Gas
Transmission

Gas Ten Year Statement 2018

nationalgrid

How to use this interactive document

To help you find the information you need quickly and easily we have published the *Gas Ten Year Statement* as an interactive document.

Home button

This will take you to the contents page. You can click on the titles to navigate to a section.

A to Z

You will find a link to the glossary on each page.

Arrows

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

Hyperlinks

Hyperlinks are highlighted in **bold text and underlined** or located in the footnotes throughout the report. You can click on them to access further information.

Contents

Foreword

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 *2018 Gas Ten Year Statement*, along with our other System Operator publications, aims to encourage and inform debate, leading to changes that ensure a secure, sustainable and affordable energy future.

GTYS 2018 continues to be an important part of how we engage with you to understand the drivers of change influencing your business. This allows us to continue to develop the National Transmission System and market framework in line with your needs.

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 Great Britain's evolving and dynamic gas market on system operations and planning into the future.

Our latest *Future Energy Scenarios* further emphasises the importance of gas in Great Britain's energy mix. Gas continues to play a key role providing flexible generation to enable the growth of renewable sources of generation; and providing top-up heating in the longer term. It is fundamentally important that we continue to enhance our approach to how we foresee the network evolving to ensure we have the tools and capability in place ahead of the need.

I hope you find this document useful, along with our other System Operator publications. Please share your views with us. You can find details of how to contact us on our website **http://www.nationalgrid.com/gtys**

Andy Malins

Andy Malins
Head of Gas Operations

Executive summary

Overview

The *2018 Gas Ten Year Statement (GTYS)* provides an update on the current and future challenges which impact the way we plan and operate the National Transmission System (NTS). In addition, the *GTYS* outlines what we are doing to address them as the System Operator (SO) and Transmission Owner (TO).

Three themes continue to be a priority for us; customer requirements, legislative change and asset health. This year's publication will again focus on these against the backdrop of the current Future Energy Scenarios.

In partnership with the *GTYS*, National Grid publishes *Gas Future Operability Planning (GFOP)* documents. These describe how changing customer requirements may affect the future operability of the NTS out to 2050. The *GFOP* is published quarterly. For more information on the *GFOP*, visit **nationalgrid.com/gfop**.

Continuing with the format used for last year's document, *GTYS* 2018 is presented across the following sections (see Figure 0.1) with the aforementioned themes of customer requirements, Future Energy Scenarios, legislative change, and asset health bridging the central three chapters of System Capability, System Operation and System Development.

Gas Ten Year Statement
November 2018

How we will plan and operate the gas network, with a ten-year view.

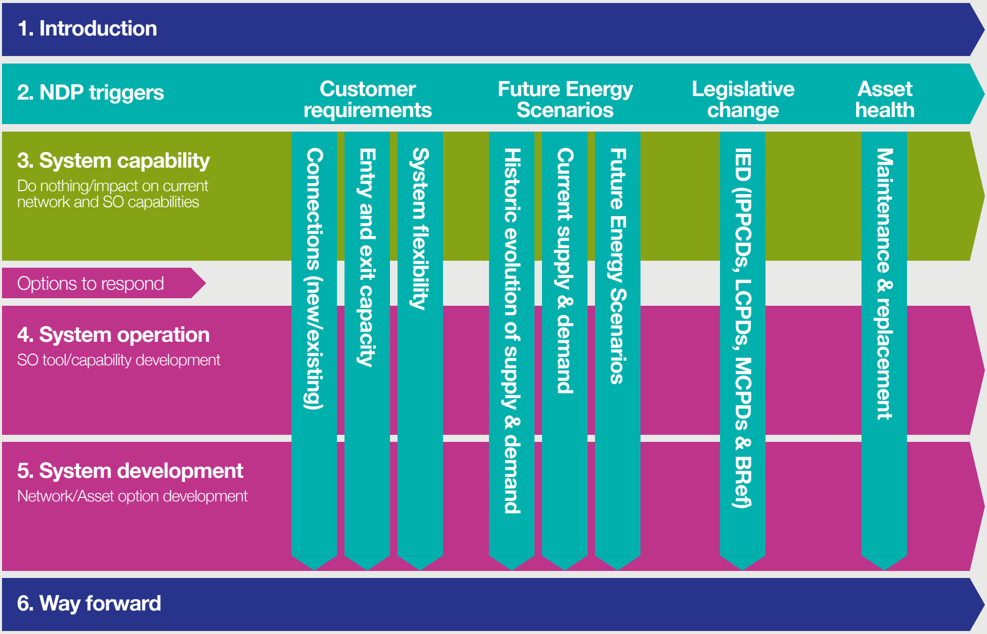
Future Energy Scenarios
July 2018

A range of plausible and credible pathways for the future of energy from today out to 2050.

Gas Future Operability Planning
Quarterly

How the changing energy landscape will impact the operability of the gas system.

Figure 0.1
GTYS 2018 structure



Key messages

Changing energy landscape – the pattern of gas supply in Great Britain has changed dramatically in the past 15 years. We have gone from being self-sufficient in 2000 to now being dependent on imported gas for around half our needs. We expect a similar change looking forward as UK Continental Shelf (UKCS) supplies continue to decline. Additionally, growing renewable generation will lead to gas fired generation being increasingly called on to provide flexibility to support intermittent supply.

These changes in gas supply and demand will create new operability challenges. We discuss these further in our suite of *GFOP* documents.

Impact of changing customer requirements – increasing interest from non-traditional gas customers in utilising the NTS supported the successful instigation of Project CLoCC (Customer Low Cost Connections), a Network Innovation Competition project which has developed a new online gas customer connections portal, created a suite of standardised connection designs and optimised commercial arrangements to offer more flexibility to our changing customer base.

The project closed on 29 October 2018 by handing over its outputs to the National Grid business for review and implementation.

A highlight of the project was onboarding a pilot customer to support with broadening testing of the project outputs to date, this opportunity has also provided valuable proof of concept information prior to project completion. Somerset Farm, when connected, will be the first time a biomethane producer will connect to the high-pressure NTS.

Asset operation on the NTS – during 2017/18 we had finalised a new Network Output Measures (NOMs) methodology with Ofgem and key stakeholders. Based around a monetised risk approach, this new methodology will significantly improve our ability to assess network risk and prioritise network investment.

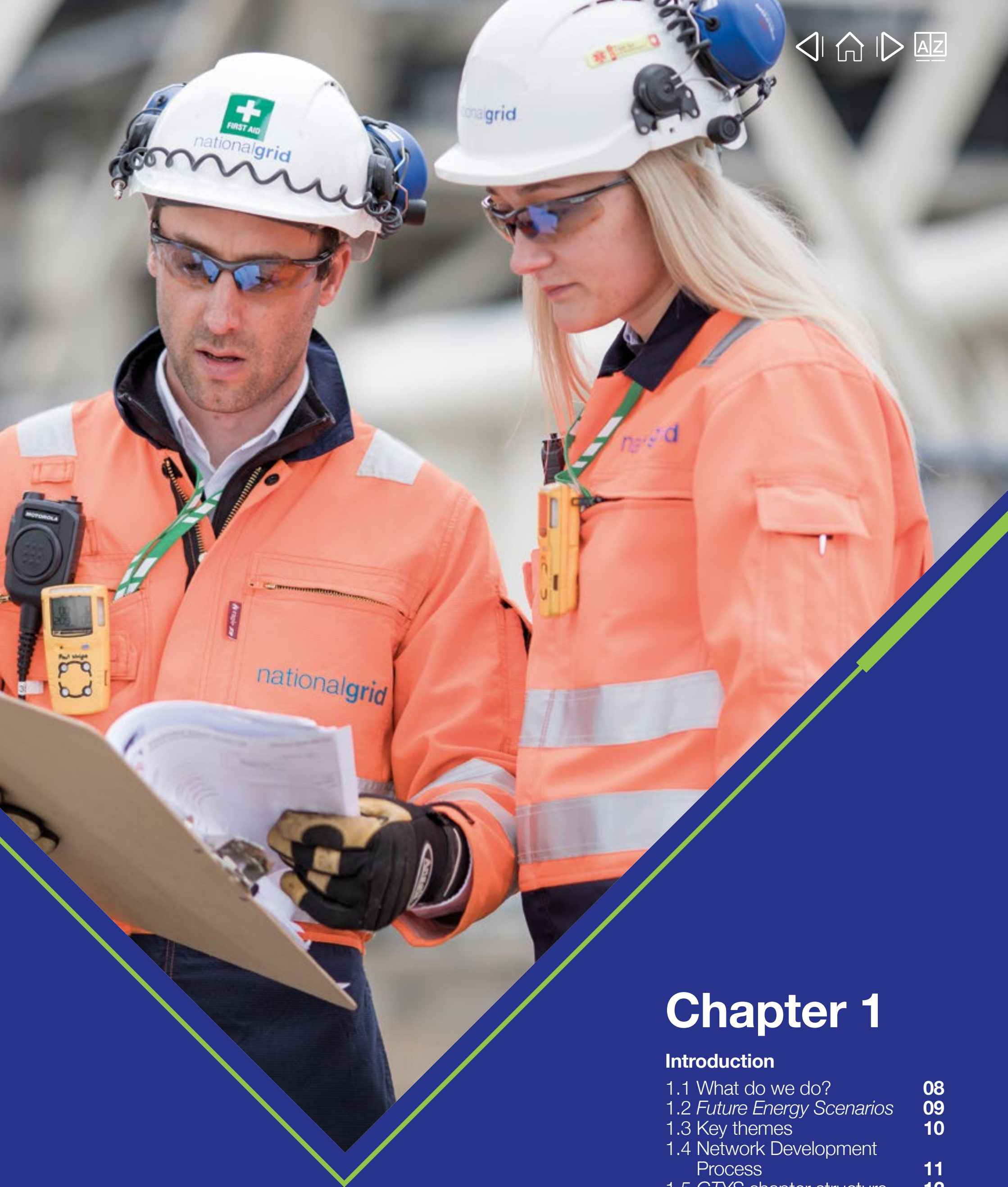
The introduction of the Industrial Emissions Directives (IED) restricts the use of 16 of our 64 compressor units on the NTS. The Medium Combustion Plant Directive (MCPD) was transposed into UK legislation in December 2017 and it impacts 41 compressor units.

Future *GTYS* editions and feedback

We are always keen to hear your comments to help shape the structure and content of future *Gas Ten Year Statements*. We also seek your views on the following areas of our gas transmission business:

- Asset health
- Gas Planning Standards
- Industrial Emissions Directive
- Network Development Policy.

If you have any feedback to help us shape *GTYS* 2019, please email us at **Box.SystemOperator.GTYS@nationalgrid.com**



Chapter 1

Introduction

Introduction

Welcome to our *2018 Gas Ten Year Statement (GTYS)*. We write the *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.

We update you on current and future challenges which impact the way we plan and operate the NTS. We also discuss what we're doing to address them as SO and TO.

GTYS is published at the end of the annual planning cycle. We use *GTYS* to provide information on an annual basis to help you to identify connection and capacity opportunities on the NTS. We summarise key projects, changes to our internal processes that may impact you, and other key publications which provide further information on our SO activities. We are keen to engage with you to get your feedback on what we're doing and how we're doing it.

1.1 What do we do?

Our role

We are the SO and TO 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.

As TO we must make sure all of our assets on the NTS are fit for purpose and safe to operate. We develop and implement 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 facilitation of a competitive gas market. We have a network of 7,600 km of pipelines, presently operated at pressures of up to 94 bar, which transports gas from coastal terminals and storage facilities to exit offtake points from the system (see Appendix 1 for NTS maps). At the exit offtake points, gas is transferred to eight 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 (pipelines to other countries).

Our regulatory framework

The RIIO (Revenue = Incentives + Innovation + Outputs) regulatory framework was implemented by Ofgem in 2013/14. RIIO uses incentives to drive innovation to develop and deliver more sustainable energy. We are currently within the RIIO-T1 period (2013–21); under this framework we have set outputs which have been agreed with our stakeholders (for more information, please see Our Performance publication[1]). We deliver these outputs in return for an agreed revenue allowance from Ofgem.

[1] http://talkingnetworkstx.com/general-performance.aspx

1.2 *Future Energy Scenarios*

We produce *FES* each year to identify a range of credible scenarios for the next 30 years and beyond. These consider how much energy we might need and where it could come from. They look at what the changes might mean for the industry and for its customers.

