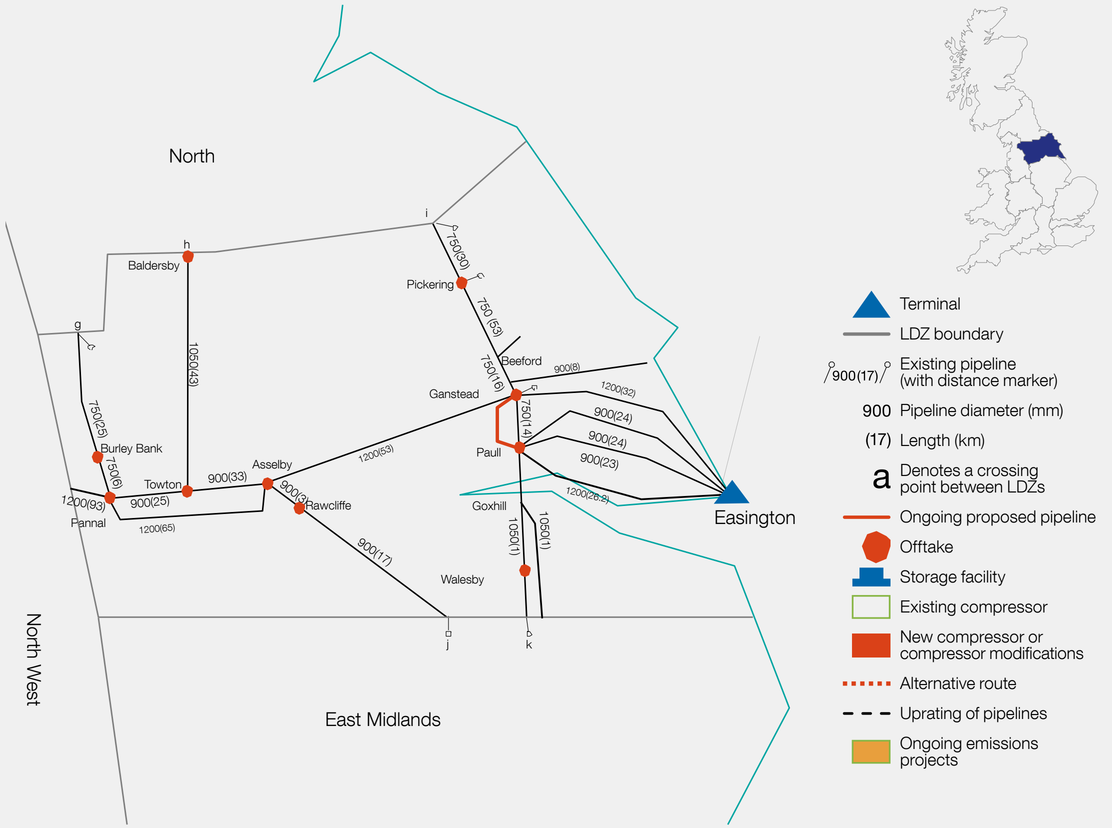


Figure A1.4
North East (NE) – NTS



Welcome >
Introduction >
Chapter 1 Drivers of change >
Chapter 2 Network Capability >
Chapter 3 Option Assessment >
Chapter 4 Development >
Chapter 5 Looking forward >
Appendix >

Appendix 1
National Transmission System maps

Figure A1.5
East Midlands (EM) – NTS

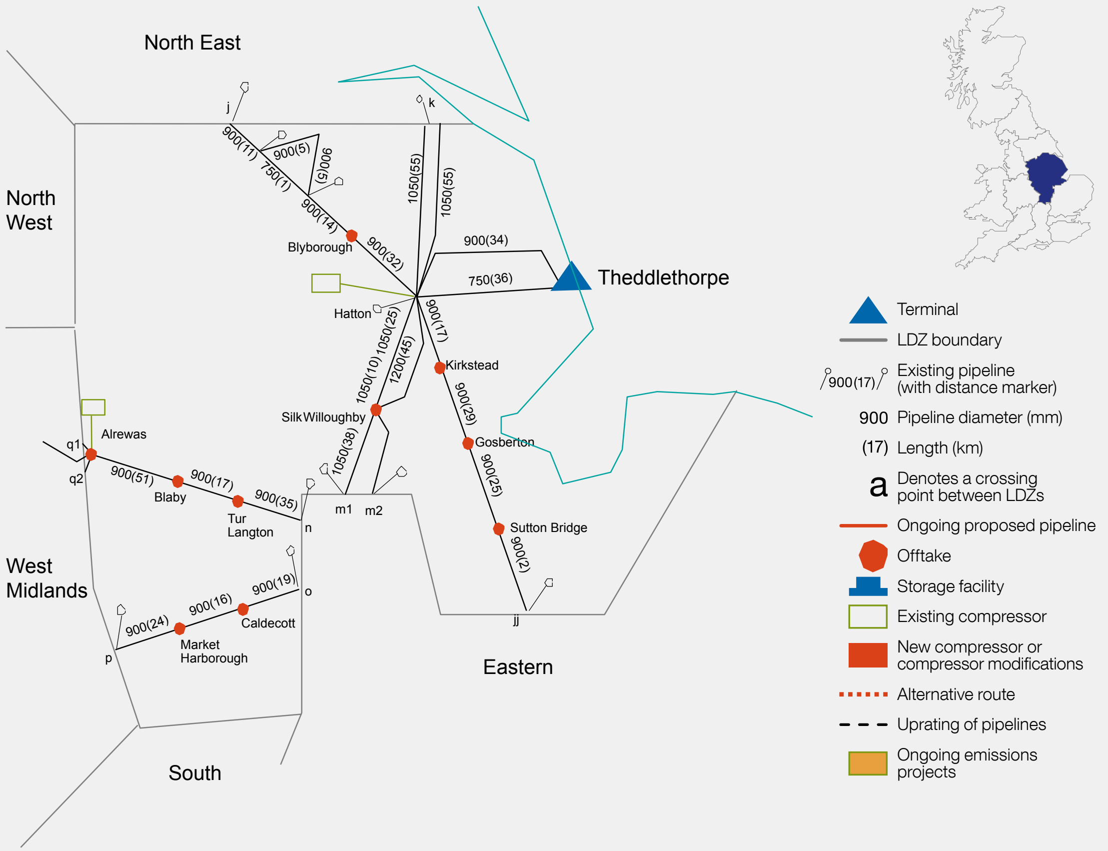


Figure A1.6
West Midlands (WM) – NTS

Appendix 1
National Transmission System maps

Figure A1.7
Wales (WN & WS) – NTS

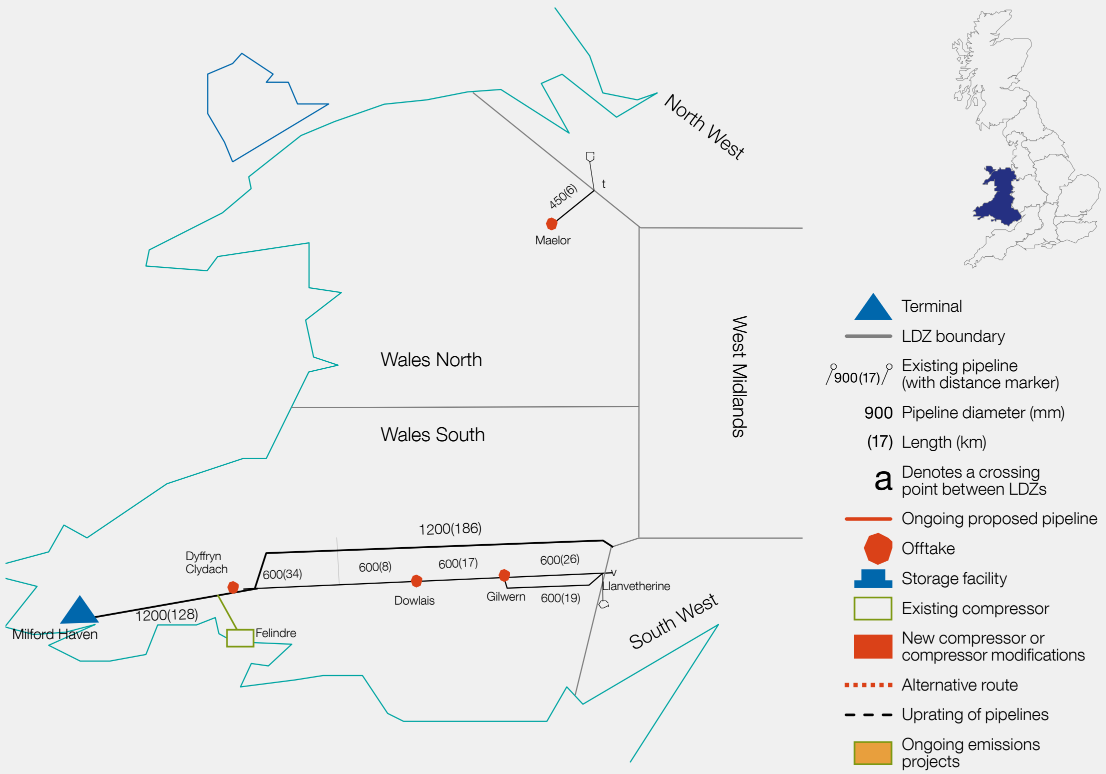
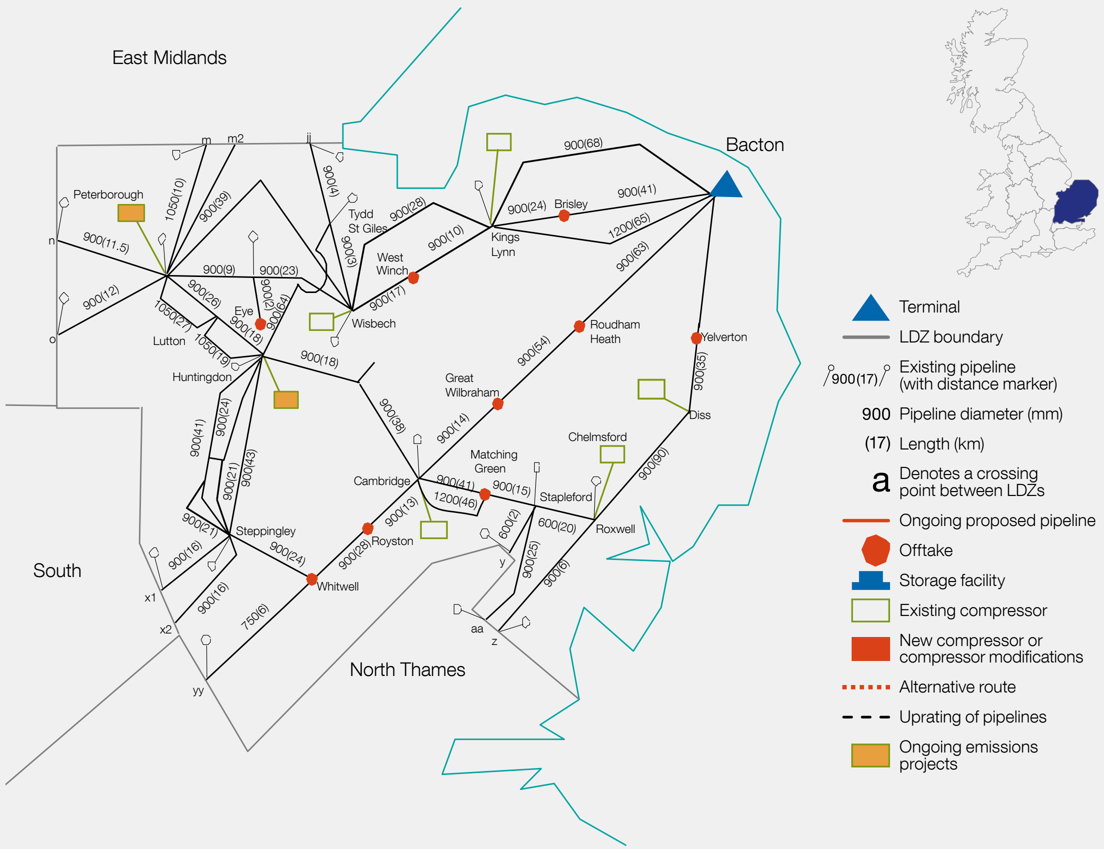


Figure A1.8
Eastern (EA) – NTS



Appendix 1
National Transmission System maps

Figure A1.9
North Thames (NT) – NTS

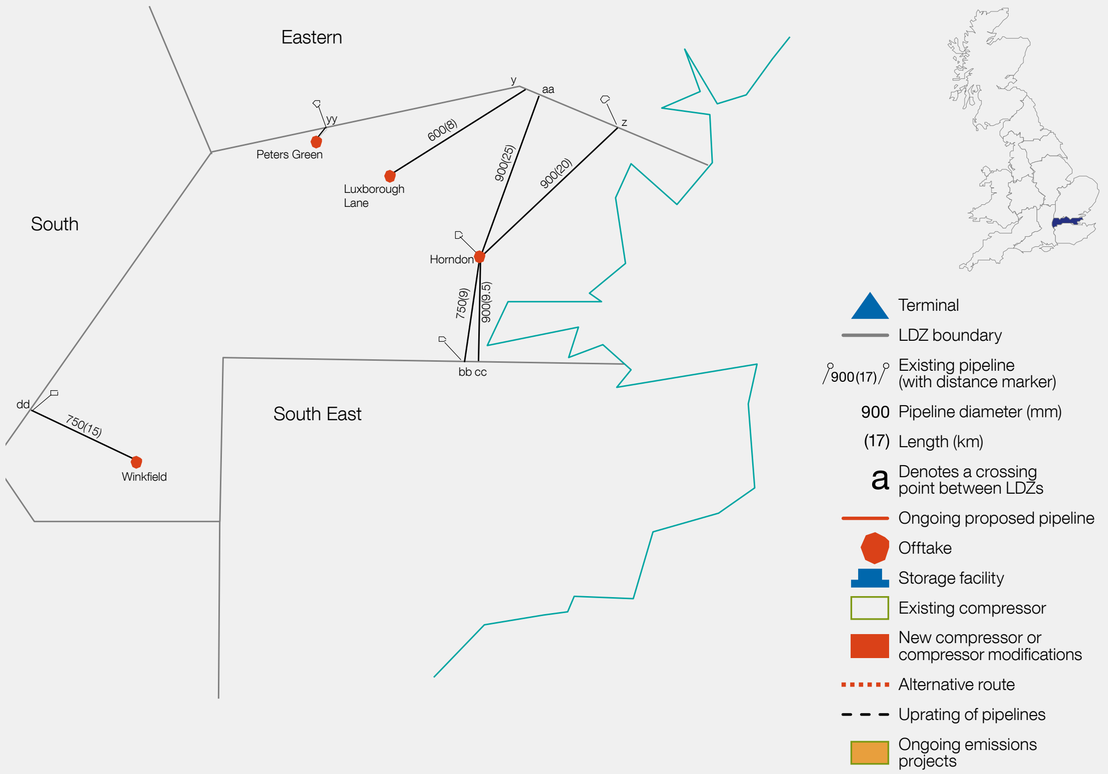
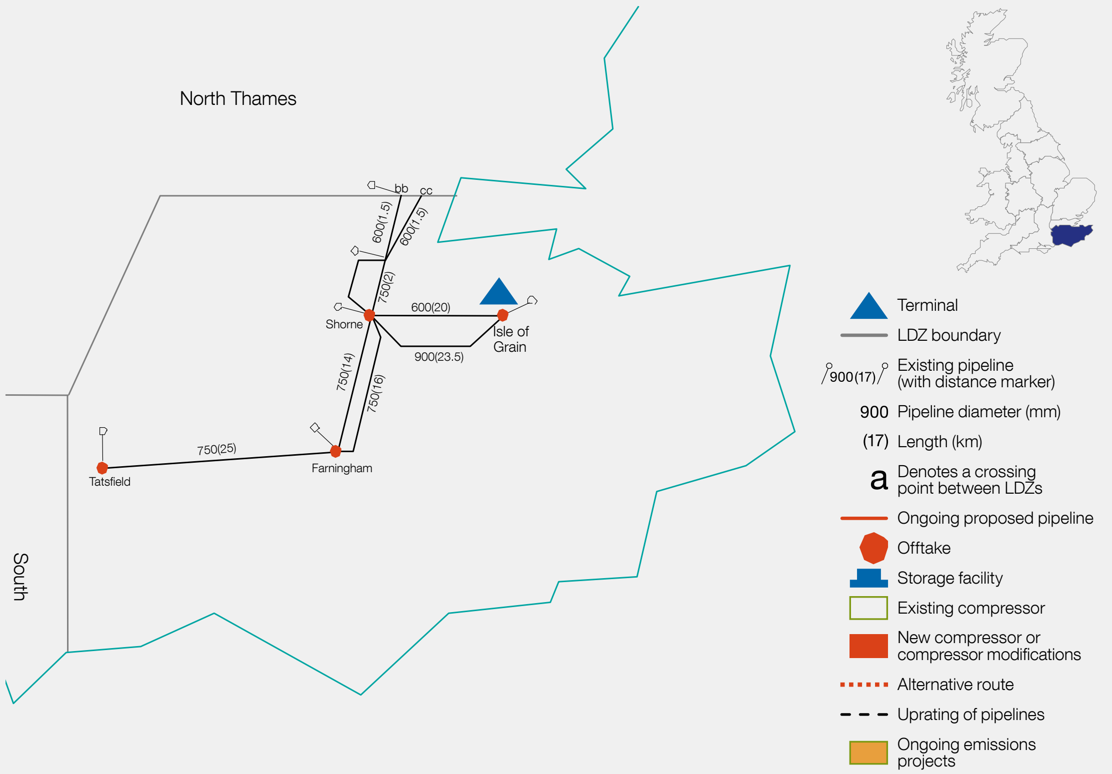


Figure A1.10
South East (SE) – NTS



Appendix 1
National Transmission System maps

Figure A1.11
South (SO) – NTS

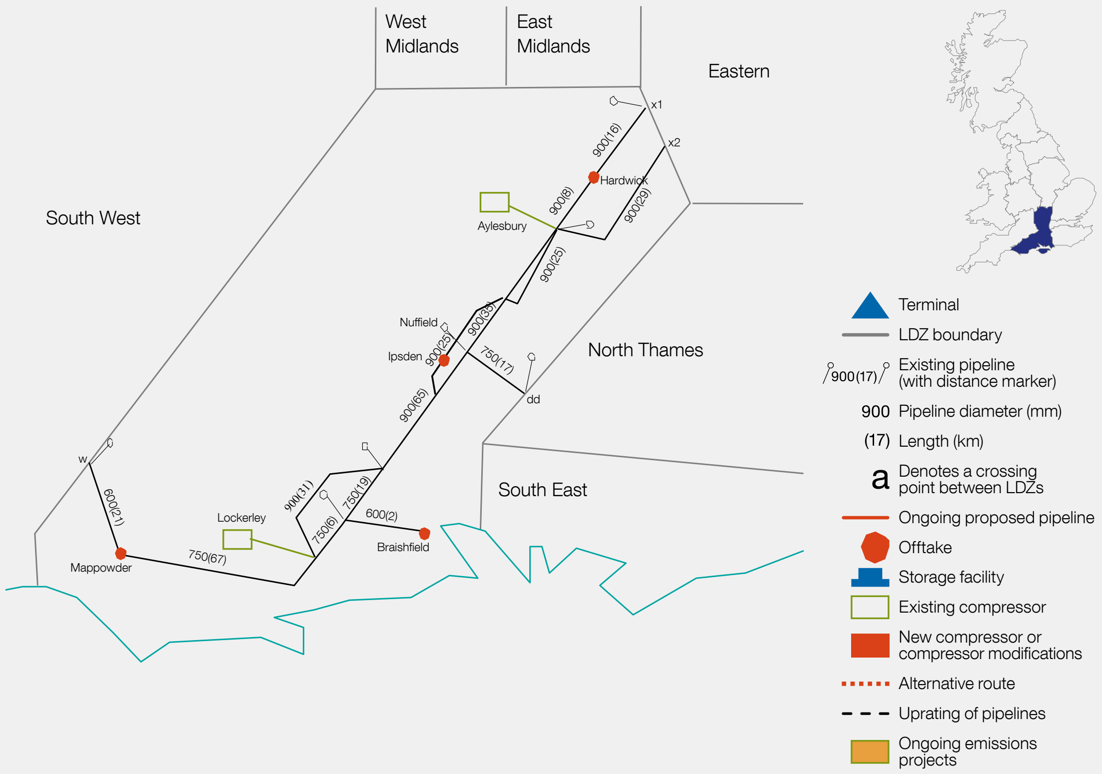
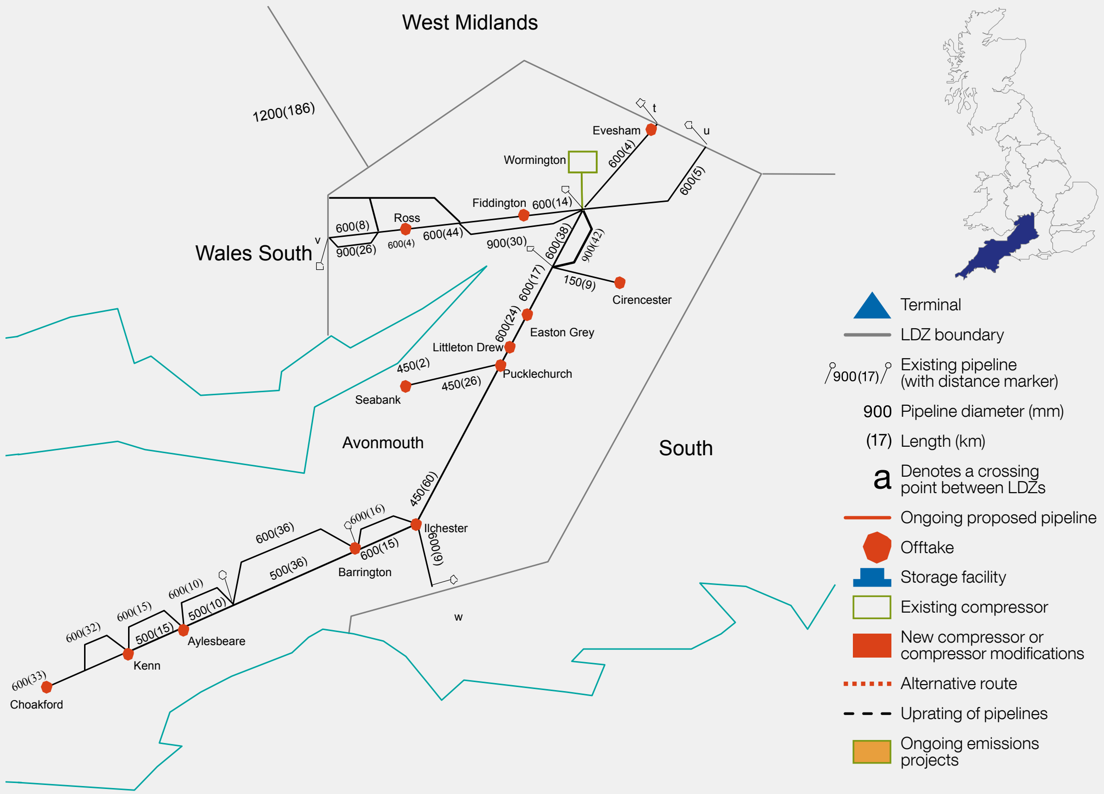


Figure A1.12
South West (SW) – NTS



Appendix 2

2.1 Network entry quality specification

For any new entry connection to our system, the connecting party should tell us as soon as possible what the gas composition is likely to be. We will then determine whether gas of this composition would be compliant with our statutory obligations and our existing contractual obligations.

From a gas quality perspective, our ability to accept gas supplies into the NTS is affected by a range of factors, including the composition of the new gas, the location of the system entry point, volumes provided and the quality and volumes of gas already being transported within the system.

In assessing the acceptability of the gas quality of any proposed new gas supply, we will consider:

- our ability to continue to meet statutory obligations, including, but not limited to, the Gas Safety (Management) Regulations (GS(M)R)
- implications of the proposed gas composition on system running costs
- implications of the new gas supply on our ability to meet our existing contractual obligations.

For indicative purposes, the specification in table A2.1 is usually acceptable for most locations. This specification encompasses, but it is not limited to, the statutory requirements set out in the GS(M)R.

Table A2.1
Gas quality specifications

Parameter	Quality requirement
Hydrogen sulphide	Not more than 5 mg/m^3
Total sulphur	Not more than 50 mg/m^3
Hydrogen	Not more than 0.1% (molar)
*Oxygen	Not more than 0.001% (molar)
Hydrocarbon dewpoint	Not more than -2°C at any pressure up to 85 barg
Water dewpoint	Not more than -10°C at 85 barg
Wobbe number (real gross dry)	The Wobbe number shall be in the range 47.20 to 51.41 MJ/m^3
Incomplete combustion factor (ICF)	Not more than 0.48
Soot index (SI)	Not more than 0.60
*Carbon dioxide	Not more than 2.5% (molar)
Contaminents	The gas shall not contain solid, liquid or gaseous material that might interfere with the integrity or operation of pipes or any gas appliance, within the meaning of regulation 2(1) of the Gas Safety (Installation and Use) Regulations 1998, that a consumer could reasonably be expected to operate.
Organo halides	Not more than 1.5 mg/m^3
Radioactivity	Not more than 5 becquerels/g
Odour	Gas delivered shall have no odour that might contravene any statutory obligation. The odourisation requirements in GS(M)R do not apply where the gas is at a pressure above 7 barg.
Pressure	The delivery pressure shall be the pressure required to deliver natural gas at the delivery point into our entry facility at any time, taking into account the back pressure of our system at the delivery point, which will vary from time to time. The entry pressure shall not exceed the maximum operating pressure at the delivery point.
Delivery temperature	Between 1°C and 38°C
Mercury	No more than 10 µg/m^3

*Requests for higher limits will be considered

Appendix 2
2.1 Network entry quality specification

Note that the incomplete combustion factor (ICF) and soot index (SI) have the meanings assigned to them in Schedule 3 of the GS(M)R.