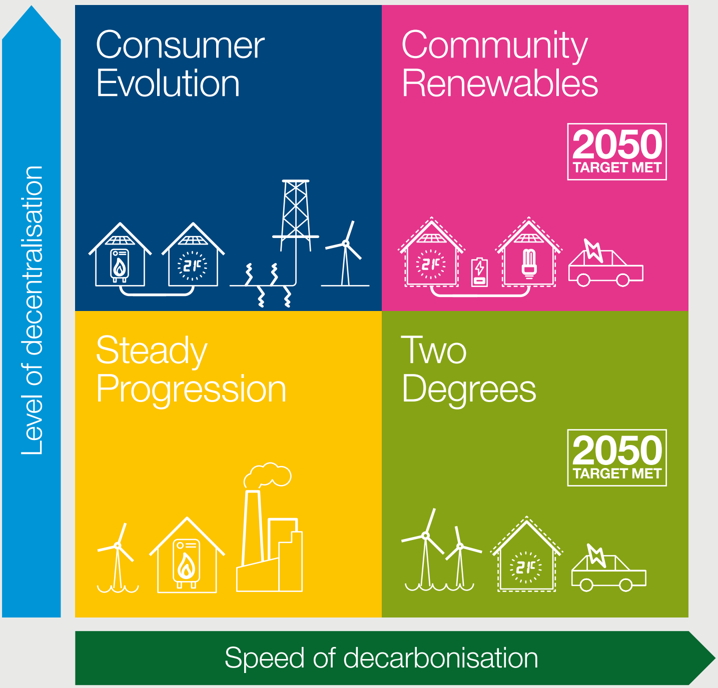
This year, as a result of our analysis and following discussions with our stakeholders, we have updated the framework that we use for creating our scenarios. We have developed four scenarios based on speed of decarbonisation and level of decentralisation, shown in Figure 1.1.

The speed of decarbonisation axis is driven by policy, economics and consumer attitudes. All scenarios show progress from today towards decarbonisation, with the two scenarios on the right meeting the target of 80 percent reduction in greenhouse gas emissions from 1990 levels by 2050.

The level of decentralisation axis indicates how close the production and management of energy is to the end consumer. This is more evident when considering electricity but is still applicable to gas. In the two scenarios with greater decentralisation there is more development of gas sources that connect to the distribution networks rather than to the NTS.

FES is the starting point for our regulated long-term investment and operability planning. You can find more detail on our *FES* website[2].

Figure 1.1
The *FES* 2018 scenario matrix



[2] http://fes.nationalgrid.com/

1.3 Key themes

Three key themes continue to be a priority for us over the next ten years:

- Customer requirements
- Legislative change
- Asset health.

This year's *GTYS* focuses on these key themes and outlines what impact they will have on how we operate and develop our network.

Customer requirements

Customer behaviour is continually changing. Often it's not a case of one customer but the combined impact of multiple changing customer behaviours occurring at the same time. This makes it ever more challenging to plan and operate the system. The NTS has to be able to respond in a more dynamic way; we call it system (or network) flexibility.

The importance of understanding our customer's requirements is discussed in more detail in Chapters 2, 3 and 4. In Chapter 4, we have outlined how we're developing our internal systems to better manage within-day customer requirements.

Legislative change

Legislative change has a big impact on how we plan and operate our network. We have outlined the key elements of the Industrial Emissions Directive (IED) and how our network could be affected.

We discuss the impact of legislative change in Chapters 2, 3, 4 and 5.

Asset health

The NTS comprises 7,600 km of pipeline, 24 compressor sites with 75 compressor units, 20 control valves and 530 above-ground installations (AGIs).

It's 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 the system, including many that are ageing, we have a growing asset health issue. An ageing network needs more maintenance but we have to balance this with the changing needs on our network.

The impact of asset health on our network is covered in Chapters 2 and 5.

1.4 Network Development Process

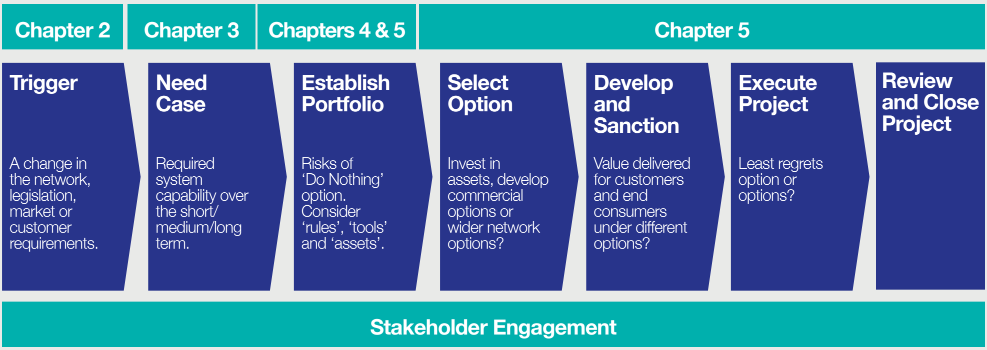
In this year's *GTYS* we have continued with a structure that makes our investment decision process more transparent, with the document outlining the initial stages of our Network Development Process (NDP).

The NDP defines the method for decision making, optioneering, development, sanction, delivery and closure for all our projects (see Figure 1.2).

The goal is to deliver projects that have the lowest whole-life cost, are fit for purpose and meet stakeholder and RIIO requirements.

In *GTYS* we focus on the first three stages of the NDP (Trigger, Need Case and Establish Portfolio) as these outline our internal decision-making process. The final three stages relate to physical asset build and non-physical solutions such as commercial options. These are briefly discussed in Chapter 5.

Figure 1.2
The Network Development Process

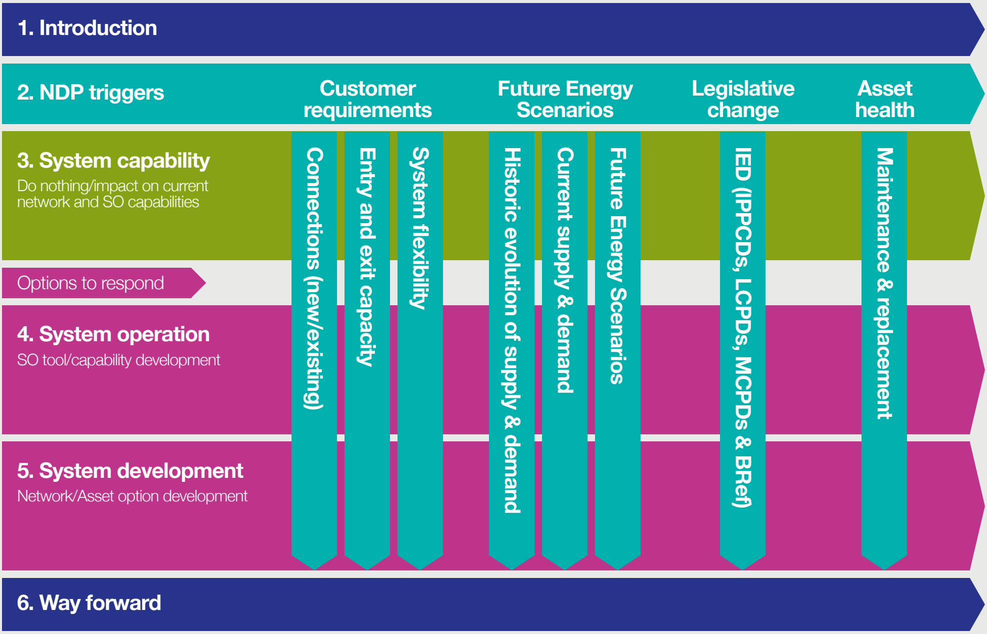


1.5 *GTYS* chapter structure

The chapter structure provided in Figure 1.3 gives you a clearer overview of what happens at each stage of the NDP and how the stages link together to provide the most robust, cost-effective solution(s).

Along with our Future Energy Scenarios the impact of the three key themes are discussed throughout this year's *GTYS*.

Figure 1.3
GTYS 2018 structure



Chapter 2. Network Development Process triggers

This chapter covers four key triggers: customer requirements, the Future Energy Scenarios, legislation and asset health. We discuss these triggers and how they impact the current and future use of the NTS.

There are many inputs that 'trigger' our NDP. For every trigger we assess the needs of our network to ensure it remains fit for purpose. We're in a period of great change. This may result in significant modifications to the way we currently plan and operate the NTS. We anticipate that we will have a wider range of triggers to our NDP in future.

Chapter 3. System capability

This chapter explores the Need Case stage of our NDP. This is where we assess our system capability requirements.

System capability defines the maximum and minimum ability of our current network infrastructure to transport gas safely and effectively. We provide information about entry and exit capacity, pressures, and the impact of the IED.

Chapter 4. System operation

This chapter explores part of the 'Establish Portfolio' stage of our NDP, specifically with our non-asset solutions.

We develop a portfolio of non-asset and asset solutions to meet the Need Case requirements. We detail the specific ongoing and planned developments to our SO capabilities (rules and tools). These developments make sure that we can keep planning to operate a fit-for-purpose network safely and efficiently, to deliver value for our customers and stakeholders.

Chapter 5. System development

This chapter explores the final part of the 'Establish Portfolio' stage of our NDP, specifically with our asset solutions.

We set out our NTS reinforcement projects that have been sanctioned, projects under construction in 2018/19 and potential investment options for later years as a result of the IED. It also covers our asset health review.

Chapter 6. Way forward

We're committed to meeting your needs and want you to help shape our *GTYS* and NDP. This chapter discusses our plans over the coming year and tells you how you can get involved.

1.6 *Gas Future Operability Planning*

We publish *GFOP* documents to provide a clearer focus on how your changing needs may impact the future operability of the NTS. The *GFOP* acts as a clear vehicle in which all participants can assess future gas transmission network needs and operational challenges. It may trigger a change in the way we respond to you and other market signals, leading to modifications in our decision-making and operational processes to ensure we continue to maintain a resilient, safe and secure NTS now and into the future.

We need to work with all interested parties to make sure that the right commercial options (rules), operational arrangements (tools) and physical investments (assets) are considered across the NTS. Any resulting impacts and changes will be documented in the *GTYS*.

We have made significant changes to our document length, frequency of publication, website interface and method of engagement. You can find out more information in chapter 2. To view the *GFOP* visit: **nationalgrid.com/gfop**.

1.7 Our key SO publications

Figure 1.4
Our SO publications

Network Options Assessment
January 2018

The options available to meet reinforcement requirements on the electricity system.

Winter Outlook Report
October 2018

Our view of the gas and electricity systems for the winter ahead.

Summer Outlook Report
April 2018

Our view of the gas and electricity systems for the summer ahead.

Electricity Ten Year Statement
November 2018

The likely future transmission requirements on the electricity system.

System Needs and Product Strategy
April 2018

Our view of future electricity system needs and potential improvements to balancing services markets.

Gas Ten Year Statement
November 2018

How we will plan and operate the gas network, with a ten-year view.

Winter Review and Consultation
June 2018

A review of last winter's forecasts versus actuals and an opportunity to share your views on the winter ahead.

Gas Future Operability Planning
Quarterly

How the changing energy landscape will impact the operability of the gas system.

Future Energy Scenarios
July 2018

A range of plausible and credible pathways for the future of energy from today out to 2050.

System Operability Framework

How the changing energy landscape will impact the operability of the electricity system.