The calorific value (CV) of gas, which is dry, gross and measured at standard conditions of temperature and pressure, is usually quoted in Megajoules per cubic metre (MJ/m^3). CV shall normally be in the range of 36.9MJ/m^3 to 42.3MJ/m^3 but the Wobbe number provides the overriding limit.

In addition, where limits on gas quality parameters are equal to those stated in GS(M)R (hydrogen sulphide, total sulphur, hydrogen, Wobbe number, soot index and incomplete combustion factor), we may require an agreement to include an operational tolerance to ensure compliance with the GS(M)R. We may also need agreement on upper limits of rich gas components such as ethane, propane and butane in order to comply with our safety obligations.

Appendix 2
2.2 Gas quality developments

EU gas quality harmonisation

The European Committee for Standardisation (CEN) published its gas quality standard EN 16726 in December 2015. The standard covers a number of gas quality parameters but does not include the key safety parameter of Wobbe Index because EU level agreement could not be reached.

Since then, CEN has been continuing its work on a harmonised Wobbe Index for inclusion in the standard. The Sector Forum Gas Committee within CEN established a number of taskforces to achieve this, and National Grid is currently able to monitor developments, contribute via ENTSOG, and provide progress updates to the industry via the Transmission Workgroup meeting.

The main challenge has proved to be that a wide range is desirable at system entry (driven by the need to attract LNG which has a high Wobbe Index, yet also facilitate biomethane and increased concentrations of hydrogen which require a lower Wobbe Index) whilst the end user at some offtakes is sensitive to variation and therefore requires a narrower range.

This challenge has led to a proposal to de-couple the entry and exit specifications with a wide range at entry and offtakes categorised according to the Wobbe Index of the gas they are expected to receive, with TSOs having a role in determining and monitoring this. We are not currently aware of a timetable by which this initiative will be concluded.

GB developments

The Institute of Gas Engineers and Managers (IGEM) has continued working with an industry workgroup seeking to make changes to the GB gas quality specification currently in Schedule 3 of the Gas Safety (Management) Regulations 1996 (GS(M)R) and incorporate the revised specification into an IGEM standard. The objective is to have a specification that can be developed more easily in the future as GB's gas supply diversifies, and to allow a wider quality of gas to be conveyed in GB networks, subject to appropriate demonstration of safety and consideration of impacts on industry stakeholders.

A draft standard was developed and consulted upon in 2020 which proposes to widen the Wobbe Index range, replace the Soot Index and Incomplete Combustion Factor parameters with relative density and increase the legal limit for oxygen content from 0.2 mol% to 1.0 mol% on below 38 bar systems. We currently expect that the proposed standard will be finalised by Q1 2021 which will be subject to a government consultation and impact assessment process led by the Health and Safety Executive (HSE). As part of our Gas Markets Plan (GMaP) programme, we are reviewing the UNC process for implementing gas quality changes with industry stakeholders. We will also soon be launching a new GMaP project, looking at how adverse impacts of a wider Wobbe range on industrial and commercial users might best be mitigated.

Appendix 2

2.2 Gas quality developments

We have also been exploring the potential for National Grid to offer a gas quality blending service at suitable NTS entry terminals where multiple sources of gas are delivered into and comingled within the National Grid terminal prior to being discharged onto NTS pipelines. We have commissioned DNV-GL to conduct a feasibility assessment and will be consulting industry formally on our ideas in Q4 2020. We are also engaged in a proposal to conduct a short term trial at Bacton as a result of UNC Modification 0714. www.gasgovernance.co.uk/0714

Appendix 3 – Connection and capacity application process

3.1 Introduction

If you need a new connection or a modification to an existing NTS connection, you will need to go through the application to offer (A2O) process. Our connection (A2O) and capacity reservation processes (Planning and Advanced Reservation of Capacity Agreement – (PARCA)) are separate.

We have produced a high-level overview of our connection and capacity application processes in table A3.1 with links to help you to navigate to the relevant chapter of this year's *GTYS*.

Our customers have the flexibility to initiate these two processes at their discretion. However, the two processes can become dependent on each other.

The PARCA process has been designed to run in parallel with the A2O process to prevent the possibility of stranded capacity. We will only allocate reserved capacity if a full connection offer (FCO) has been progressed and accepted. Typically, customers should allow between 6 and 12 months to progress and sign an FCO. This means that the A2O process (if required) needs to be initiated at least 6 months before the capacity allocation date defined in the PARCA contract.

In some cases, we may need to reinforce our system to ensure we can meet our customers' connection or capacity requirements. This was one of the key drivers for implementing the PARCA process as we can now align works we need to complete with our customers' projects.

Appendix 3 – Connection and capacity application process

3.1 Connection and capacity application process

Table A3.1
Our connection and capacity application process

	Our connection and capacity processes				
	Our customers and their key service requirements:	Find more information in *GTYS*:	Gas shipper	Distribution Network (DN)	Customers
Connections	Application to offer (A2O)	Appendix 3, chapter 3.2	✗	✓	✓
	Disconnection/ Decommissioning	Appendix 3, chapter 3.2	✗	✓	✓
Entry and exit capacity	Quarterly System Entry Capacity Auctions	Appendix 3, chapter 3.3	✓	✗	✗
	Exit Application Windows	Appendix 3, chapter 3.4	✓	✓	✗
	Exit Application Window Enduring annual NTS exit capacity	Appendix 3, chapter 3.4	✓	✓	✗
	Flexible Capacity for flow changes	Appendix 3, chapter 3.4	✗	✓	✗
	Entry/Exit Planning and Advanced Reservation of Capacity Agreement	Appendix 3, chapter 3.6	✓	✓	✓
CAM incremental	Incremental entry/exit capacity trigger process for interconnection points (IP). This follows the principles of PARCA.	Appendix 3, chapter 3.5 and 3.7	✓	✗	✓

Appendix 3 – Connection and capacity application process
3.2 Connecting and disconnecting to/from our network

Connection and disconnection

Table A3.2 summarises the four different NTS gas connections that are currently available, as well as the process of disconnecting and decommissioning.

Please note, we offer four types of connection to the NTS. We also offer the possibility to modify existing NTS connections. If you need to modify an existing connection arrangement, this request will be considered using the same approach as a new NTS connection.

Table A3.2
NTS gas connection and disconnection

	NTS gas connection and disconnection
Entry connections	Connections to delivery facilities processing gas from gas producing fields or liquefied natural gas (LNG) vaporisation (importer) facilities, biomethane facilities or any other gas delivery facility, for the purpose of delivering gas into the NTS.
Exit connections	These connections allow gas to be supplied from the NTS to the premises (a supply point), to a distribution network (DN) or to connected systems at connected system exit points (CSEPs). These may include for example power stations, peaking plants, CNG refuelling stations, industrial premises.
Storage connections	Connections to storage facilities, for supplying gas from the NTS and delivering it back later.
International interconnector connections	These are connections to pipelines that connect Great Britain to other countries. They can supply gas from and/or deliver gas to the NTS.
Disconnection and decommissioning	Disconnection is the positive isolation from the NTS and the customers' facilities through a physical air gap between the two assets. Decommissioning is where the site is returned to its original state. All assets are disconnected and removed including the removal of pipeline.

Appendix 3 – Connection and capacity application process

3.2 Connecting and disconnecting to/from our network

Customer connections – application to offer (A2O)

The Uniform Network Code (UNC) provides a robust and transparent framework for new customer connections and modifications to an existing connection.

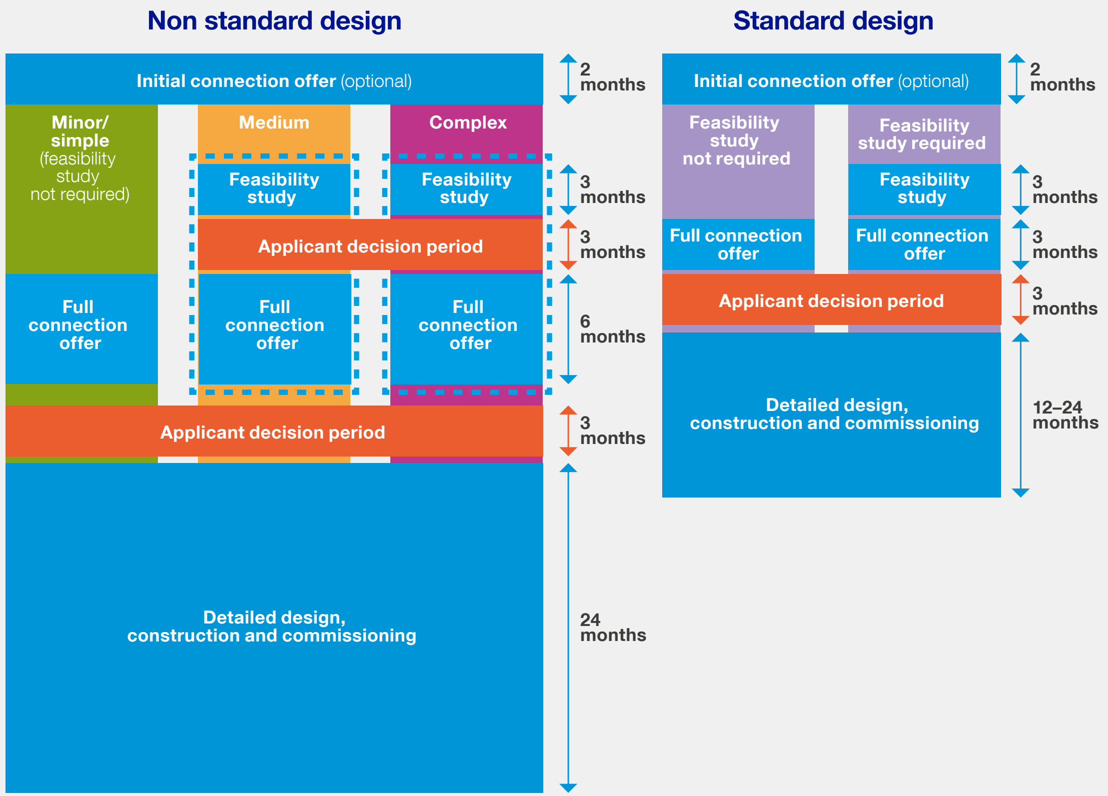
The UNC provides:

- a formal connection application process (TPD V.13)
- definition of the content of an initial connection offer
- definition of the content of a full connection offer
- how to request a modification to a full connection offer
- timescales for National Grid to produce a connection offer
- timescales for customers to accept initial/full connection offers (up to three months)
- application fee principles for an initial connection offer and full connection offer
- requirement for National Grid to review the application fees on an annual basis.

On our website you can find more information on the A20 connections process.

Figure A3.3 summarises the A2O process and the timescales associated with each stage. These timescales are indicative for construction, and each connection project has a bespoke programme for the detailed design, construction and commissioning phase.

Figure A3.3
Application to offer (A2O) process



Appendix 3 – Connection and capacity application process

3.2 Connecting and disconnecting to/from our network

Connection application charges

Our charging policy for all customer connections is set out in the publication The Statement for Gas Transmission Connection Charging, which complies with Licence Condition 4B.

When you connect to the NTS, the connection costs are calculated based on the time and materials used to undertake the activity.

Following the trial project for self-lay to the NTS, we are developing this as a potential future option for customers. We intend to consult on self-lay fees in a specific connection charging consultation in Q1 2021 to be effective from 1 April 2021.

Connection pressures

There are four primary types of defined pressure on the NTS:

- Standard Offtake Pressures as defined in the UNC.
- Assured Offtake Pressures (AOP) as defined in the UNC.
- Anticipated Normal Operating Pressures (ANOP).
- Maximum operating pressure (MOP).

These pressures will be stated in the Network Entry Agreement (NEA), Network Exit Agreements (NExA) or Storage Connection Agreement (SCA) depending on the connection you require.

When agreeing or revising a NExA, we can provide information regarding historical pressures which should help you to understand how we assess pressures and indicate how AOPs and ANOPs relate to typical operating pressures.

Shippers may also request a 'specified pressure' for any supply meter point, connected to any pressure tier, in accordance with the Uniform Network Code Section J 2.2.

General connection pressure information

NTS offtake pressures tend to be higher at entry points and outlets of operating compressors, and lower at the system extremities and inlets to operating compressors.

Offtake pressure varies throughout the day, from day-to-day, season-to-season and year-to-year. We currently plan normal NTS operations with start-of-day pressures no lower than 33 barg. Note that these pressures cannot be guaranteed as pressure management is a fundamental aspect of operating an economic and efficient system.

Appendix 3 – Connection and capacity application process

3.2 Connecting and disconnecting to/from our network

Ramp rates and notice periods

Directly connected offtakes have restrictions in terms of ramp rates and notice periods written into NExAs and SCAs.

A ramp rate of 50 MW/minute can be offered for a simple connection. Higher ramp rates can be agreed subject to completion of a ramp rate assessment or study.

Notice periods will only be enforced in these circumstances when system flexibility is limited. More detail regarding access to system flexibility can be found on our website in the Short Term Access to System Flexibility Methodology Statement.

Reinforcements to our network

The Gas Act 1986 (as amended 1995) states we "must develop and maintain an efficient and economical pipeline system and comply with any reasonable request to connect premises, as long as it's economic to do so".

Connecting a new supply or demand may require system reinforcement to maintain system pressures and capability. Depending on the scale, reinforcement projects may require significant planning, resourcing and construction lead-times. Therefore we need as much notice as possible. Project developers should approach us as soon as they are in a position to discuss their projects so that we can assess the potential impact on the NTS and help inform their decision making.

The PARCA process was designed to encourage developers to approach us at the initial stages of their project (see appendix 3.6). This process allows alignment between both the developer's project timeline and any reinforcement works required on the NTS to accept or deliver capacity.

Appendix 3 – Connection and capacity application process

3.3 NTS entry capacity

Entry capacity provides shippers with the right to flow gas onto the NTS. Only licenced shippers can apply for and obtain entry capacity. A licenced shipper is considered a 'User' of the NTS under the terms of the Uniform Network Code (UNC).

NTS entry capacity types

National Grid make firm and interruptible NTS entry capacity available to the market at each Aggregated System Entry Point (ASEP).

The volume of firm capacity made available at each ASEP consists of the following:

- Baseline NTS entry capacity (obligated)
- Funded incremental NTS entry capacity (obligated)
- Non-obligated NTS entry capacity.

Interruptible NTS entry capacity can be made available to the market at ASEPs; the volume of interruptible NTS entry capacity available at an ASEP consists of two parts:

- Use it or Lose it (UIOLI)
- Discretionary.

If there are concerns for network stability then we may limit interruptible NTS entry capacity rights without any compensation for the Users affected.

NTS entry capacity auctions

Spotlight

To obtain firm entry capacity, a shipper can bid for capacity on the Gemini system and European Platform (PRISMA) through a series of auctions. For long-term UK capacity, shippers can bid in 3 auctions:

- Quarterly System Entry Capacity (QSEC) please see figure A3.4 for more information on the results from this year's QSEC
- Annual Monthly System Entry Capacity (AMSEC)
- Rolling Monthly Trade & Transfer (RMTnTSEC)

Information on interconnection points entry capacity auctions can be found in appendix 3 chapter 3.5 and 3.7.

Incremental obligated capacity

In order to increase the obligated level of entry capacity at an ASEP, shippers or developers should submit a PARCA application. If this capacity can be made available via capacity substitution, then the baseline capacity at the location will be increased. If this request for additional capacity leads to a requirement to reinforce the network, it can only be triggered when the customer enters into a PARCA.

An economic test is applied prior to the decision to release incremental obligated capacity, further details of this test can be found within the Entry Capacity Release Methodology Statement. If insufficient revenue is received to pass the economic test, capacity in excess of the obligated baseline level can be released on a non-obligated basis.

Appendix 3 – Connection and capacity application process

3.3 NTS entry capacity

Figure A3.4
2020 QSEC auction

1. **The QSEC auctions opened on Monday 16 March and closed on Wednesday 18 March 2020.**
2. **No bids were received at any ASEPs.**

Appendix 3 – Connection and capacity application process

3.4 NTS exit capacity

Exit capacity provides shippers and Distribution Network Operators (DNO) with the right to take gas off the NTS. Only licenced shippers and DNOs can apply for and obtain exit capacity. A licenced shipper or DNO is considered a 'User' of the NTS under the terms of the UNC.

NTS exit capacity types

National Grid makes firm and off peak capacity available to the market at each offtake point. The volume of firm capacity made available at each offtake point consists of the following:

- baseline NTS exit capacity (obligated)
- incremental NTS exit capacity (obligated)
- non-obligated NTS exit capacity

Off peak capacity is made available to the market at offtake points. The volume of off peak capacity available at an offtake consists of three parts:

- use it or Lose it (UIOLI)
- unutilised Maximum NTS Exit Point Offtake Rate (MNEPOR)
- discretionary

Off peak capacity rights may be curtailed by National Grid without any compensation for the Users affected if there are low pressures on the network; in addition, the Gas National Control Centre may curtail off peak capacity in the event of a constraint on the NTS.

NTS exit capacity application windows and auctions — Spotlight

To obtain firm exit capacity a shipper can apply for capacity through three auctions, these relate to interconnection points, and four exit capacity application windows:

- Annual NTS (Flat) exit capacity (AFLEC)
- Enduring Annual Exit (Flat) Capacity Increase (EAFLEC)
- Enduring Annual Exit (Flat) Capacity Decrease (EAFLEC)
- Ad-hoc Enduring Annual Exit (Flat) Capacity

For our DNO Users we also make NTS exit (flexibility) capacity available. This allows the DNO to vary the offtake of gas from the NTS over the course of a Gas Day. DNOs can apply for NTS exit (flexibility) capacity during the 1 to 31 July enduring annual exit (flat) capacity application window.

All capacity requests are subject to network analysis to assess the impact on Network Capability. Where the capacity requested can be accommodated through substitution, the capacity request is accepted. If incremental capacity cannot be met via substitution, the customer will need to enter into a PARCA as reinforcement works may be required to meet the capacity request.

Appendix 3 – Connection and capacity application process

3.5 Capacity at interconnection points

The UK currently has three direct gas pipelines (gas interconnectors) connecting the NTS to other states. These include Moffat to the Republic of Ireland, Balgzand to Bacton Line (BBL) to the Netherlands and IUK to Belgium.

The interconnection point auctions are held in accordance with the Capacity Allocation Mechanisms (CAM) EU network code. There are a total of six long-term interconnection point auctions, three for entry and three for exit:

Entry:

Interconnection point annual yearly auctions (IPAYSEC)
Interconnection point annual quarterly auctions (IPAQSEC)
Interconnection point rolling monthly auctions (IPRMSEC)

Exit:

Interconnection point annual yearly auctions (IPAYNEX
Interconnection point annual quarterly auctions (IPAQNEX)
Interconnection point annual rolling monthly auctions (IPRMNEX)

The annual yearly auction opens on the 1st Monday of July and makes bundled/unbundled firm* capacity available from October Y+1 to September Y+15 (where Y is the current gas year).

The annual quarterly capacity auctions conducted for four quarters of the upcoming gas year will be auctioned via four concurrent annual quarterly capacity auctions.

The first is held on the 1st Monday of August, capacity will be auctioned for all four quarters (October–December, January–March, April–June and July–September).

- The second is held on the 1st Monday of November, capacity will be auctioned for the quarters January–March, April–June and July–September.
- The third is held on the 1st Monday of February, capacity will be auctioned for the quarters April–June and July–September).
- The fourth is held on the 1st Monday of May, capacity will be auctioned for the last quarter (July–September).
- The rolling monthly capacity auction will be held once a month. It will open on the third Monday of each month for the following monthly standard capacity product.

* Please note: as part of the modification to facilitate capability of two-way flow from BBL, we release daily interruptible exit capacity at Bacton BBL.

Please view this page for an explanation of how the trading of gas with European states will operate in the event of a no-deal Brexit and the actions you will need to take to prepare.

Appendix 3 – Connection and capacity application process

3.6 PARCA framework

The Planning and Advanced Reservation of Capacity Agreement (PARCA) is a bilateral contract that allows long-term NTS entry and/or exit capacity to be reserved for a customer while they develop their project. The customer can buy the reserved capacity at an agreed future date.

The PARCA framework is based on a development of the long-term NTS entry and exit capacity release mechanisms and extends the UNC ad-hoc application provisions that allow users to reserve enduring NTS exit (flat) capacity and NTS entry capacity.

Baseline capacity, non-obligated capacity and incremental capacity that can be provided via substitution will be made available through the Quarterly System Entry Capacity (QSEC) auction(s) and enduring annual NTS exit (flat) capacity processes, and can also be reserved through a PARCA by a developer or a User (both DNO and shipper).

Incremental capacity that cannot be provided via substitution is only guaranteed for release where a PARCA has been agreed by National Grid and a developer or a User (both DNO and shipper).

3.6.1 PARCA framework structure

Initially, a customer will submit a PARCA application requesting the capacity they need. We will use the information provided in the PARCA application to determine how and when the capacity requested can be delivered.

A customer might be a gas shipper, DNO or any other third party such as a developer and may or may not be a party signed up to the Uniform Network Code (UNC). The PARCA arrangements apply to all NTS entry and exit points, NTS storage and NTS interconnectors.

A key aspect of the PARCA is that it helps the customer and us to progress our respective projects in parallel. It also assures the customer that capacity has been reserved with the option to buy it later. Financial commitment to the capacity (allocation of capacity) is only required once the customer is certain that their project will go ahead.

The PARCA framework is split into four logical phases: Phase 0 to Phase 3 (see figure A3.5). This phased structure gives the customer natural decision points where they can choose whether to proceed to the next phase of activities. The PARCA process is flexible to allow the customer to leave the process at any time before full financial commitment to the capacity through capacity allocation. Please note, a reservation of capacity through a PARCA does not provide an NTS connection.

More information on the PARCA process is provided on our website, including the full PARCA customer guide.

Appendix 3 – Connection and capacity application process

3.6 PARCA framework

Figure A3.5
PARCA framework process

Phase 0
- Customer approaches National Grid for initial project discussions
- Informal assessment completed
- Customer submits PARCA application and PARCA application fee

Phase 1
Up to 6 months
- National Grid confirms receipt of the application within two business days
- National Grid provides formal acceptance of a competent application to the customer within six business days
- National Grid initiates Phase 1 works
- Within ten business days National Grid may trigger a PARCA window and an ad-hoc QSEC capacity auction
- National Grid will issue the customer with the Phase 1 Output Report and the PARCA contract

Phase 2
Up to 60 months
- National Grid will reserve the capacity on behalf of the customer (reservation date)
- National Grid initiates the Phase 2 works
- Customer provides demonstration information and annual financial security
- Where customer is a non-code party, nominates a User(s) at least one month prior to capacity allocation date
- National Grid formally allocate the capacity to the customer (allocation date)

Phase 3
Up to 24 months
- National Grid will conduct network reinforcement if this is required
- Capacity is delivered (registration date)

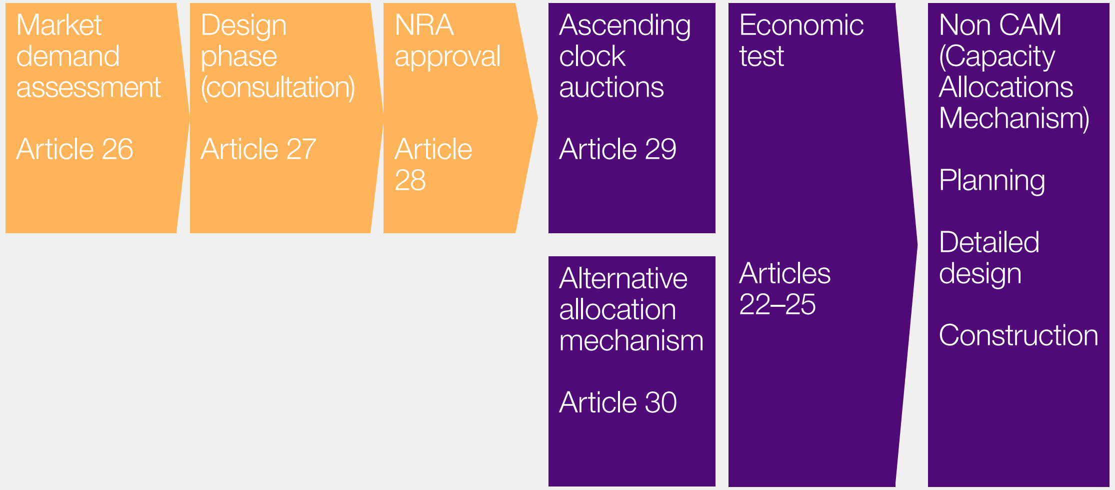
Appendix 3 – Connection and capacity application process

3.7 Incremental capacity at interconnection points

In order to harmonise the development process for incremental capacity at interconnection points, rules for incremental capacity have been included in the network code on Capacity Allocations Mechanism (CAM NC).

This development process includes several phases (figure A3.6). Incremental projects can be initiated based upon market demand and new capacity requirements. The market demand assessment is conducted in accordance with the UNC European Interconnection Document (EID) Section E.

Figure A3.6
Phases of releasing incremental capacity



Please view this page for an explanation of how the trading of gas with European states will operate in the event of a no-deal Brexit and the actions you will need to take to prepare.

Appendix 4 – Meet the teams

4.1 Customer Projects Contact Management team

Our role within the Gas Connections Contract Management team is to manage and deliver all commercial aspects of your National Transmission System (NTS) connection, diversion and/or PARCA processes. We deliver all of the commercial and contractual requirements including new and/or modifications to your NTS connection, reservation of capacity on the NTS (PARCA), diversions, distribution network offtake arrangements, associated operator agreement changes and framework changes, and UNC customer lifecycle processes.