1.8 *GTYS* document suite

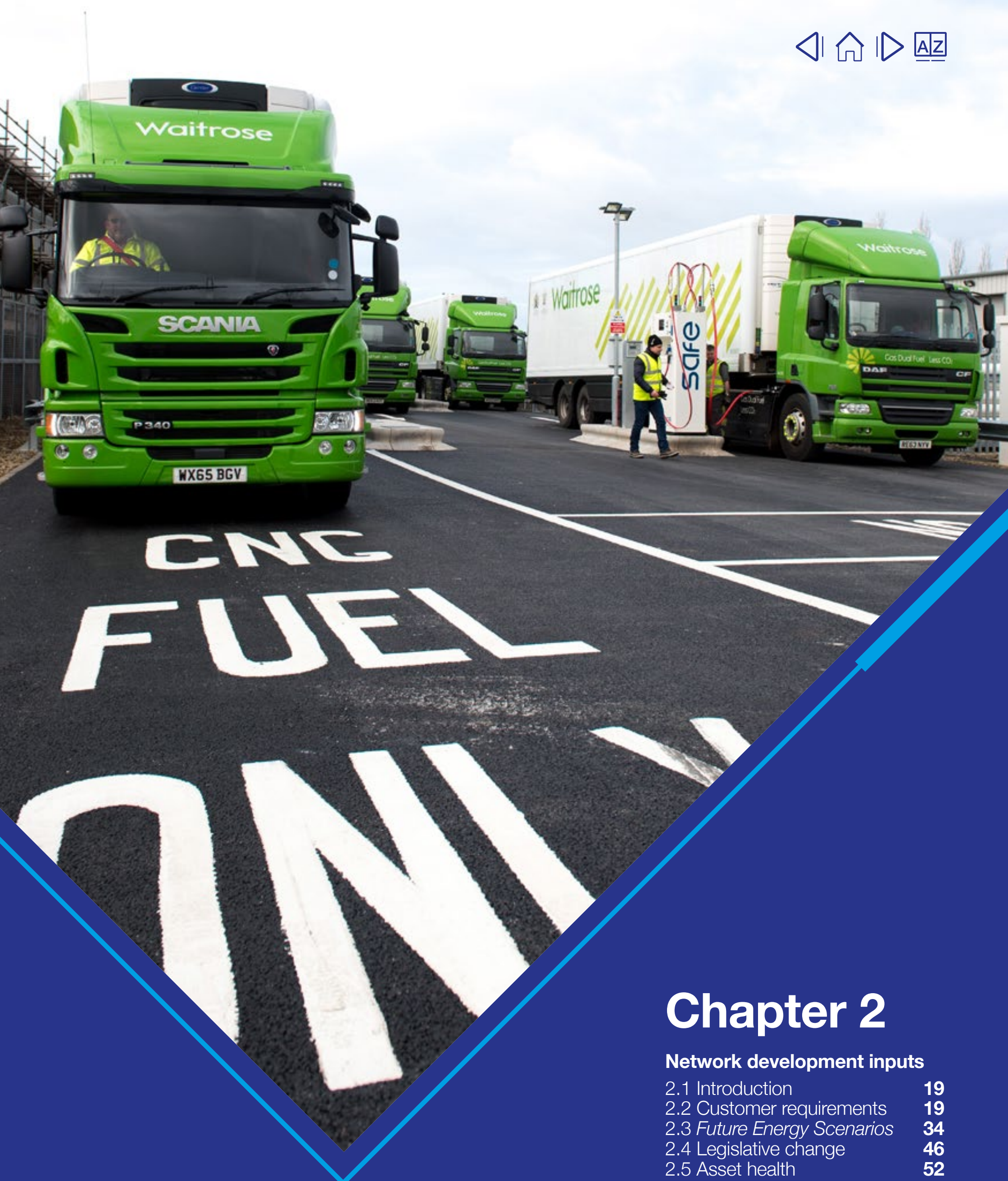
As part of the *GTYS* publication we produce a huge amount of analysis and data. For ease of use we have not included all of this data in the main *GTYS* document.

Our Charts and Tables Workbook contains the following:

- All graphs and tables contained in *GTYS* 2018
- Actual demand for 2017 (TWh)
- Peak day, maximum and minimum physical NTS entry flows for Gas Year 2017/18
- Peak day, maximum and minimum physical NTS exit flows for Gas Year 2017/18
- 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 & annual supply by terminal out to 2050.

To view our workbook and for more information visit: **http://www.nationalgrid.com/gtys**

We'd love to hear your views on the content and structure of the *GTYS* 2018. If you'd like to get in touch, please email us at **Box.SystemOperator.GTYS@nationalgrid.com**



Chapter 2

Network development inputs

Network development inputs

Several inputs trigger our Network Development Process (NDP). In this year's *GTYS* we focus on four triggers: customer requirements, Future Energy Scenarios, legislative change and asset health. We respond to these particular triggers because they affect network requirements and future system operability.

Key insights

Customer requirements

- We are seeing more connections to the NTS that were not viable or foreseen in the past due to the changes in the energy landscape, such as an increase in new types of non-traditional gas connection request, for example shale and biomethane entry connections and natural gas-powered vehicle refuelling stations exit connections.
- Project CLoCC (Customer Low Cost Connections) has developed the full end-to-end process to minimise the time and cost to connect to the NTS, allowing any potential connection party (a new generation of gas customers) to be fully engaged in all stages of the connection process. The project closed on 29 October 2018 and delivered its innovation outputs to the National Grid business for implementation. This innovation programme was in clear response to previous stakeholder concerns about connection timescales and costs.
- The Planning and Advanced Reservation of Capacity Agreement (PARCA) arrangements are in place. Customers can use them to reserve capacity before making final investment decisions in their projects. This reserved NTS capacity will be exclusive to PARCA applicants.

Future Energy Scenarios

- All scenarios show progress from today towards decarbonisation, with **Community Renewables** and **Two Degrees** meeting the target of 80% reduction in greenhouse gas emissions from 1990 levels by 2050.
- Import dependency has grown considerably since the early 2000s and reaches 83% in 2035.
- Peak supply capacity exceeds peak demand.
- Gas peak day demand generally mirrors the movement of annual gas demand in each scenario, but the declines are not as sharp. Gas is still required to support electricity generation when intermittent generation is producing less.

Legislative change

- The Industrial Emissions Directive (IED) was introduced in January 2013 combining the Integrated Pollution Prevention and Control Directive (IPPCD), and Large Combustion Plant Directive (LCPD).
- The IPPCD affects 23 of our 24 compressor sites.
- LCPD affects 16 of our 64 gas turbine driven compressor units.
- The Medium Combustion Plant Directive (MCPD) legislation was transposed into UK legislation in December 2017. Based on the requirements, a total of 41 units will be impacted.
- EU rules and regulations will continue to apply in the UK until the UK is no longer a member of the EU. The date for EU exit is 29 March 2019 at 11.00pm. We anticipate a suite of Statutory Instruments will be laid before Parliament to translate EU network codes and other relevant EU regulations directly into UK legislation in time for EU exit.
- We are engaging with the UK Government, Ofgem and other affected gas Transmission System Operators (TSOs) to understand and minimise the impact of EU exit on the operation of the Great Britain gas market and the UK's interconnections with neighbouring EU gas markets.

Asset health

- Over 70% of our network will be beyond its original life expectancy of 40 years by the end of RIIO-T1.
- Over the RIIO-T1 period, we are planning to invest a total of £672m to maintain the health of our assets and to continue to deliver a safe and reliable network for our customers.
- During 2017/18 we have been improving our asset management capability through investment in processes, data and technology systems, by developing a monetised risk based approach to the planning and targeting of investments and reporting the outcomes to Ofgem. This takes the form of the new Network Output Measures methodology with Ofgem and key stakeholders.

2.1 Introduction

As we outlined in Chapter 1, our NDP defines our decision making, optioneering and project development processes for all projects. Certain triggers initiate the NDP. Three key triggers have emerged from our NDP work:

- customer requirements
- legislative change and
- asset health.

The Future Energy Scenarios also influence the NDP.

These triggers are interlinked so a change in one trigger will affect another (see Figure 2.1), such as the changes to emissions legislation. This has resulted in generators closing or reducing their use of coal plants leading to increased combined cycle gas turbine (CCGT) plant usage. This has changed the supply and demand patterns on the network, which feeds into our Future Energy Scenarios.

This chapter describes how each of the above can trigger an NDP.

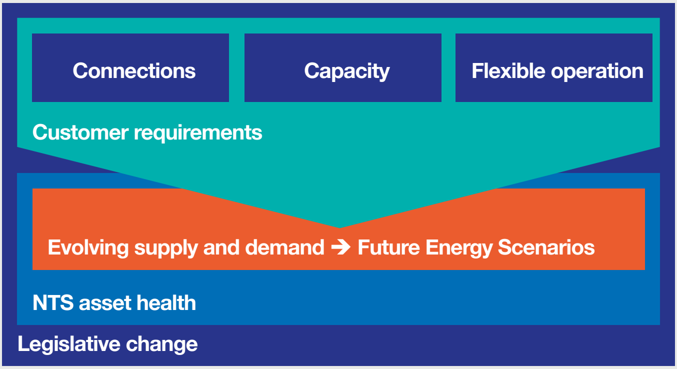
2.2 Customer requirements

The connection and capacity processes initiated by our customers trigger our NDP. We need to assess what impact a connection (new or modified) or a capacity change (supply or demand increase/decrease) 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. In addition we can reserve capacity for you; however, you must be aware that a Shipper must buy and hold your capacity.

We can only enter into transportation arrangements with Shippers and Gas Distribution Network Operators (DNO). Our Gas Transporters Licence stipulates that capacity can only be made available to these parties.

Figure 2.1
Key NDP triggers



2.2.1 Our connection and capacity application processes

We have produced a high-level overview of our connection and capacity application processes in Table 2.1. We have included chapter and section numbers to help you to navigate to the relevant section of this year's *GTYS*.

Table 2.1
Our connection and capacity application process

	Our connection and capacity processes				
	Our customers and their key service requirements	**Find more information in *GTYS* go to:**	**Gas Shipper** (signatory to the Uniform Network Code (UNC) Capacity Rights to flow gas onto the system (short, medium, long term)	**Distribution network (DN)** (signatory to the UNC) B4:B9 Rights to offtake gas from the system	**Customers** New site Developers (that are not signatory to the UNC) and/or currently connected customers. Both new and currently connected customers have Capacity Rights to flow gas onto and offtake gas from the system
Connections	Application to offer (A2O) includes physical pipeline connections to the NTS (if required) for new connections, modifications and diversions	Chapter 2 – Sections 2.2.2, Appendix 2	✗	✓	✓
	Physical Disconnection/ Decommissioning follow the application to offer (A2O) process. Disconnection from the NTS covers the creation of a physical air gap and the removal of all assets	Chapter 2 – Section 2.2	✗	✓	✓
Entry and exit capacity	Quarterly System Entry Capacity (QSEC – Gas Years y+2 to y+17) Auctions	Chapter 2 – Section 2.2.3	✓	✗	✗
	Exit Application Windows (unsold within baseline capacity – Gas Years y+1 to y+3)	Chapter 2 – Section 2.2.4, Appendix 2	✓	✓	✗
	Exit Application Window (Enduring Annual – Gas Years y+4 to y+6 – Evergreen Rights) & (Adhoc – m+6 – Evergreen Rights) Enduring annual NTS exit capacity	Chapter 2 – Section 2.2.4, Appendix 2	✓	✓	✗
	Flexible capacity for flow changes	Chapter 2 – Sections 2.2.3, 2.2.4, Appendix 2	✗	✓	✗
	Entry/Exit Planning and Advanced Reservation of Capacity Agreement (PARCA – reserve unsold/ additional capacity & allocation)	Chapter 2 – Section 2.2.6 – 2.2.7, Appendix 2	✓	✓	✓
CAM incremental	Incremental entry/exit capacity trigger process for Interconnection Points (IPs). This process follows the principles of PARCA.	Chapter 2 – Section 2.2.8	✓	✗	✓

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 (see Section 2.2.2). Our connection (A2O) and capacity processes (Planning and Advanced Reservation of Capacity Agreement – PARCA) are separate.

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 (see Section 2.2.6 for more detail).

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 any works we need to complete with our customers' projects.

If you have any queries about our connections or capacity processes please contact the gas customer team directly (see Appendix 3 for our contact details).

2.2.2 Connecting to our network

We offer four types of connection to the NTS as well as modifications to existing NTS connections[1]. To connect your facility to the NTS you will need to initiate the A2O process. You can either have other parties build the facility's connection or have the connection adopted by the host Gas Transporter (depending upon their circumstances).

You can then pass the connecting assets on to a chosen SO/transporter, or retain ownership yourselves.

Table 2.2 summarises the five different NTS gas connections that are currently available and the process of disconnecting and decommissioning.

[1] https://www.nationalgrid.com/uk/gas/industrial-connections

Table 2.2
Our connection and capacity application process

NTS gas connections categories	
Entry connections	Connections to delivery facilities processing gas from gas-producing fields or Liquefied Natural Gas (LNG) vapourisation (importer) facilities, 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). There are several types of connected system including: – a pipeline system operated by another Gas Transporter – a pipeline operated by a party that is not a Gas Transporter, for transporting gas to premises consuming more than 2,196 MWh per annum.
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 be for supply of gas from and/or delivery of 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.

If you need to make a change to the connection arrangement (e.g. request an increase in gas supply) this request will be considered using the same approach as a new NTS connection.

Customer connections – application to offer (A2O)

The Uniform Network Code (UNC)[2] provides a robust and transparent framework for new customer connections and modifications to an existing connection.

The UNC provides:
- a formal connection application template for customers to complete
- 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:
  – Initial connection offer – up to two months
  – Full connection offer – up to six months (Non–Standard Design minor, Non–Standard Design simple, and Standard Design) or nine months (Non Standard Design medium and Non Standard Design complex)
- timescales for customers to accept initial/full connection offer (up to three months)
- application fees for an initial connection offer and full connection offer
- a requirement for National Grid to review the application fees on an annual basis.