Our dedicated contract management team will manage your connection, diversions and all PARCA applications:

The Gas Connections Contract team – box.UKT.customerlifecycle@nationalgrid.com

James Abrahams
Nicola Lond
Belinda Agnew
Claire Gumbley
Louise McGoldrick
Richard Hounslea
Steven Ruane
Daniel Caldecote
Tim Dart
Jeremy Tennant

4.2 Operational Liaison and Business Planning team

Our Operational Liaison team facilitates our best customer practice across Gas Operations by managing our engagement and improvement strategy. We deliver a range of customer and stakeholder facing meetings and forums, including:

- Gas Operational Forum
- Annual Liaison Meetings
- Industry Webinars.

We also co-ordinate Last Mile Commissioning (the system set up for connections and biomethane sites), and are the business custodian for Operational Data. The team also drive the development of the Gas Operations business plan, including change portfolio deliverables.

Find out more about the work completed by our Operational Liaison and business planning teams at our Operations or Data Community pages or contact our dedicated Operational Liaison and Business Planning team directly:

The Operational Liaison team – Box.OperationalLiaison@nationalgrid.com

Joshua Bates
Martin Cahill
Manesh Bulsara
Sam Holmes
Craig Shipley
George Killick

Appendix 5
EU activity

The EU objective to be climate-neutral by 2050 is at the heart of its European Green Deal, which will encompass new and revised energy legislation expected to be drafted in 2021. As members of the European National Transmission System Operators Gas (ENTSOG) and Gas Infrastructure Europe (GIE), we support the important input these organisations have into shaping these future gas market developments.

We are working closely with Ofgem, BEIS and stakeholders in preparation for EU Exit, and will continue to engage with domestic and European stakeholders to prepare for the future UK/EU relationship.

In section 1.4.2 we discussed the European Union (EU) Third Energy Package of legislation which was introduced in 2009. Since then, we have worked with multiple stakeholders to enable the development of several EU gas Network Codes including:

- Capacity Allocation Mechanisms (CAM)
- Balancing (BAL)
- Interoperability and Data Exchange (INT)
- Tariffs (TAR).

In accordance with Article 6 of CAM, we continue to meet once a year with adjacent TSOs at Bacton and Moffat to discuss, analyse and agree the amount of available capacity at interconnection points (IP) that would be offered in the annual yearly capacity auction.

We have carried out extensive work with GB shippers to review GB charging arrangements under UNC Modifications 0621 and 0678 (and their various alternatives) in accordance with the harmonised tariff arrangements required under the TAR code. Whilst the compliance date for this TAR code obligation is 31 May 2019 for the following tariff year, the final modification report for 0678 was discussed at a UNC Modification Panel in May 2019 and, following an Impact Assessment, a decision to approve 0678A was announced by Ofgem on 28 May 2020 with an implementation date of 1 October 2020.

We have worked closely with UK Government and Ofgem to assess the impact of the revised Regulation on Gas Security of Supply – (EU) 2017/1938 – and the activities required for its implementation. This regulation requires closer cooperation between EU Member States, whose ‘competent authorities’ are required to work together to develop regional Risk Assessments and Preventive Action Plans, with ‘solidarity principles’ to be applied in the event of a prolonged supply emergency. We are currently working with relevant stakeholders to implement revised solidarity arrangements.

The UNC modifications to implement the EU Codes and Guidelines that have been completed since the 2019 *GTYS* or are ongoing include:

- 0678/A/B/C/D/E/F/G/H/I/J (Amendments to Gas Transmission Charging Regime). Sent by the UNC Panel to Ofgem for decision on 23 May 2019. Alternative 0678A has been approved for implementation with a commencement date of 1 October 2020.

Appendix 6 – Exit and entry capacity application process

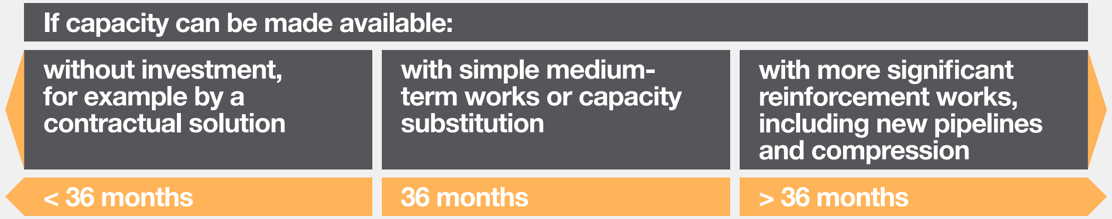
6.1 Exit capacity on the NTS

Understanding our customers' gas demand (exit capacity) requirements across the NTS allows us to plan and operate our system efficiently and effectively. When we receive an exit capacity request, we complete analysis to assess what impact an increase in demand has on our current Network Capability. This allows us to identify and plan for any geographical constraints which may arise from increasing customer exit capacity demand in an area of the NTS. Where constraints to current Network Capability are detected, we identify options to meet our customers' needs in the most cost-effective and efficient way.

In this chapter of the *GTYS* we provide shippers, Distribution Network Operators and developers with information about the lead time for gaining NTS exit capacity. The same timescales apply to entry capacity. Figure A6.1 summarises these lead times.

Please note, works on our existing sites, including modification of compressors and above-ground installations (AGIs), may not require planning permission. This may result in shorter lead times.

Figure A6.1
Capacity lead times



Following the Planning Act (2008), significant new pipelines require a Development Consent Order (DCO). This can result in capacity lead times of 72 to 96 months. Construction of new compressor stations may also require DCOs if a new high-voltage electricity connection is needed and, subject to local planning requirements, may require similar timescales to pipeline projects.

6.1.1 Available (unsold) NTS exit (flat) capacity

The obligated exit capacity level is the amount of exit capacity that we make available through the application and auction processes (please see appendix 3 for a detailed description of our capacity application and auction process).

If we have unsold NTS exit (flat) capacity available at an existing exit-point, then it can be accessed through the July application process for the following winter.

We can increase exit capacity above the obligated levels when our Network Capability allows, through capacity substitution and via funded reinforcement works. Further information on capacity release and capacity substitution can be found online in the Capacity Methodology Statements. If capacity substitution is not possible, we will consider whether further Network Capability analysis is required to investigate rules, tools, and asset solutions.

Appendix 6 – Exit and entry capacity application process

6.1 Exit capacity on the NTS

Table A6.1 includes the quantities of unsold NTS exit (flat) capacity in each zone of our NTS exit capacity map that could also be used to make capacity available at other sites through exit capacity substitution.

This table has been updated to shows how unsold capacity has changed since the publication of the *2019 Gas Ten Year Statement*.

Table A6.1
Quantities of unsold NTS exit (flat) capacity

Region number	Region	Obligated	Unsold		
		(GWh/d)	(GWh/d)	% of unsold capacity	% change from *2019 GTYS*
1	Scotland & the North	719	213	30	+8
2	North West & West Midlands (North)	1,110	423	38	0
2.1	North Wales & Cheshire	315	202	64	-1
3	North East, Yorkshire and Lincolnshire	1,558	710	46	+29
4	South Wales and West Midlands (South)	569	157	28	+19
5	Central & East Midlands	281	113	40	0
6	Peterborough to Aylesbury	126	17	13	-10
7	Norfolk	367	137	37	+5
8	Southern	526	201	38	-18
9	London, Suffolk and the South East	1,504	428	28	+4
10	South West	461	55	12	-2

Appendix 6 – Exit and entry capacity application process

6.1 Exit capacity on the NTS

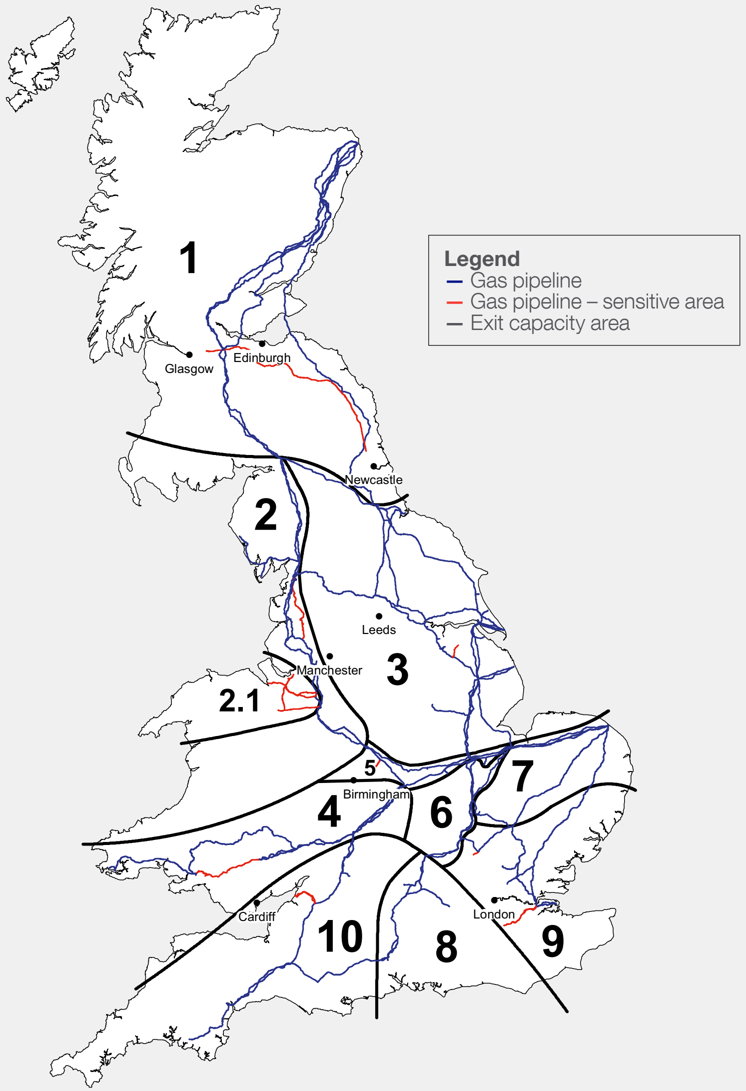
6.1.2 NTS exit capacity map

The NTS exit capacity map divides the NTS into zones based on key compressor stations, and multi-junctions (figure A6.2). These zones are purely for information and were created for the *GTYS*.

Within these zones, any new connection and/or capacity request is likely to be met through capacity substitution within the zone. It is likely that substitution within a zone will be close to a 1-to-1 basis. All of our substitution analysis is carried out to the substitution methodology statement rules and while it is very likely that capacity will be substituted from within a zone, it is not guaranteed.

In the following chapter we have provided a commentary explaining the potential capacity lead times and likelihood of substitution in each zone, including areas of sensitivity. This information is an indication, and actual capacity lead times and availability will depend on the quantity of capacity requested from all customers within a zone and interacting zones. This information recognises the impact Electricity Market Reform may have on interest in NTS connections and capacity.

Figure A6.2
NTS exit capacity map



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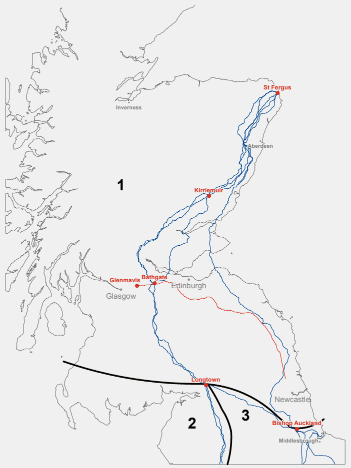
Appendix 6 – Exit and entry capacity application process

6.1 Exit capacity on the NTS

Figure A6.3
Region 1 – Scotland and the North



Legend
● Key sites
– Gas pipeline
– Gas pipeline – sensitive area
– Exit capacity area

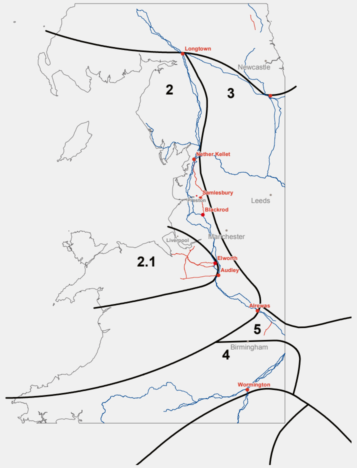
NTS location:
North of Longtown and Bishop Auckland

NTS/DN exit zones:
SC1, 2, 3, 4, NO1, 2

This region is sensitive to St Fergus flows. High St Fergus flows mean that exit capacity will be available, as flows from the St Fergus Terminal are predominately in a North to South direction. As St Fergus flows reduce, exit capacity will be constrained.

There is only a small quantity of substitutable capacity in the area, but compressor flow modifications, including reverse flow capability, can be delivered to provide significant quantities of capacity without requiring Planning Act timescales. Capacity may be more limited in the sensitive area (Feeder 10 Glenmavis to Saltwick) due to smaller diameter pipelines.

Figure A6.4
Region 2 – North West and West Midlands (North)



Legend
● Key sites
– Gas pipeline
– Gas pipeline – sensitive area
– Exit capacity area

NTS location:
South of Longtown, north of Alrewas and east of Elworth

NTS/DN exit zones:
NW1, WM1

This region is highly sensitive to national supply patterns and use of storage; this area was historically supplied with gas from the North but increasingly receives gas from the South and from the East across the Pennines. The amount of unsold capacity in the region indicates that capacity could be made available by exit capacity substitution. A capacity request in zone 2 is likely to be met through substitution from zone 2, including zone 2.1, and then from the downstream zones, in this case zone 5. Capacity is likely to be available on the main feeder sections between Carnforth and Alrewas. Potential non-Planning Act reinforcements could release capacity, but then significant pipeline reinforcement would be required, particularly in the sensitive regions between Nether Kellett and Blackrod on Feeder 11.