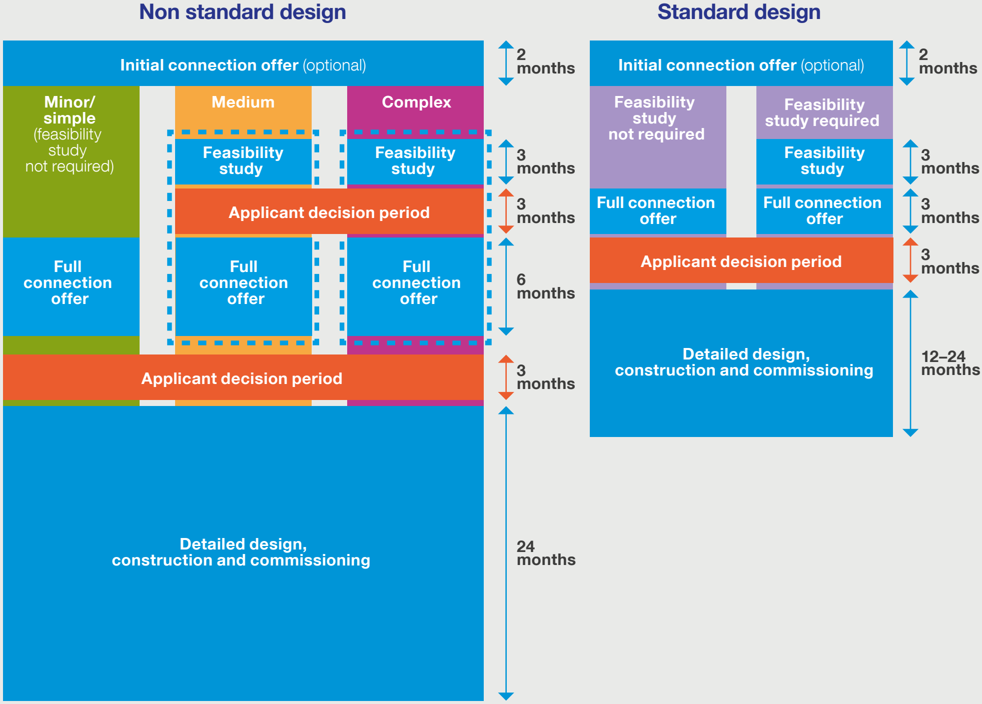
The NTS connection application form and more information on the A2O connections process can be found on our website[3].

[2] http://www.gasgovernance.co.uk/UNC

[3] https://www.nationalgrid.com/uk/gas/industrial-connections/applying-connection

Figure 2.2 summarises the A2O process and the timescales associated with each stage.

Figure 2.2
Application to offer (A2O) process



The build phase will be different for each project due to site specific requirements. For further details please see **https://www.nationalgridgas.com/connections/applying-connection**

Connection application charges

Our charging policy for all customer connections is set out in the publication The Statement and Methodology for Gas Transmission Connection Charging[4] which complies with Licence Condition 4B[5].

When you connect to the NTS, the connection costs are calculated based on the time and materials used to undertake the activity. For a Minimum Offtake Connection (MOC) at a greenfield site, the cost of the connection is generally around £1-2m and can take between one and three years to deliver, depending upon the project. The costs and timescales for more complex connections can be significantly higher than those for a MOC.

Connecting pipelines

If you want to lay your own connecting pipeline from the NTS to your facility, ownership of the pipe will remain with you. This is our preferred approach for connecting pipelines.

The Statement and Methodology for Gas Transmission Connection Charging describes other options for the installation and ownership of connecting pipelines. For all options, the connecting party is responsible for the costs of the pipeline.

Connection pressures

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

- **Standard Offtake Pressures as defined in the UNC** – A minimum pressure of 25 barg of gas will be made available at NTS supply meter point offtakes. For NTS/Local Distribution Zone (LDZ) offtakes see Assured Offtake Pressures.
- **Assured Offtake Pressures (AOP) as defined in the UNC** – These are minimum pressures required to maintain security of supply to our DN customers. A significant number of these assured pressures are set at 38 barg, the anticipated minimum pressure in most sections of the NTS under normal operating conditions.
- **Anticipated Normal Operating Pressures (ANOP)** – These are advisory pressures and indicate to our directly connected customers the minimum pressure likely to be available on the NTS in their connection area under normal operation. If our capability analysis shows an increasing likelihood that these pressures will not be met under normal operation, the customer will be notified of revised ANOPs with at least 36 months' notice.
- **Maximum Operating Pressure (MOP)** – This is the maximum pressure that each section of the NTS can operate at and is relevant to connected NTS exit and NTS entry point/terminals.

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.

[4] https://www.nationalgrid.com/uk/gas/industrial-connections/applying-connection

[5] https://epr.ofgem.gov.uk//Content/Documents/Gas_transporter_SLCs_consolidated%20-%20Current%20Version.pdf

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 (the rate at which the offtake of gas can be increased) 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 are typically defined as the number of hours' notice for increases of up to 25%, up to 50% and greater than 50% of maximum offtake rate. These notice periods are required to ensure that pressures can be maintained at times of system stress including high demand. 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[6].

Connections and capacity

The Gas Act 1986 (as amended 1995) states that 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 (see Section 2.2.6) was designed to encourage Developers to approach us at the initial stages of their project. This new process allows alignment between both the Developer's project timeline and any reinforcement works required on the NTS to accept or deliver capacity.

Evolving our connections process

As a result of changes in the energy sector and an increase in non-traditional gas development, we are seeing more connections to the NTS that were not foreseen in the past. These new and non-traditional gas suppliers see value in connecting to the NTS because of the system location and/or the benefits of a higher pressure network.

We have begun to see new types of connection requests, from industries such as shale, biomethane entry connections and natural gas-powered vehicle refuelling station exit connections. The system requirements for these connections are fundamentally different to more traditional project connections.

Many of you have told us that the existing connection regime does not meet your project's requirements. It is in National Grid's best interest to meet your requirements and we are continuing to develop ways to making the NTS adaptable for the future.

We want to make the NTS more accessible to these new gas sources, and one way we are addressing this challenge is through Project CLoCC.

[6] https://www.nationalgridgas.com/data-and-operations/constraint-management

Spotlight
Facilitating flexible connections for gas customers

Project CLoCC (Customer Low Cost Connections) has been working on simplifying the process of connecting to the NTS for a new generation of gas customers. The project closed on 29 October 2018 and delivered its innovation outputs to the National Grid business for review and implementation.

Background

This £5.4m Network Innovation Competition (NIC) project was set up due to the demand for connecting lower flow customers to the NTS. It has addressed the main hurdles our customers were facing by reducing costs to connect down to under £1 million (previously an average of £2m) and the time to connect to under a year (previously up to 2 years).

The project challenged the current 'Application to Offer' connection process with both technical and commercial solutions that aligned to the needs of our non-traditional gas customers, such as those in the biomethane, small gas generation and potentially shale industries. In addition, CLoCC also supports the development of exit projects such as Compressed Natural Gas (CNG) for transport.

By facilitating these new connections to the NTS from emerging markets, we can help maximise the potential for newer forms of indigenous gas, thereby improving the nation's energy security and reducing our carbon footprint in the process.

Innovation outputs

The project is now completed and has handed over its final developments to the National Grid business for review and implementation. The project has delivered three main outputs:

1. Development of a new online **gas customer connections portal** which gives an indicative guide on how much it will cost customers to connect new sites to our network in a matter of minutes. The portal also includes information about capacity availability on our network and now both connection and capacity processes, although separate applications, can be explored from a single location. This new connection portal is available for all gas customers to use, regardless of flow.
2. **A suite of standardised, pre-approved and pre-appraised physical connection designs** tailored to the needs of our changing customer base. These will be ready to use 'off the shelf', reducing the level of design work required and hence timeline to connect. The designs will be available in pipework diameter sizes of 80mm, 200mm and 300mm (nominal bore), accommodating a broad range of customers with a wide range of gas flows.
3. **Optimised commercial arrangements** offering more flexibility for our customers by ensuring adaptations to relevant gas regime governance. We made the National Grid oxygen specification more flexible allowing us to now consider applications up to the Gas Safety (Management) Regulations (GS(M)R) limit, and we have also significantly reduced connection application fees by up to 88% for standard design connection customers. In addition, the project facilitated the removal of the absolute requirement for an exit connection to have a remotely operable valve, which could save some customers more than £100,000.

When you combine these elements together it gives customers more opportunity to practically consider connecting to the NTS.

Progress throughout 2018

As the project moved through its final phase in 2018, we built one of our standard connection designs at Eakring. Our "Skiosk", combining telemetry kiosk and connecting pipework design, successfully completed end-to-end testing of its signals back to the National Grid Gas Control centre in September 2018.

Alongside this, we also appointed a pilot customer to verify the project's outputs. From stakeholder feedback, it was clear there was a significant appetite from customers to benefit from CLoCC's developments at the earliest opportunity. To help us prove the concepts of our project before it closed, we invited expressions of interest from potential pilot customers in January 2018. From nine interested applicants, we selected Somerset Farm in Cambridgeshire which is owned by Biocow Ltd, a leading operator of anaerobic digestion plants, and is supported by CNG Services.

When Somerset Farm begins injecting its biogas into the NTS, it will be the first time a biomethane producer will connect to the high-pressure NTS. This underlines our support for the UK's Clean Growth Strategy and is an example of how the gas network can be used on the journey to decarbonise transport, heat and power generation.

Gas connections moving forward

Once appropriate security testing has been completed by National Grid, the portal will be fully accessible for our customers, enabling customers to register to use the portal to generate cost estimates and apply for a gas connection online.

For more information on gas connections, please get in touch with the Gas Contract Management Team at **Box.UKT.customerlifecycle@nationalgrid.com** or visit **www.nationalgrid.com/uk/gas/industrial-connections/applying-connection**

2.2.3 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)** – as defined by our Gas Transporters Licence.
- **Funded Incremental NTS entry capacity (obligated)** – firm capacity made available over and above baseline, in response to market demand and backed by User commitment.
- **Non-Obligated NTS entry capacity** – at our discretion, we can release additional firm NTS entry capacity at an ASEP, over and above obligated levels.

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)** – any NTS entry firm capacity that has been underutilised is made available as interruptible NTS entry capacity.
- **Discretionary** – we can make additional interruptible NTS entry capacity available to the market at our discretion.

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

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 capacity, Shippers can bid in six auctions:

Quarterly System Entry Capacity (QSEC) – The QSEC auction is held every March and can be open for up to ten working days. NTS entry capacity is made available in quarterly strips from October Y+2 to September Y+16 (where Y is the current Gas Year).

Annual Monthly System Entry Capacity (AMSEC) – The AMSEC auction is run every February and NTS entry capacity is sold in monthly strips from April Y+1 through to September Y+2. This auction is 'pay as bid' and subject to a minimum reserve price. The auction is open for four days from 8am to 5pm. Each auction window is separated by two business days as detailed in the UNC. The processing and allocation is completed after 5pm on each day.

Rolling Monthly Trade & Transfer (RMTnTSEC)

- The RMTnTSEC is held on a monthly basis at the month ahead stage. Any unsold quantities from AMSEC are made available in the RMTnTSEC auction and sold in monthly bundles. The auction is 'pay as bid', and subject to the same reserve price as AMSEC.

The other three entry capacity auctions relate to Interconnection Points. More detail on these can be found in Section 2.2.5.

Incremental obligated capacity

In order to increase the obligated level of entry capacity at an ASEP, Shippers or Developers should submit a PARCA application. More information on the PARCA Framework can be found in Section 2.2.6. If this capacity can be made available via capacity substitution[9], then the baseline capacity at the location will be increased. Capacity substitution involves moving unused capacity from one or more system points to a point where there is excess demand. 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 (see Section 2.2.6).

If insufficient bids are received to pass the economic test, capacity in excess of the obligated baseline level can be released on a non-obligated basis which would mean that the obligated capacity level does not increase for future auctions.

The QSEC auctions opened on Monday 12 March and closed on Tuesday 13 March 2018. Bids were received for incremental entry capacity at Cheshire which resulted in substitution from Partington.

All bids received at other ASEPs were satisfied from current unsold obligated levels for future quarters.

[9] https://www.nationalgrid.com/uk/gas/charging-and-methodologies/methodologies

2.2.4 NTS exit capacity

Exit capacity provides Shippers and DNOs 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)** – as defined by our Gas Transporters Licence.
- **Incremental NTS exit capacity (obligated)** – firm capacity made available over and above baseline, in response to market demand and supported by User commitment. This increase in capacity is permanent.
- **Non-Obligated NTS exit capacity** – at our discretion, we can release additional firm capacity at an offtake point over and above obligated levels.

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)** – any firm capacity that has been underutilised over recent days can be resold to the market as off peak (interruptible) capacity.
- **Unutilised Maximum NTS Exit Point Offtake Rate (MNEPOR)** – at 13:30 hrs D-1, the NTS Demand Forecast is published. Where this demand forecast is less than 80% of the annual peak 1-in-20 demand forecast, National Grid is obligated to release any remaining capacity up to the MNEPOR level as off peak capacity.
- **Discretionary** – National Grid can make additional off peak capacity available to the market at our discretion.

If there are low pressures on the network, then National Grid may curtail off peak capacity rights without any compensation for the Users affected. 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.

NTS exit capacity application windows and auctions

To obtain firm exit capacity a Shipper can apply for capacity through four exit capacity application windows and three auctions:

Annual NTS (Flat) Exit Capacity (AFLEC) – This application window is for capacity covering the period Y+1 to Y+3 in yearly strips. The capacity allocated in this application window is not enduring and therefore cannot be increased or decreased. The application period for this application window is 1 to 31 July.

Enduring Annual Exit (Flat) Capacity Increase (EAFLEC) – This application window is for capacity covering the period Y+4 to Y+6 (where Y is the current Gas Year). The capacity bought in this application window is enduring and can be increased or decreased in a later application window (subject to User commitment). The application period for this auction is 1 to 31 July.

Enduring Annual Exit (Flat) Capacity Decrease (EAFLEC) – This application window allows a User to decrease their enduring capacity holdings from Year Y+1 (October following the July window). Further decreases and increases can be requested in subsequent application windows. The application period for this auction is 1 to 15 July.

Ad-hoc Enduring Annual Exit (Flat) Capacity – This application window allows a User to apply between 1 October to 30 June for capacity from Year Y. The capacity release date must not be earlier than the 1st of the month M+7 (where M is the month in which the application is made) and no later than 1 October in Y+6. The User (or Users in aggregate) must hold equal to or more than 125% of the Baseline NTS exit (flat) capacity for the year in which the application is received or the application must exceed 1 GWh/day.

DNOs 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 system capability. Where the capacity requested can be accommodated through substitution, the capacity request is accepted. Capacity substitution involves moving unused capacity from one or more offtakes to a point where there is excess demand. 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 (see Section 2.2.6).

Successful applications submitted in the AFLEC window will be allocated within ten business days of the application window closing. Successful applications submitted in the EAFLEC window (both increases and decreases) will be allocated on or before 30 September.

The three exit capacity auctions relate to Interconnection Points. More detail on these can be found in Section 2.2.5.

2.2.5 Capacity at Interconnection Points

The Interconnection Point auctions are held in accordance with the Capacity Allocation Mechanisms (CAM) EU network code[10]. Please see link, **https://www.entsog.eu/publications/capacity-allocation-cam/2018#2-CAM-NC-EARLY-IMPLEMENTATION-DOCUMENTS-AND-AUCTION-CALENDAR**. There are a total of six 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 first 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).

Annual Quarterly Capacity for four quarters of the upcoming Gas Year will be auctioned via four concurrent annual quarterly capacity auctions.

- The first held on the first Monday of August, capacity will be auctioned for all four quarters (October–December, January–March, April–June and July–September).
- The second held on the first Monday of November, capacity will be auctioned for the quarters January–March, April–June and July–September.
- The third held on the first Monday of February, capacity will be auctioned for the quarters April–June and July–September).
- The fourth held on the first 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.

2.2.6 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 own project. The customer can buy the reserved capacity at an agreed future date.

The PARCA Framework was implemented on 2 February 2015. It replaces the Advanced Reservation of Capacity Agreement (ARCA) for NTS exit capacity and the Planning Consent Agreement (PCA) for both NTS entry and exit capacity.

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).

The PARCA Framework provides a number of benefits for PARCA customers, other NTS customers/Users and National Grid.

[10] https://www.entsog.eu/publications/capacity-allocation-cam

Benefits for PARCA customers
It is designed to help customers to reserve NTS entry and/or exit capacity early on in their project development without full financial commitment to formally booking capacity.
Reserved NTS capacity will be exclusive to the PARCA applicant (or their nominated NTS User) and will not be available to other NTS Users.
It provides the customer with greater certainty around when capacity can be made available should their project progress to completion.
It aligns the customer's and our project timelines; this is particularly important where reinforcement is required, so the projects can progress together.
The customer can align the NTS capacity and connection processes for their project.
The process is flexible, with logical 'drop-out points' before capacity allocation. Capacity allocation would be closer to the customer's first Gas Day than under previous arrangements. As a result, the customer would be able to take advantage of these 'drop-out points', should their project become uncertain.
They are available to both UNC parties and project developers and therefore available to a wider range of customers compared to the existing annual NTS capacity auction and application processes.
Benefits for other NTS customers and Users
Throughout the lifecycle of a PARCA, we will publish more information externally (compared to the existing auction/application mechanisms), increasing transparency for other NTS Users.
The PARCA entry capacity process includes an ad hoc QSEC auction mechanism to allow other NTS Users to compete for unsold QSEC before it is reserved.
The PARCA process includes a PARCA application window during which other NTS Users can approach us to sign a PARCA. This provides a prompt for those customers considering entering into a PARCA. It would allow multiple PARCAs to be considered together. This way, we will make best use of unsold levels of NTS capacity and existing system capability when determining how to meet our customers' requirements. This will enable the most economic and efficient investment decisions to be made.
Throughout the lifecycle of a PARCA, each customer must provide us with regular project progress updates. If a customer fails to provide the required information in the appropriate timescales, their PARCA may be cancelled and any reserved NTS capacity would either be used for another live PARCA or returned to the market. This will ensure that NTS capacity is not unnecessarily withheld from other NTS Users.
A PARCA customer will be required to provide financial security to reserve NTS capacity. If the customer cancels their PARCA, a termination amount will be taken from the security provided. This would be credited to other NTS Users through the existing charging mechanisms.
The timescales for the release of incremental NTS capacity to the PARCA applicant will be aligned to our timescales for providing increased system capability. This will take into account the Planning Act requirements for a reinforcement project. As a result, the risk of constraint management actions taking place and any costs potentially being shared with end consumers will be reduced.
They are available to both UNC parties and project developers and therefore available to a wider range of customers compared to the existing annual NTS capacity auction and application processes.
Benefits for us
Throughout the lifecycle of a PARCA, the customer will be required to provide regular project progress updates. We would not begin construction on any investment projects until the customer has received full planning permission for their project. This will allow our case for any required investment to be clearly linked to our customer requirements.

2.2.7 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 2.3).

This phased structure gives the customer natural decision points where they can choose whether to proceed to the next phase of activities.

More information on the PARCA process is provided on our website, including the full customer guide **https://www.nationalgrid.com/uk/gas/industrial-connections/reserving-capacity-parca-and-cam**

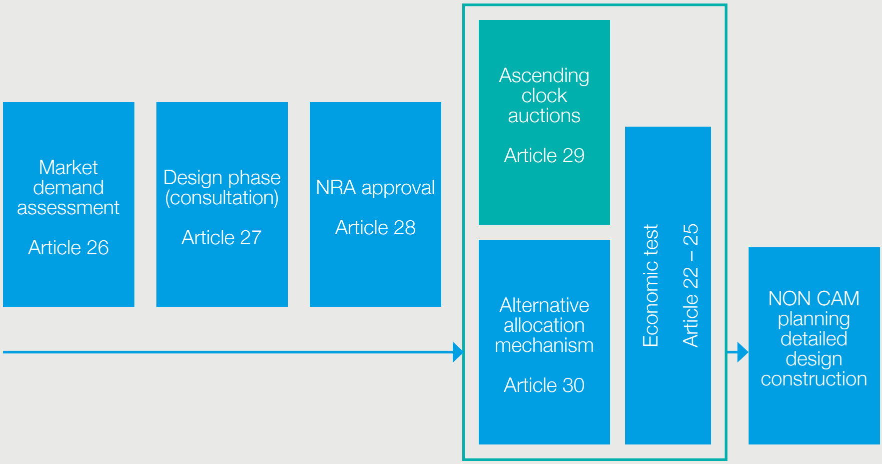
Figure 2.3
PARCA framework phases

2.2.8 Incremental capacity at Interconnection Points

In order to harmonise the development process for incremental capacity at Interconnection Points (IPs), new rules for incremental capacity have been included in the network code on Capacity Allocations Mechanism (CAM NC). An amended version was approved by the EU Member States in October 2016 and the entry into force date was 6 April 2017.

The newly introduced process provides for several phases. Certain requirements need to be fulfilled before an incremental project can be initiated based on market demand and new capacity requirements.

Figure 2.4
Phases of releasing incremental capacity



- The market demand assessment will be conducted in accordance with Article 26 of the Official Regulation (EU) 2017/459 of the amended CAM code, hereafter referred to as the CAM code, and covers how the market will signal to TSOs a potential need for capacity beyond the unsold technical capacity available. The next Demand Assessment process is scheduled to be run in July 2019.
- The project design covers technical studies and a TSO led public consultation on the proposed incremental project.
- National Regulatory Authority (NRA) approval covers the finalisation of the project proposal followed by an NRA decision on whether the project goes ahead.
- The allocation mechanism can be via the standard annual yearly auctions at IPs, or an alternative mechanism can be proposed under the project design.
- National Grid intends to make use of the alternative mechanism to follow the existing PARCA process as much as possible.
- Any allocation or reservation of capacity will be subject to an economic test.
- The CAM process does not cover rules for gaining planning consent or for construction. However, these remain a necessary part of the process for creating incremental capacity and are considered as part of the process rules where appropriate.

For more information on CAM visit
https://www.gasgovernance.co.uk/Tx/061016

2.3 *Future Energy Scenarios*

We produce *FES*[11] each year to identify a range of credible scenarios for the next 30 years and beyond. These consider how much energy we might need and where it could come from. They look at what the changes might mean for the industry and for its customers.

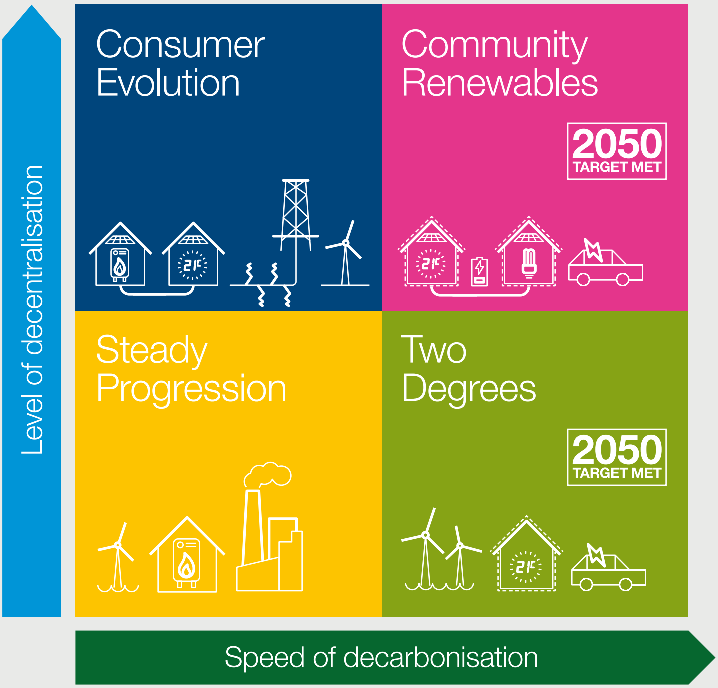
This year as a result of our analysis and following discussions with our stakeholders we have updated the framework that we use for creating our scenarios. We have developed four scenarios based on speed of decarbonisation and level of decentralisation, shown in Figure 2.5.

The speed of decarbonisation axis is driven by policy, economics and consumer attitudes. All scenarios show progress from today towards decarbonisation, with the two scenarios on the right meeting the target of 80 percent reduction in greenhouse gas emissions from 1990 levels by 2050.

The level of decentralisation axis indicates how close the production and management of energy is to the end consumer. This is more evident when considering electricity but is still applicable to gas. In the two scenarios with greater decentralisation there is more development of gas sources that connect to the distribution networks rather than to the NTS.

In this chapter we are not repeating the detailed description of gas demand and supply scenarios that is available in our *FES* publication. Instead we show a selection that highlights some of the more interesting features. We also only show results as far as 2035 rather than 2050, as this period is of the greatest relevance to decisions that need to be taken on the gas network today. Our Charts and Tables Workbook gives full details of gas supply and demand for our scenarios.