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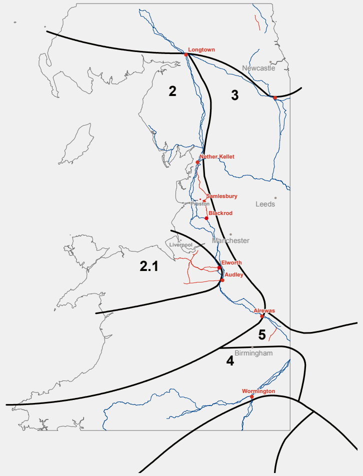
Appendix 6 – Exit and entry capacity application process

6.1 Exit capacity on the NTS

Figure A6.5
Region 2.1 – North Wales and Cheshire



Legend
- Key sites
- Gas pipeline
- Gas pipeline – sensitive area
- Exit capacity area

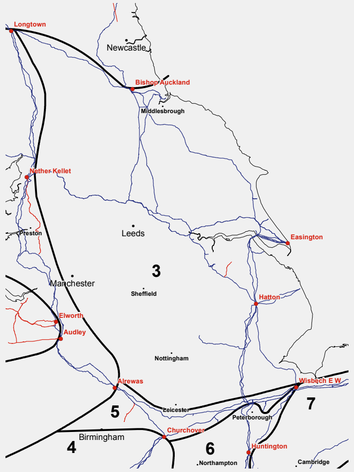
NTS location:
West of Elworth and Audley (Feeder 4)

NTS/DN exit zones:
NW2, WA1

This is an extremity of the system with limited local supplies (Burton Point) and a significant number of storage facilities.

The quantity of unsold capacity within the region indicates a good probability that capacity could be made available via exit capacity substitution. However, this would be available at direct connect offtakes where capacity can be booked. Potential non-Planning Act reinforcements could release small amounts of additional capacity, but significant pipeline reinforcement would be required, resulting in long (Planning Act) timescales.

Figure A6.6
Region 3 – North East, Yorkshire and Lincolnshire



Legend
- Key sites
- Gas pipeline
- Gas pipeline – sensitive area
- Exit capacity area

NTS location:
South of Bishop Auckland, north of Peterborough and Wisbech and east of Nether Kellet

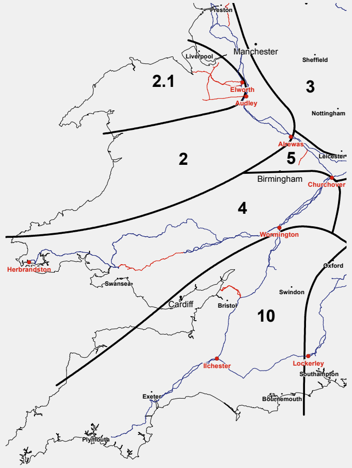
NTS/DN exit zones:
NE1, 2, EM1, 2

There are numerous power stations in this region and this may impact on future ramp rate agreements. The amount of unsold capacity in the region indicates that capacity could be made available through exit capacity substitution. Further capacity should be available without needing reinforcement, assuming stable North–East supplies; however, this may be limited on smaller diameter spurs, including between Brigg and Blyborough on Feeder 7. Non-Planning Act reinforcements, including compressor modifications, could be carried out to make additional capacity available.

Appendix 6 – Exit and entry capacity application process

6.1 Exit capacity on the NTS

Figure A6.7
Region 4 – South Wales and West Midlands (South)



Legend
- Key sites
- Gas pipeline
- Gas pipeline – sensitive area
- Exit capacity area

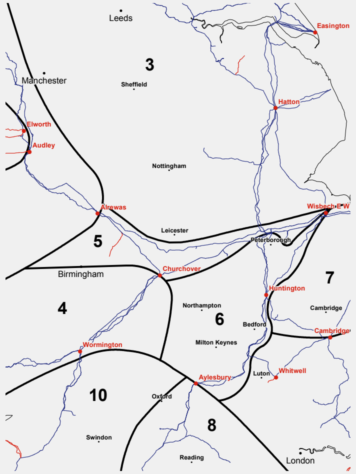
NTS location:
West of Churchover

NTS/DN exit zones:
WM3, SW1, WA2

Exit capacity availability is highly sensitive to Milford Haven flows. Low Milford Haven flows result in reduced South Wales pressures, which limit capacity. High Milford Haven flows result in reduced pressures in the West Midlands which may limit capacity.

The quantity of unsold capacity within the region indicates a limited quantity of capacity could be substituted. Potential non-Planning Act reinforcements could release small quantities of capacity, but significant pipeline reinforcement would be required, particularly in the sensitive area on Feeder 2, South of Cilfrew between Dyffryn Clydach and Gilwern, due to the different pressure ratings.

Figure A6.8
Region 5 – Central and East Midlands



Legend
- Key sites
- Gas pipeline
- Gas pipeline – sensitive area
- Exit capacity area

NTS location:
South of Alrewas, north of Churchover, west of Wisbech

NTS/DN exit zones:
EM3, 4, WM2

The unsold capacity here indicates a limited scope for substitution. Potential non-Planning Act reinforcements could be carried out to release a small amount of capacity, but significant pipeline reinforcement would be required, particularly for the sensitive area on Feeder 14 between Austrey to Shustoke.

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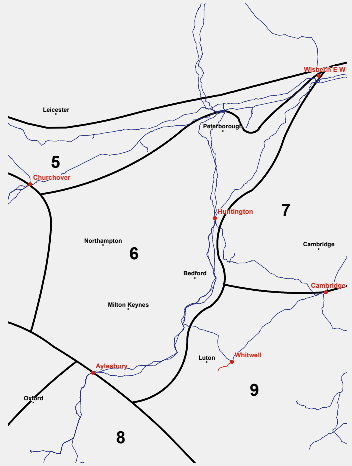
Appendix 6 – Exit and entry capacity application process

6.1 Exit capacity on the NTS

Figure A6.9
Region 6 – Peterborough to Aylesbury



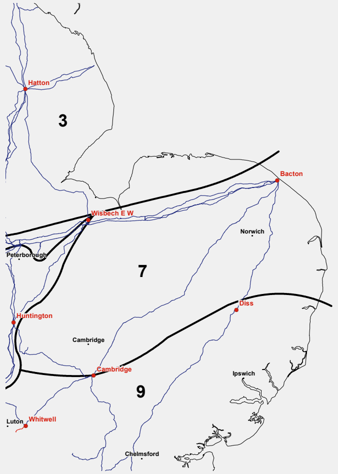
Legend
- Key sites
- Gas pipeline
- Gas pipeline – sensitive area
- Exit capacity area

NTS location:
North of Aylesbury, south of Peterborough and Wisbech, west of Huntingdon

NTS/DN exit zones:
EA6, 7

Capacity availability is sensitive to demand increases downstream in region 10, the South West. The quantity of unsold capacity indicates limited scope for exit capacity substitution from the single offtake in the region, but there may be scope for substitution from the Southern region downstream of Aylesbury. Potential non-Planning Act reinforcements could be carried out to release capacity.

Figure A6.10
Region 7 – Norfolk



Legend
- Key sites
- Gas pipeline
- Gas pipeline – sensitive area
- Exit capacity area

NTS location:
North of Diss and Cambridge, east of Wisbech

NTS/DN exit zones:
EA1, 2, 3

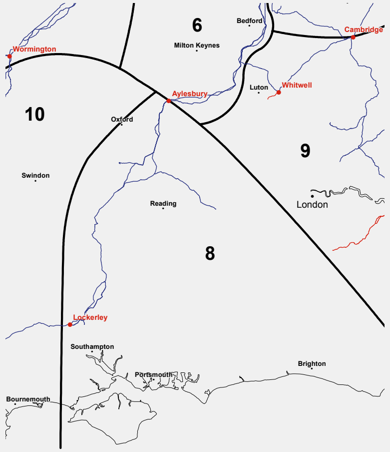
This region is sensitive to South East demand; if demand increases in the South East, capacity may become more constrained.

Unsold capacity here indicates a good probability that capacity could be substituted. Additional capacity could be made available without reinforcement works, assuming stable Bacton supplies.

Appendix 6 – Exit and entry capacity application process

6.1 Exit capacity on the NTS

Figure A6.11
Region 8 – Southern



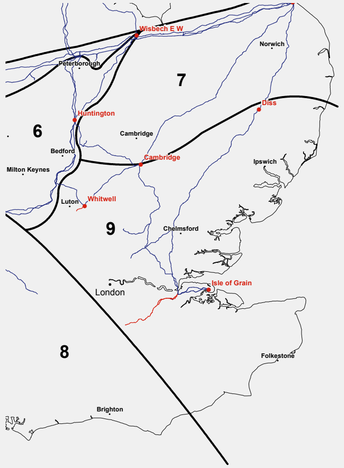
Legend
- Key sites
- Gas pipeline
- Gas pipeline – sensitive area
- Exit capacity area

NTS location:
South of Aylesbury and north of Lockerley

NTS/DN exit zones:
SO1, 2

The region is sensitive to demand in the South West; if demand increases, capacity may become more constrained. The amount of unsold capacity indicates a good chance that capacity could be made available via exit capacity substitution. Potential non-Planning Act reinforcements (compressor station modifications) could release a small amount of capacity.

Figure A6.12
Region 9 – London, Suffolk and the South East



Legend
- Key sites
- Gas pipeline
- Gas pipeline – sensitive area
- Exit capacity area

NTS location:
South Diss, Cambridge, east of Whitwell

NTS/DN exit zones:
EA4, 5, NT1, 2, 3, SE1, 2

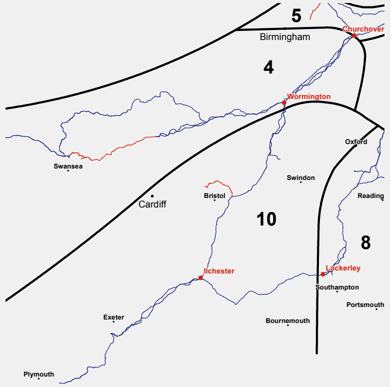
The region is sensitive to Isle of Grain flows, with low flows limiting capacity. Capacity may be more limited in the sensitive areas at the extremities of the system, for example at Feeders 5 and 18 from Shorne to Tatsfield, and Feeder 3 from Whitwell to Peters Green.

The significant number of power stations in the region may impact on future ramp rate agreements. Unsold capacity indicates some capacity could be made available via exit capacity substitution; however, exchange rates may vary between locations. Potential non-Planning Act reinforcements could be carried out to release small quantities of additional capacity but significant pipeline reinforcement would be needed.

Appendix 6 – Exit and entry capacity application process

6.1 Exit capacity on the NTS

Figure A6.13
Region 10 – South West



Legend
- Key sites
- Gas pipeline
- Gas pipeline – sensitive area
- Exit capacity area

NTS location:
South of Wormington and Lockerley

NTS/DN exit zones:
SW2, 3

The quantity of unsold capacity in this region indicates limited scope for capacity being made available through exit capacity substitution. Exchange rates may be high due to small diameter pipelines. Potential non-Planning Act reinforcements could release small quantities of additional capacity, but significant pipeline reinforcement would be needed, resulting in long (Planning Act) timescales, particularly in the sensitive area from Pucklechurch to Seabank on the Feeder 14 spur due to small diameter pipelines. There is also sensitivity to low Milford Haven flows. During peak demand with low Milford Haven flows it becomes more difficult to maintain assured pressures in the South West.

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Appendix 6 – Exit and entry capacity application process

6.1 Exit capacity on the NTS

6.1.3 Directly connected exit points

Table A6.2 shows which region the current directly connected (DC) offtakes fall within the NTS exit capacity map. There are no such offtakes in region 6.