Figure 2.5
The 2018 *FES* scenario matrix



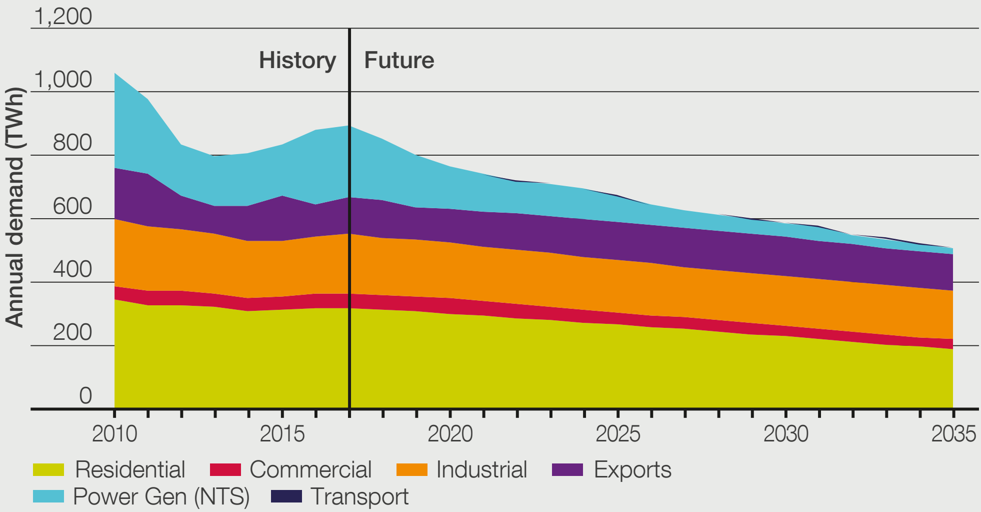
[11] http://fes.nationalgrid.com/

2.3.1 Gas demand

Figure 2.6 shows gas demand[12] for **Community Renewables**. In this scenario we explore how the 2050 decarbonisation target can be achieved through a more decentralised energy landscape. Gas demand in this scenario is lower than in any of our other scenarios.

Residential gas demand declines as homes become more thermally efficient and heat pumps become the dominant heating technology. Onshore wind and solar dominate the electricity supply picture with gas being used in small plant providing flexibility in electricity supply.

Figure 2.6
Annual gas demand in **Community Renewables**



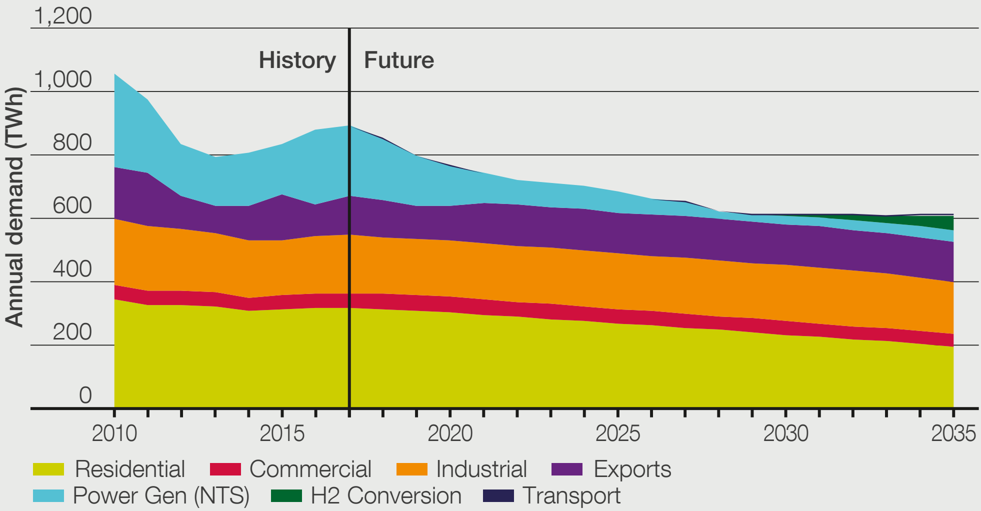
[12] For consistency with *FES* we discuss gas demand in energy units; GWh or TWh. Gas supply is discussed in units of volume: millions or billions of cubic metres, mcm or bcm. For gas in Great Britain a good approximation for converting energy to volume is to divide by 11. So, for example, 44 GWh approximates to 4 mcm and 880 TWh approximates to 80 bcm.

In contrast to **Community Renewables**, the **Two Degrees** scenario, shown in Figure 2.7, shows how the 2050 decarbonisation target can be met using more centralised technologies.

Residential gas demand declines as homes become more thermally efficient. However, this scenario does not have the large scale rollout of heat pumps seen in **Community Renewables**. Instead, decarbonisation of heating is achieved by using hydrogen as an energy source. This is produced from natural gas via a process known as steam methane reforming, combined with carbon capture utilisation and storage (CCUS). Successful development of CCUS allows the technology to be used in some large scale gas fired power stations as well, though offshore wind and nuclear are the dominant electricity sources.

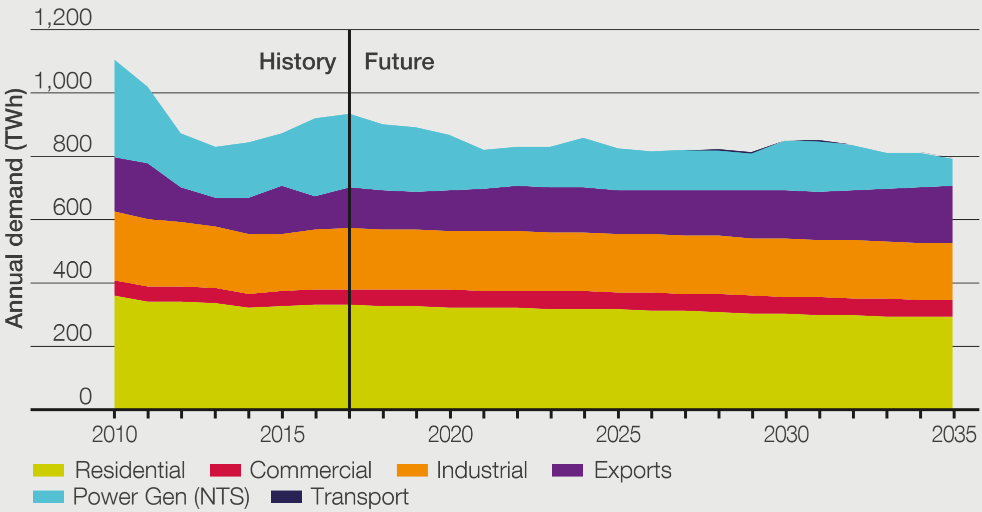
The use of hydrogen and CCUS means that this scenario has a higher gas demand than any other 2050 compliant scenario that we have produced.

Figure 2.7
Annual gas demand in **Two Degrees**



The highest gas demand in our scenarios in 2035 is found in **Consumer Evolution**, shown in Figure 2.8. In this scenario, limited progress is made towards decarbonising heat. There are only small improvements in thermal efficiency. There is some progress in the rollout of heat pumps but current heating technologies retain their market share.

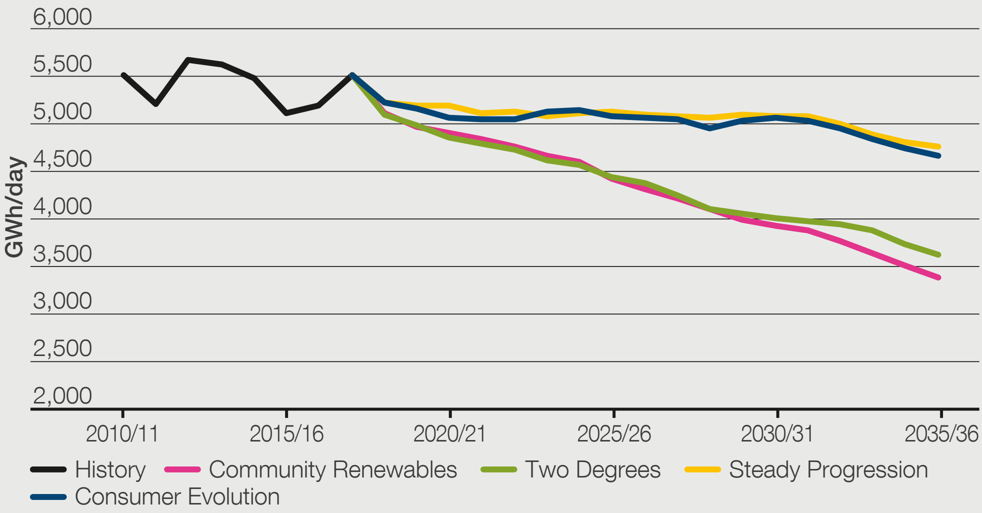
Figure 2.8
Annual gas demand in **Consumer Evolution**



Peak daily demand

Gas peak day demand is illustrated in Figure 2.9. Generally it mirrors the movement of annual gas demand in each scenario, but the declines are not as rapid. Gas is still required as a supporting electricity generation source when intermittent generation is producing less. It is also used for heating in gas boilers, hybrid systems (electric heat pumps with gas boilers for peak load) or hydrogen production, depending on the scenario.

Figure 2.9
1-in-20 peak demand

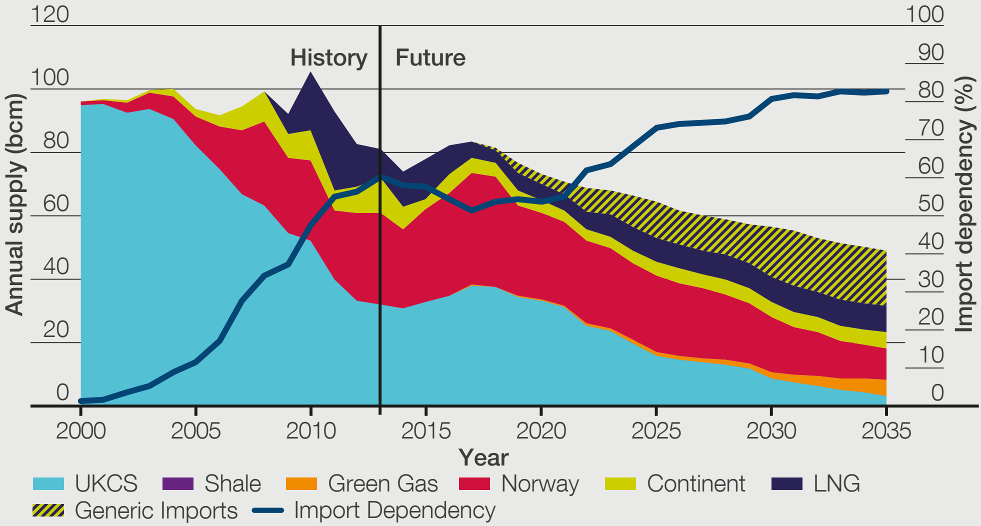


2.3.2 Gas supply

The pattern of gas supply in Great Britain has changed dramatically in the past 17 years. We have gone from being self-sufficient in gas in 2000 to being dependent on imported gas for around half of our needs in 2017. Supply from the UK Continental Shelf (UKCS) declined from 95 bcm in 2000 to 38 bcm in 2017. This has been replaced with gas from Norway, Continental Europe, and the world market delivered as *liquefied natural gas* (LNG). We can expect a similarly large change looking forward. Over the next 20 years, the UKCS will continue to decline. In some scenarios we consider the development of other indigenous sources; shale gas, biomethane and bio-substitute natural gas (bioSNG). Some of these may connect either to the NTS or to the distribution networks. In three out of four scenarios imported gas will become even more important. In **Community Renewables**, shown in Figure 2.10, with its very low gas demand, there is little policy support of continued development of the UKCS. There is greater support for green gas – biomethane and bioSNG – which reaches 5 bcm by 2035. This will be connected to both the transmission and distribution networks. In this scenario, there is some gas used for heating and some for providing flexibility in electricity supply.

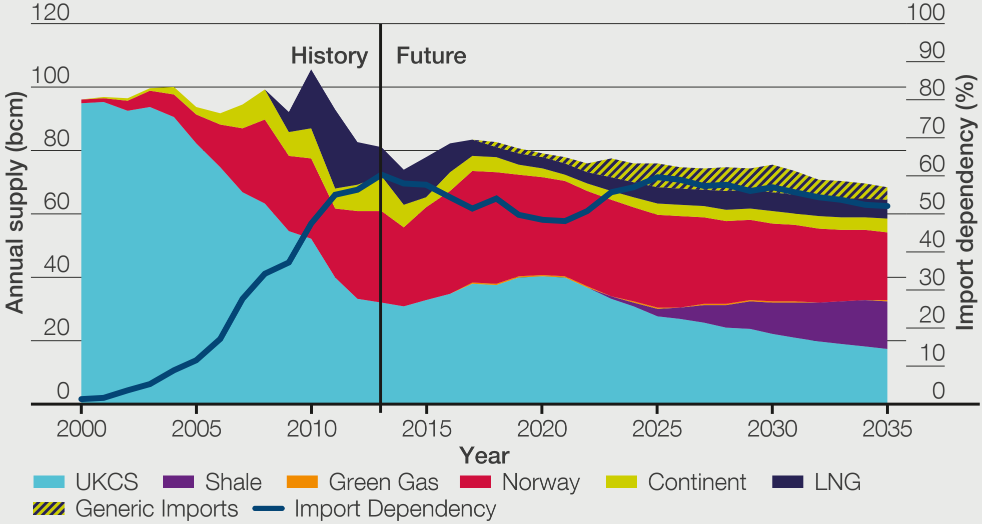
To match the requirement for flexibility, the majority of the remaining gas supply is from LNG and Continental Europe. The chart also shows a range marked as generic imports. This is gas which could be LNG, gas from Continental Europe, or a mixture of both, and is our way of addressing difficulties in predicting flows of gas in the world market. Supplies from Norway are low in this scenario. Import dependency reaches 83 percent in 2035.

Figure 2.10
Annual supply pattern in **Community Renewables**



In contrast, demand in **Steady Progression**, at 69 bcm in 2035 is still 78 percent of the 2017 value. In this scenario, shown in Figure 2.11, with emphasis on centralised energy solutions, there is support for maintaining production on the UKCS, and there is still around 17 bcm being supplied in 2035. There is less emphasis on decarbonisation, and so green gas receives no support for development greater than the current level, less than 1 bcm per year. There is some development of shale gas, which will connect at both transmission and distribution level. Gas imports from Norway, Continental Europe and LNG are important. Import dependency is around 52 percent in 2035.

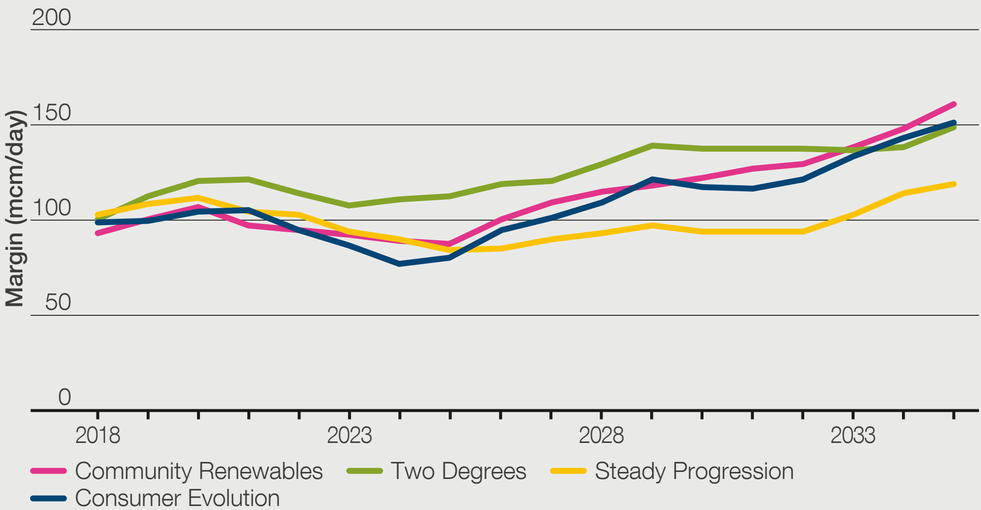
Figure 2.11
Annual supply pattern in **Steady Progression**



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 the assessment assuming that the single largest piece of infrastructure is not available. This means that in our analysis we remove the pipeline connecting the two LNG terminals at Milford Haven to the rest of the network. This is known as the N-1 test and is used by the government in assessing security of gas supply. In Figure 2.12 we show the margin of supply over peak demand under N-1 conditions. This shows that supply capacity exceeds peak demand by more than 50 mcm/day in all scenarios.

Figure 2.12
Peak supply margin under N-1 conditions



2.3.3 Gas Future Operability Planning

GFOP document is published by National Grid in our capacity as Great Britain's SO. Its aims are to:

- assess a range of views of the future through the lens of National Grid's *FES*
- act as a vehicle for all market participants to discuss and quantify their future gas transmission network needs
- describe the operability challenges we could see in the future
- set a clear direction for the development of commercial options (rules), operational arrangements (tools) and physical investments (assets).

Using our network analysis software (SIMONE), we assess supply and demand patterns forecasted in the Future Energy Scenarios to identify potential operability challenges that could require innovative solutions. Figure 2.13 summarises the future operability challenges we may face out to 2050 in each Future Energy Scenarios.

Figure 2.13
Future operability challenges we could face out to 2050

<table>
<tr><th>Operationally challenging to meet pressures</th><th>because of…</th><th>at the following demand levels…</th><th>2025</th><th>2030</th><th>2040</th><th>2050</th></tr>
<tr><td rowspan="6">across Scotland and certain northern offtakes</td><td rowspan="6">reduced supplies at St Fergus (declining UKCS)</td><td rowspan="4">peak</td><td rowspan="6"></td><td colspan="3">Two Degrees</td></tr>
<tr><td colspan="3">Community Renewables</td></tr>
<tr><td rowspan="4"></td><td colspan="2">Steady Progression</td></tr>
<tr><td colspan="2">Consumer Evolution</td></tr>
<tr><td rowspan="2">summer</td><td colspan="2">Community Renewables</td></tr>
<tr><td>Two Degrees</td><td></td></tr>
<tr><td rowspan="2">at the Irish interconnector (Moffat)</td><td rowspan="2">increasing Irish export demand</td><td rowspan="2">peak</td><td rowspan="2"></td><td rowspan="2"></td><td>Steady Progression</td><td rowspan="2"></td></tr>
<tr><td>Two Degrees</td></tr>
<tr><td rowspan="2">across West Midlands and North West DN offtakes</td><td rowspan="2">high LNG flows at Milford Haven</td><td>peak</td><td rowspan="2"></td><td>Steady Progression</td><td colspan="2"></td></tr>
<tr><td>peak and summer</td><td></td><td colspan="2">Two Degrees</td></tr>
<tr><td rowspan="2">in the South East</td><td rowspan="2">reduced supplies at Bacton</td><td>peak</td><td rowspan="2"></td><td>Community Renewables</td><td colspan="2"></td></tr>
<tr><td>summer</td><td colspan="2"></td><td>Consumer Evolution</td></tr>
<tr><td rowspan="3">in the South</td><td rowspan="3">high net demand in the South East, reducing gas flows in the southern pipelines</td><td rowspan="2">peak</td><td rowspan="3"></td><td rowspan="3"></td><td>Two Degrees</td><td></td></tr>
<tr><td></td><td>Community Renewables</td></tr>
<tr><td>summer</td><td colspan="2">Consumer Evolution</td></tr>
</table>

Future gas supply patterns

As discussed in Section 2.3.2, we expect supply patterns to change as UKCS supplies continue to decline in the future.

Having already identified the challenge of securing Scotland under our 1-in-20 obligation, we are actively working with SGN to put in place a cost-effective and enduring solution. This is explained in more detail in Chapter 5.

In June 2018, we published a document which illustrates how we now see higher levels of seasonal and day-to-day variability in supply patterns in comparison to the past, making it more challenging to: design the system in anticipation for future needs; schedule maintenance and construction activities; and utilise our compressors within their original intended requirements. We anticipate that this will continue to increase. Through the *GFOP*, we are looking to better understand the future impact this has on our short-, medium- and long-term processes.

Changing within-day behaviour

Throughout a Gas Day, supply and demand are rarely in balance, so linepack levels fluctuate. We are seeing several underlying trends in within-day supply and demand behaviour which are leading to greater fluctuations in linepack, particularly in terms of managing NTS pressures and ensuring that they remain within safety and contractual tolerances.

Our next *GFOP* document, to be released in February, will take a deeper look at within-day behaviour. It aims to act as an engagement platform to better understand what factors impact how you put gas on and take it off the NTS currently, and how these factors may change in the future. Your input will help to further refine our future within-day modelling, improving our ability to forecast whether this creates operational challenges in the future.

To find out how you can get involved please **click here** to see our operability insight.

Engage with us

Regular interaction with our stakeholders help us to identify solutions that ensure we can continue to deliver your future network needs, while meeting our statutory and commercial obligations. The *GFOP* allows stakeholders to:

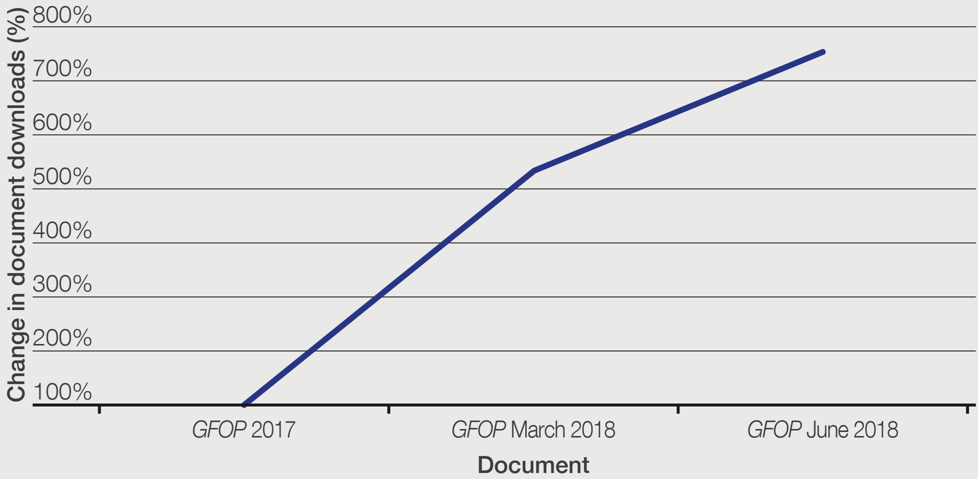
- challenge our assumptions about future uncertainties
- share what they want from the gas transmission network.

Over the last year, we have made changes to: our document length, frequency of publication, website interface and method of engagement (see Figure 2.14). This has helped to facilitate richer conversations with a wider audience and increase document downloads significantly (see Figure 2.15).

We want to continue to focus 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 **nationalgrid.com/gfop** and get in touch with us at **box.gfop@nationalgrid.com** to become part of the future energy debate.

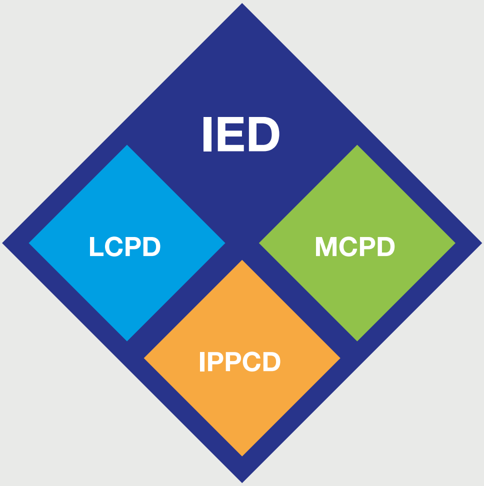
Figure 2.14
GFOP method of engagement

Figure 2.15
GFOP document downloads



2.4 Legislative change

This section outlines the key legislative changes which will impact how we plan and operate the NTS over the next ten years. We will outline what impact these changes will have on our network in Chapter 3 and what we are doing in order to comply with these legislative changes in Chapter 5.