Table A6.2
Direct connects offtakes by NTS exit capacity map zone

Region	Offtake
1	Blackness (BP Grangemouth)
	Fordoun Industrial
	Glenmavis (Storage)
	Gowkhall (Longannet)
	Moffat Irish interconnector
	St Fergus (Peterhead)
	St Fergus (Shell Black Start)
2	Barrow (Bains)
	Barrow (Blackstart)
	Barrow (Gateway)
	Carrington (Partington) Power Station
	Ferny Knoll (AM Paper)
	Fleetwood (Preesall) Storage
	Roosecote Power Station
	Sandy Lane (Blackburn) Power Station
	Sellafield Power Station
	Trafford Power Station
	Wyre Power Station
2.1	Burton Point (Connahs Quay)
	Deeside Power Station
	Harwarden (Aka Shotton Paper)
	Hill Top Farm Storage
	Hole House Farm Storage
	Holford Storage
	Hollingsgreen (Hays Chemicals)
	ICIR (CastnerKelner_ICI_Runcorn)
	King Street Storage
2.1	Pickmere (Winnington Power Station)
	Shellstar (Aka Kemira)
	Shotwick (Bridgewater Paper)
	Stublach Storage
	Weston Point (Rocksavage) Power Station
	Willington Power Station
3	Aldborough Storage
	Billingham ICI
	Blyborough (Brigg)
	Blyborough (Cottam)
	Caythorpe Storage
	Eastoft (Keadby Blackstart)
	Eastoft (Keadby)
	Enron Billingham
	Goole (Guardian Glass)
	Hatfield Moor Storage
	Hatfield Power Station
	Hatfield West Storage
	Hornsea Storage
	Phillips Petroleum Teesside
	Rosehill (Saltend) Power Station
	Rough Storage
	Saltend BPHP
	Saltfleetby Storage
	Spalding 2 (South Holland) Power Station
	Stalingborough
	Staythorpe
3	Sutton Bridge Power Station
	Teesside (BASF)
	Teesside Hydrogen
	Teesside (Seal Sands) Power Station
	Thornton Curtis (Humber Refinery)
	Thornton Curtis (Killingholme)
	West Burton Power Station
	Whitehill Storage
	Wragg Marsh (Spalding)
	Zenica (ICI Avecia)
4	Abergelli Power Station
	Abernedd Power Station
	Hirwaun Power Station
	Pembroke Power Station
	Tonna (Baglan Bay)
	Upper Neeston (Milford Haven) Refinery
5	Caldecott (Corby) Power Station Refinery
	Drakelow Power Station
	Peterborough Power Station
7	Bacton (Baird) Storage
	Bacton (Deborah) Storage
	Bacton (Esmond Forbes) Storage
	Bacton Great Yarmouth
	Bacton IUK Interconnector
	Saddle Bow (Kings Lynn) Power Station
	St Neotts (Little Barford)
8	Didcot Power Station
	Humbly Grove Storage
	Marchwood Power Station
9	Barking (Horndon)
	Coryton 2 (Thames Haven) Power Station
	Epping Green (Enfield Energy)
	Grain Power Station
	Medway (Isle of Grain) Power Station
	Middle Stoke (Damhead Creek) Power Station
	Ryehouse
	Stanford Le Hope (Coryton)
10	Abson (Seabank) Power Station
	Avonmouth Storage
	Centrax Industrial
	ICI Sevenside
	Langage Power Station
	Portland Storage
	Seabank Power Station

Appendix 6 – Exit and entry capacity application process

6.1 Exit capacity on the NTS

6.1.4 NTS/DN exit zones

Figure A6.14 and table A6.3 show which distribution network exit zones current NTS/DN offtakes fall within. Please note, the NTS/DN exit zone map below is separate to the previous NTS exit capacity maps. The NTS/DN exit zones below are defined by the Notice of Gas Transmission Transportation Charges.

Table A6.3
NTS/DN exit zones

Exit zone	Offtake
EA1	Eye
	West Winch
	Brisley
	Bacton Terminal
EA2	Bacton Terminal
	Great Wilbraham
	Roudham Heath
EA3	Bacton Terminal
	Yelverton
EA4	Matching Green
	Royston
	Whitwell
EA6	Hardwick
EM1	Thornton Curtis
	Walesby
EM2	Kirkstead
	Sutton Bridge
	Silk Willoughby
	Gosberton
	Blyborough
EM3	Alrewas (EM)
	Blaby
	Drointon

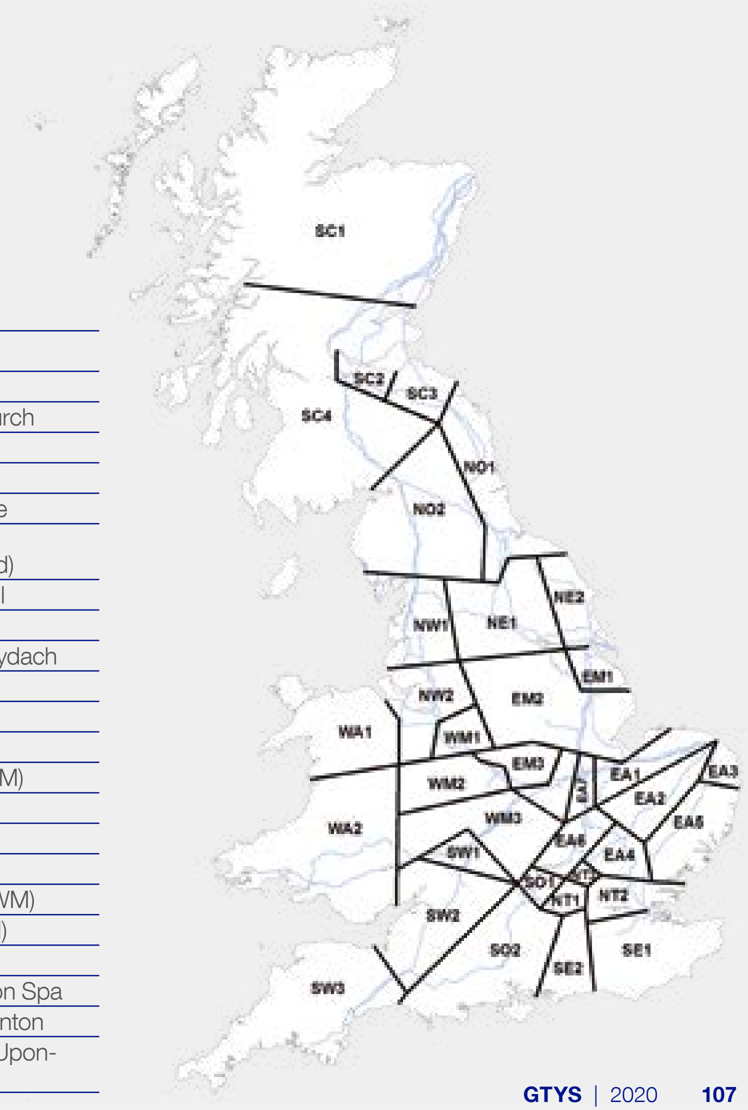
Exit zone	Offtake
EM3	Tur Langton
EM4	Market Harborough
	Caldecott
NE1	Towton
	Rawcliffe
	Baldersby
	Pannal
	Asselby
	Burley Bank
NE2	Ganstead
	Pickering
	Paull
NO1	Guyzance
	Cowpen Bewley
	Coldstream
	Bishop Auckland
	Corbridge
	Thrintoft
	Saltwick
	Humbleton
	Little Burdon
	Elton
NO2	Wetheral
	Keld

Exit zone	Offtake
NO2	Melkinthorpe
	Tow Law
NT1	Winkfield (NT)
NT2	Horndon
	Luxborough Lane
NT3	Peters Green
NW1	Blackrod
	Salmesbury
	Lupton
NW2	Mickle Trafford
	Malpas
	Warburton
	Weston Point
	Partington
	Holmes Chapel
	Ecclestone
	Audley (NW)
SC1	Careston
	Balgray
	Kinknockie
	Aberdeen
SC1	St Fergus
	Mosside
SC2	Broxburn

Exit zone	Offtake
SC2	Armadale
SC3	Hulme
	Soutra
SC4	Nether Howleugh
	Lockerbie
	Pitcairngreen
	Bathgate
	Stranraer
	Glenmavis
	Drum
SE1	Tatsfield
	Shorne
	Farningham
SE2	Winkfield (SE)
SO1	Ipsden
	Winkfield (SO)
SO2	Mappowder
	Braishfield
SW1	Fiddington
	Evesham
SW1	Ross (SW)
SW2	Littleton Drew
	Easton Grey
	Cirencester

Exit zone	Offtake
SW2	Ilchester
	Pucklechurch
	Seabank
SW3	Kenn
	Aylesbeare
	Lyneham (Choakford)
	Coffinswell
WA1	Maelor
WA2	Dyffryn Clydach
	Dowlais
	Gilwern
WM1	Aspley
	Audley (WM)
	Milwich
WM2	Shustoke
	Austrey
	Alrewas (WM)
WM3	Ross (WM)
	Rugby
	Leamington Spa
	Lower Quinton
	Stratford-Upon-Avon

Figure A6.14
NTS/DN exit zones



Appendix 6 – Exit and entry capacity application process

6.2 Entry capacity on the NTS

As with exit capacity, it is important for us to understand our customers' gas supply (entry capacity) requirements to the NTS to allow us to plan and operate our system efficiently and effectively.

When we receive an entry capacity request, we complete analysis to assess what impact an increase in supply at a part of our system has on our current Network Capability. This allows us to identify and plan for any geographical constraints which may arise from an increase in customer entry capacity in an area of the NTS. Where constraints to current Network Capability are encountered, we identify options that include rules, tools and asset solutions to meet our customers' needs in the most cost-effective and efficient way.

This chapter contains information about capacity availability and the lead time for providing NTS entry capacity as a guide for shippers and developers. Unsold NTS entry capacity available at an existing Aggregate System Entry Point (ASEP) can be accessed via the daily, monthly and annual entry capacity auction processes. If unsold capacity is not available, including at new entry points, the lead times may be longer.

The *GTYS* aims to help you understand the likely lead time associated with new entry points. New entry points can result in significant changes to network flow patterns, and we encourage you to approach our customer contracts team to discuss specific requirements. The following information is just an indication; actual capacity availability will depend on the amount of capacity requested from all customers at an ASEP and interacting ASEPs.

6.2.1 Gas supply diversity

In the Gas Supply section we discussed the diversity of our future gas supply mix which arises from both existing supplies and potential new developments.

Currently, the available gas supplies, in aggregate, are greater than peak demand.

The diversity of our future gas supply mix, however, does make it both unpredictable and uncertain. The uncertainty is amplified by the Gas Transporters Licence requirements for us to make obligated entry capacity available to shippers up to and including the gas flow day. This creates a situation where we are unable to take long-term auctions as the definitive signal from shippers about their intentions to flow gas.

We are continuing to develop our processes to better manage the risks that arise from such uncertainties as part of our *Gas Future Operability Planning (GFOP)* work.

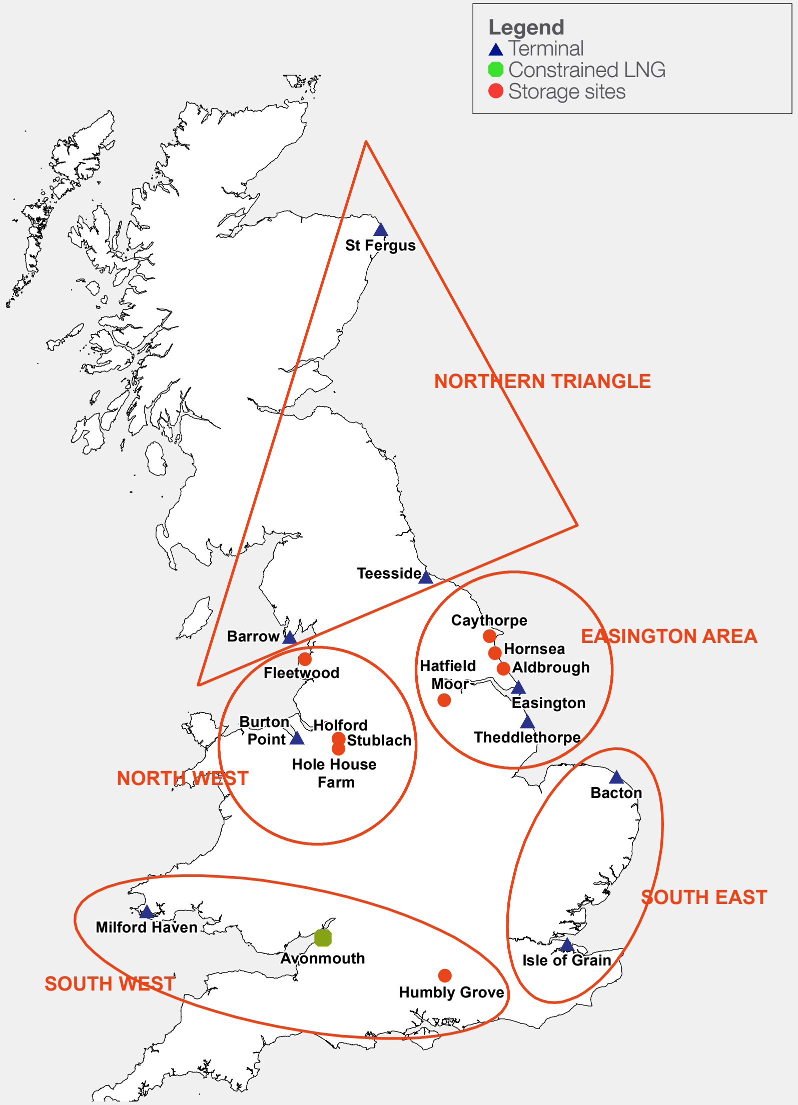
Appendix 6 – Exit and entry capacity application process
6.2 Entry capacity on the NTS

6.2.2 Entry capacity zones

In the *GTYS*, we use the concept of entry zones which contain groups of ASEPs to illustrate our entry capacity capability (figure A6.15). The entry points in each entry zone often make use of common sections of infrastructure to transport gas, and therefore have a high degree of interaction. There are also interactions between supplies in different zones, this means interactions between supplies must also be determined when undertaking entry Network Capability analysis.

Examples of zonal interaction include between Milford Haven and Bacton, or Easington and Bacton entry points, where shared infrastructure assists capacity provision at both ASEPs by moving gas east–west or west–east across the country.

Figure A6.15
Zonal grouping of interacting supplies



Appendix 6 – Exit and entry capacity application process

6.2 Entry capacity on the NTS

6.2.3 Customer entry capacity applications

When we examine customer entry applications, key scenarios that we analyse in our Network Capability analysis include geographical considerations such as:

- high West to East flows generated by increased entry flows in the West travelling east across the country, to support demands in the East and South East of the UK, including IUK export.
- high South to North flows created by reduced entry flows into St Fergus, with a corresponding increase in entry flows in the South, requiring gas to be moved from South to North.

In addition to the traditional geographical scenarios, we may also investigate several commercially driven sensitivities, for example: a sensitivity scenario with a reduction in imported gas, balanced by high medium-range storage entry flows to meet winter demand.

Historically, we have considered entry application scenarios on an individual basis using 'steady state' gas flows consistent with an overall 'end of day' energy balance. As customer requirements from the network evolve, it is increasingly necessary for us to consider the ability of the system to switch between different flow scenarios, explicitly considering changing flows on the network.

If our Network Capability analysis indicates future requirements from the network are outside of current capability, we would investigate a range of possible solutions. This ensures that a broad spectrum of options for solutions are identified.

6.2.4 Available (unsold) NTS entry capacity

Table A6.4 contains the ASEP names as defined in the NTS Licence, and indicates the quantities of obligated and unsold NTS entry capacity at each ASEP within each entry zone. This table has been updated to shows how unsold capacity has changed since the publication of the 2019 *Gas Ten Year Statement*.

This unsold capacity (obligated less any previously sold or reserved) is available at each relevant ASEP and could also be used to make capacity available at other ASEPs through entry capacity substitution. Substitution may also be possible across entry zones.

Appendix 6 – Exit and entry capacity application process

6.2 Entry capacity on the NTS

Our *Charts and Tables Workbook* provides further information about the level of booked and obligated entry capacity at each ASEP. We also provide data points representing historic maximum utilisation and the range of future peak flow scenarios for these ASEPs.

Table A6.4
Quantities of entry capacity by zone

Entry zone	ASEP	Obligated capacity GWh/day	Unsold capacity 2020/2021 GWh/day	Unsold capacity 2024/2025 GWh/day	Unsold capacity 2025/2026 GWh/day
Northern Triangle	Barrow	340.01	265.9	338.53	340.01
	Canonbie	0	0	0	0
	Glenmavis	99	99	99	99
	St Fergus	1,670.70	1,571.98	1,663.74	1,666.94
	Teesside	445.09	368.54	390.76	399.5
North West	Burton Point	73.5	65.13	73.5	73.5
	Cheshire (includes Holford and Stublach storage facilities)	556.27	28.59	28.59	28.59
	Fleetwood	350	350	35	70
	Hole House Farm (includes Hill Top Farm storage facility)	296.6	13.16	13.16	13.16
	Partington	201.43	201.43	201.43	201.43
Easington Area	Caythorpe	90	0	0	90
	Easington	1,407.15	106.20	531.91	647.48
	Garton (includes Aldborough storage facility)	420	0	420	420
	Hatfield Moor (onshore)	0.3	0.3	0.3	0.3
	Hornsea	233.1	27.31	233.1	233.1
	Hatfield Moor (storage)	25	3	3	25
	Theddlethorpe	610.7	610.7	610.7	610.7
South West	Avonmouth	179.3	179.3	179.3	179.3
	Barton Stacey (includes Humbley Grove storage facility)	172.6	82.6	172.6	172.6
	Dynevor Arms	49	49	49	49
	Milford Haven	950	0	95	95
	Wytch Farm	3.3	3.3	3.3	3.3
South East	Bacton IP	1,297.80	1,034.36	1,181.82	1,297.80
	Bacton UKCS	485.60	0.00	0.00	180.02
	Isle of Grain	699.68	35.38	177.08	277.08

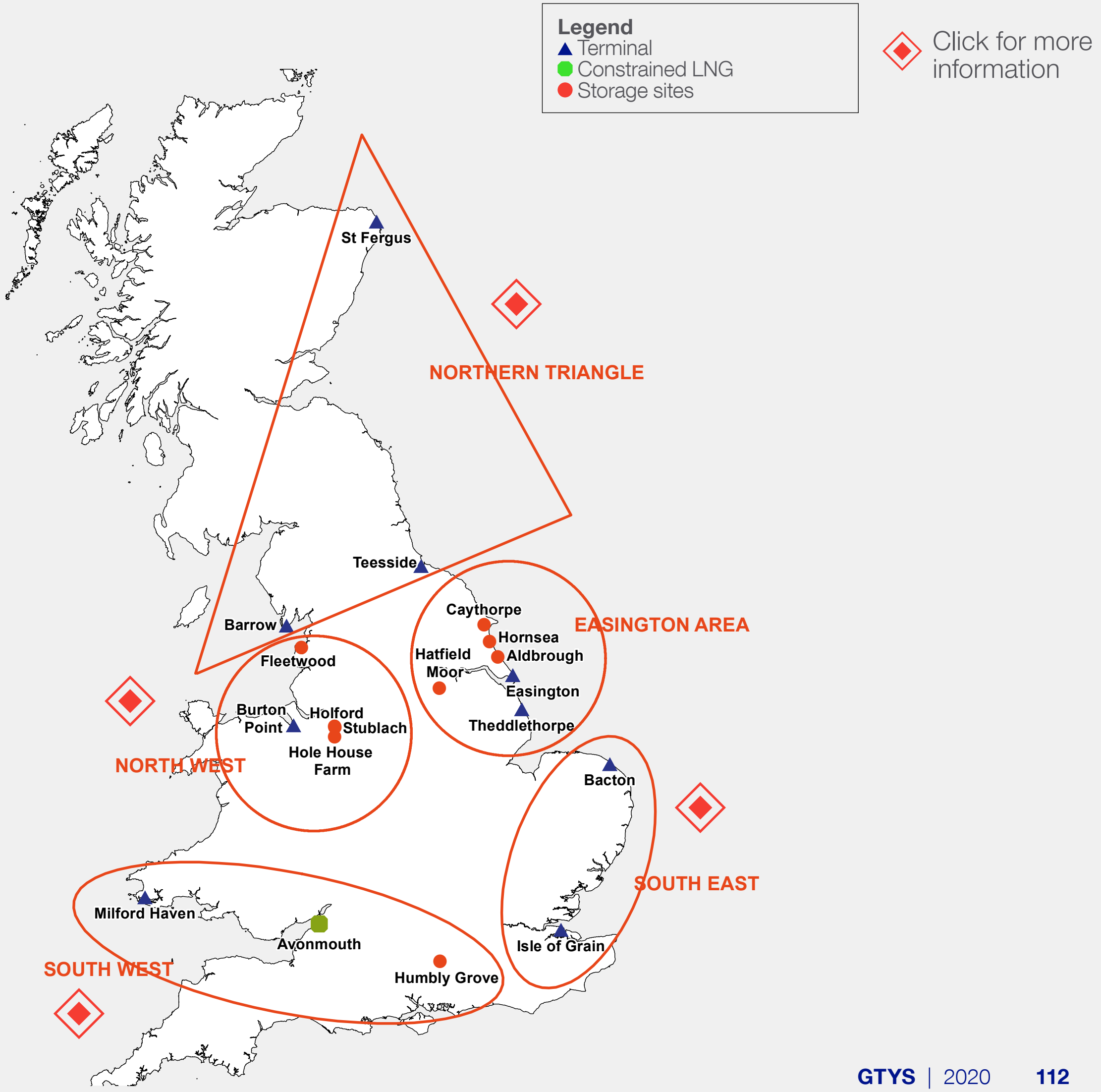
Appendix 6 – Exit and entry capacity application process

6.2 Entry capacity on the NTS

Figure A6.16 provides further information on the available and potential for entry capacity within the NTS entry zones.

While all unbooked capacity can be considered for entry capacity substitution, future bookings may change and the gap between the scenario peak flow data and the obligated capacity level may be a better indication of the capacity available for substitution. Using this indicator, significant capacity for substitution exists at St Fergus and Theddlethorpe.

Figure A6.16
NTS entry capacity by zone



Appendix 7
Conversion matrix

To convert from the units on the left-hand side to the units across the top, multiply by the values in the table.

Table A7.1
Conversation matrix

	KWh	GWh	mcm	Million therms	Thousand toe
GWh	1,000,000	1	0.091	0.034	0.086
mcm	11,000,000	11	1	0.375	0.946
Million therms	29,307,000	29.307	2.664	1	2.520
Thousand toe	11,630,000	11.63	1.057	0.397	1
KWh	1	0.000001	0.000000091	0.000000034	0.000000086

Note:
All volume to energy conversions assume a calorific value (CV) of 39.6 MJ/m^3.
GWh = Gigawatt hours
mcm = Million cubic metres
Thousand toe = Thousand tonne of oil equivalent
MJ/m^3 = One million joules per metres cubed
KWh = Kilowatt hours

Appendix 8 – Import and storage infrastructure

8.1 Import infrastructure

Great Britain is served through a diverse set of import routes from Norway, the Netherlands, Belgium and from other international sources through the LNG import terminals. Total import capacity is currently around 149 bcm/year, split into three near equal parts: Continental Europe (43 bcm/year), Norway (56 bcm/year)* and LNG (49 bcm/year).

Table A8.1 shows existing import infrastructure and table A8.2 shows proposals for further import projects.

Table A8.1
Existing import infrastructure

Facility	Operator/ developer	Type	Location	Capacity (bcm/year)
Interconnector	IUK	Pipeline	Bacton	26.9
BBL Pipeline	BBL Company	Pipeline	Bacton	16.4
Isle of Grain 1-3	National Grid	LNG	Kent	20.4
South Hook 1-2	Qatar Petroleum and ExxonMobil	LNG	Milford Haven	21
Dragon 1	Shell / Petronas	LNG	Milford Haven	9.4
Langeled	Gassco	Pipeline	Easington	26.3
Vesterled	Gassco	Pipeline	St Fergus	14.2
Tampen	Gassco	Pipeline	St Fergus	9.9
Gjoa	Gassco	Pipeline	St Fergus	6.2
			Total	**150.7**

Source: National Grid
* Norwegian import capacity through Tampen and Gjoa is limited by available capacity in the UK FLAGS pipeline.

Table A8.2
Proposed import infrastructure**

Project	Operator/ Developer	Type	Location	Start-up	Capacity (bcm/ year)	Status
Isle of Grain 4	National Grid	LNG	Kent	~	~	Open Season

Source: National Grid
** This list is in no way exhaustive; other import projects have at times been detailed in the press.

Appendix 8 – Import and storage infrastructure

8.2 Storage infrastructure

In the last 12 months, no proposals have attained Final Investment Decision (FID) for subsequent construction. The following tables detail UK storage in terms of existing storage sites, those under construction and proposed sites.

Table A8.3
Storage sites

Site	Operator/ Developer	Location	Space (bcm)	Approximate max delivery (mcm/d)
Aldborough	SSE/Statoil	East Yorkshire	0.32	31.1
Hatfield Moor	Scottish Power	South Yorkshire	0.12	1.8
Holehouse Farm*	EDF Trading	Cheshire	0.02	0
Holford	Uniper	Cheshire	0.22	32.2
Hornsea	SSE	East Yorkshire	0.3	11.7
Humbly Grove	Humbly Grove Energy	Hampshire	0.29	7.3
Hill Top Farm	EDF Energy	Cheshire	0.06	14
Stublach	Storenergy	Cheshire	0.4	30
		Total	**1.73**	**128.2**

Source: National Grid

It is important to note that due to operational considerations, the space and deliverability may not be consistent with that used for operational planning as reported in the 2020/21 *Winter Outlook* report.

The economics, particularly the winter to summer spread, are very challenging for the development of new storage sites. Nevertheless, many new storage sites have been proposed over the past ten years and there are currently plans for nearly 9 bcm of space, both for medium-range fast-cycle facilities and long-range seasonal storage.

Appendix 8 – Import and storage infrastructure

8.2 Storage infrastructure

Table A8.4
Proposed storage projects*

Project	Operator/ Developer	Location	Space (bcm)	Status
Gateway	Stag Energy	Offshore Morecambe Bay	1.5	Planning granted, no FID
Deborah	Eni	Offshore Bacton	4.6	Planning granted, no FID
Islandmagee	InfrasStrata	County Antrim, Northern Ireland	0.5	Planning granted, no FID
King Street	King Street Energy	Cheshire	0.3	Planning granted, no FID
Preesall	Halite Energy	Lancashire	0.6	Planning granted, no FID
Saltfleetby	Wingaz	Lincolnshire	0.8	Planning granted, no FID
Whitehill	E.ON	East Yorkshire	0.4	Planning granted, no FID
		Total	**8.7**	

Source: National Grid
* This list is in no way exhaustive; other storage projects at times have been detailed in the press.

Please note that tables A8.1, A8.2, A8.3 and A8.4 represent the latest publicly available information to National Grid at the time the *GTYS* went to press. Developers are welcome to contact us to assess or revise this data.

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