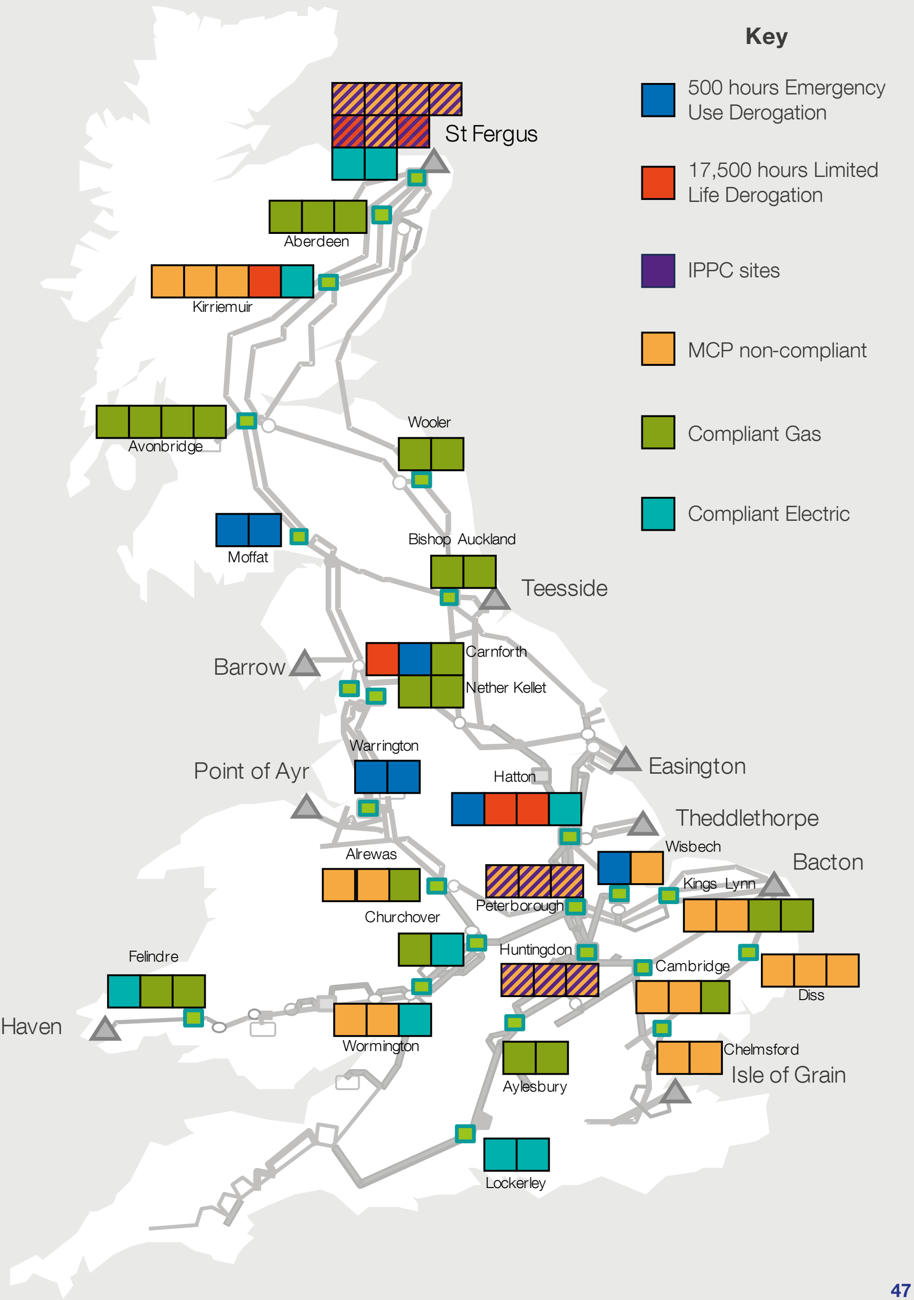


2.4.1 Industrial Emissions Directives (IED)

The European Union (EU) has agreed targets and directives that determine how we should control emissions from all industrial activity. The Industrial Emissions Directive[13] (IED) is the biggest change to environmental legislation in over a decade, and consolidates several European emissions-related directives. It forms the new mandatory minimum emission standards that all European countries must comply with by 2023. It came into force on 6 January 2013 and it heavily impacts our current compressor fleet, with implications for everyone who relies on the NTS.

[13] http://ec.europa.eu/environment/industry/stationary/ied/legislation.htm

Figure 2.16
Impact of IED on our current compressor fleet



Integrated Pollution Prevention and Control Directive

The Integrated Pollution Prevention and Control Directive (IPPCD)[14] was implemented in 2008 and applies to 23 of our 24 NTS compressor sites. It requires progressive pollution reduction and applies at a fleet level across the NTS. It states that any installation with a high pollution potential (e.g. oxides of nitrogen (NOx) and carbon monoxide (CO)) must have a permit to operate.

To obtain a permit we must demonstrate that Best Available Techniques (BAT, see below for more information) have been employed on the permitted installation to prevent/reduce emitting these pollutants by means of an assessment. These BAT assessments provide a balance between costs and the environmental benefits of the options considered.

We have to ensure that all of our compressor installations covered by the regime have a permit. These permits will specify the maximum emission limit values (ELVs) to the air for each unit, along with other operating conditions.

We are currently working on 3 compressor sites in order to ensure compliance with the IPPCD. No final decision has been made yet, we expect the funding to be agreed during 2019. Further information on these works can be found in Chapter 5.

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.

This network-wide approach is described in the annual Network Review which is 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.

BAT Reference documents

BAT Reference (BRef) documents[15] have been adopted under both the IPPCD and IED. We will be taking BRef into account when determining the BAT for all options considered on IED non-compliant units going forward. We do not anticipate any significant changes to the BAT process we currently follow when assessing our compressor options. The BRef documents outline:

- techniques and processes currently used in each sector
- current emission levels
- techniques that should be implemented by each sector as BAT
- emerging techniques to comply with the legislation.

The BRef document for large combustion plants was issued by the European Commission in August 2017 and compliance with its requirements is required by 2021.

Large Combustion Plant Directive

Within the IED, the Large Combustion Plant Directive[16] (LCPD), implemented in 2001, affects a significant number of our compressor units in operation on the NTS (it applies to 16 of our 64 gas turbine driven compressor units). It sets clear emission targets for pollutants such as nitrous oxides (NOx) and carbon monoxide (CO) at a combustion unit level. It is applicable to industrial emissions for units with a thermal input 50 MW and above. Significant works have been completed, with more planned, to ensure compliance with the LCPD by 31 December 2023.

All of our compressor units that fall within the LCPD must meet the ELVs defined in the directive. The ELVs are legally enforceable limits of emissions to air for each LCPD unit. 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.

[14] http://eur-lex.europa.eu/legal-content/EN/TXT/?uri=URISERV:l28045

[15] http://eippcb.jrc.ec.europa.eu/reference

[16] https://eur-lex.europa.eu/search.html?qid=1543509868181&text=IPPCD&scope=EURLEX&type=quick&lang=en

Limited lifetime derogation

In the IED it states that from January 2016 to 31 December 2023 combustion plant may be exempt from compliance with the ELVs for plant 50 MW and above provided certain conditions are fulfilled:

- The operator makes a declaration before 1 January 2014 not to operate the plant for more than 17,500 hours starting from 1 January 2016 and ending no later than 31 December 2023.
- The operator submits each year a record of the number of hours since 1 January 2016.
- The ELVs set out in the permits as per the IPPCD are complied with.

We have already made the declaration above and have been allowed to use this derogation for our current affected units.

500 hour/emergency use provision

The IED includes the possibility of using plant for emergency use:
"Gas turbines and gas engines that operate less than 500 operating hours per year are not covered by the emission limit values set out in this point. The operator of such plant shall record the used operating hours."

This means that we may be able to use our non-compliant compressor units for 500 hours or less each calendar year.

Further information on our compliance with the LCPD can be found in Chapters 3 and 5.

Medium Combustion Plant Directive

The Medium Combustion Plant Directive (MCPD) was transposed into UK legislation in December 2017. The requirements are detailed in Pollution Prevention and Control (Scotland) (Amendment) Regulations 2017, which came into force 19 December 2017 and for England and Wales in Environmental Permitting (England and Wales) (Amendment) Regulations 2018 which came into force 29 January 2018. The emissions compliance derogation for gas driven compressors was originally 2025. National Grid has secured a longer derogation for gas compressors that are required to ensure the safety and security of a national gas transmission system, which now have a further five years (to 2030) to comply with the requirements.

The MCPD applies to smaller gas compressors and will impact 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. Details of what we are doing to adapt our sites to comply with this legislation are outlined in Chapter 5. We are committed to reducing emissions from our compressor operations, as we continue to transport gas in the direction of a decarbonised world. Figure 2.15 summarises the key features of emissions legislation.

Figure 2.17
Legislation timelines

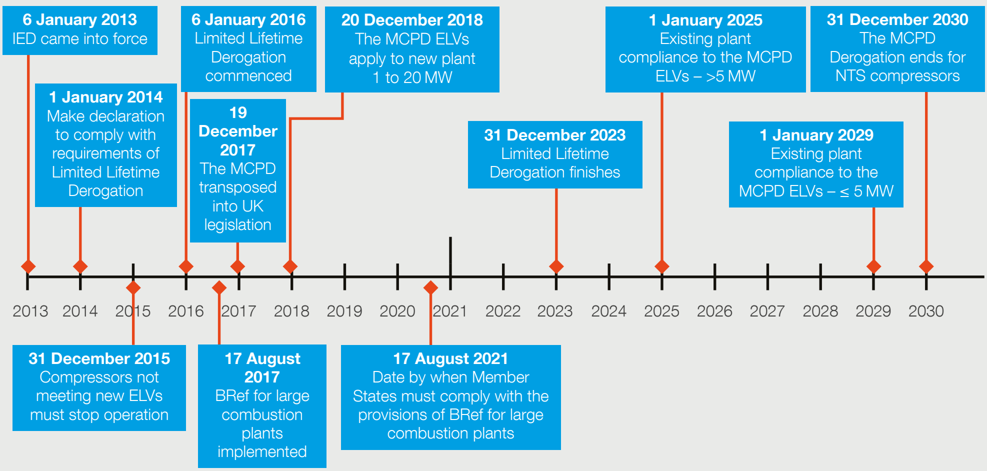
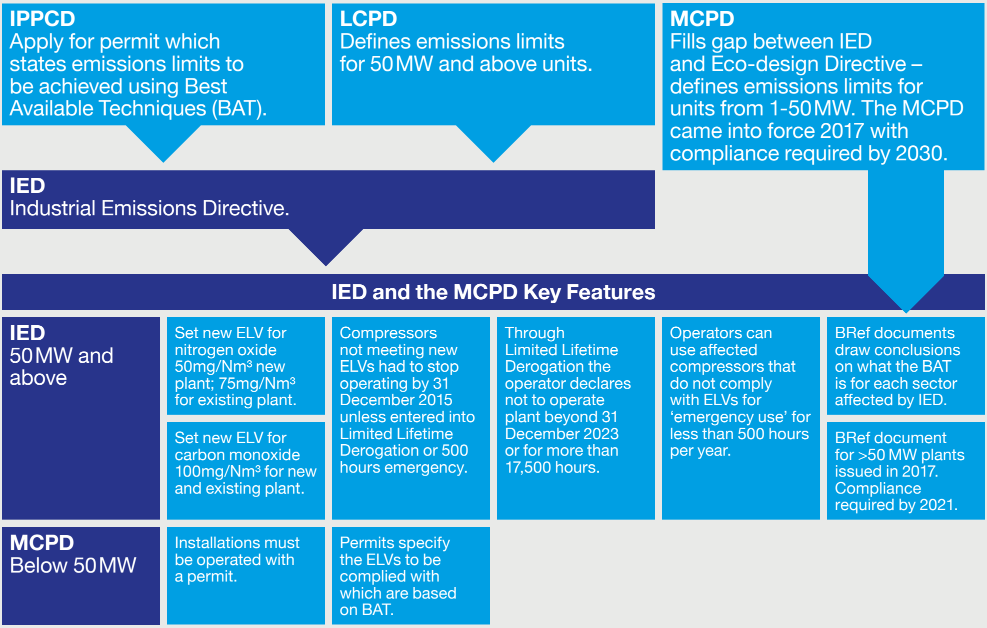


Figure 2.18
IED and the MCPD emissions legislation key features



2.4.2 Other legislation

Following the UK's referendum result on EU membership in June 2016, we note that EU rules and regulations will continue to apply in the UK until EU exit day. We will continue to take forward implementation of EU requirements whilst the terms of the EU Withdrawal Agreement and the future EU/UK energy relationship and arrangements are defined. However, we continue to 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.

European Union Third Energy Package

One of the most important pieces of European gas and electricity markets legislation is referred to as the Third Energy Package, comprising several EU Regulations establishing harmonised arrangements for EU gas markets and the establishment of pan-European organisations to support its detailed development and implementation. This was transposed into law in Great Britain by Great Britain Regulations that came into force in 2011.

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 Great Britain's domestic legislation and associated regulations and codes, including the Uniform Network Code (UNC). We, as the TSO, have raised a series of EU-related UNC modifications to comply with the EU legislation, which are listed in Appendix 5. The focus to date has been on:

a. Commission Decision (2012/490/EU) of 24 August 2012) on amending Annex I to Regulation (EC) 715/2009 on conditions for access to the natural gas transmission networks **(Congestion Management Procedures ("CMP"))**. This specifies rules to ensure booked capacity at Interconnection Points is used efficiently to address issues of contractual congestion in transmission pipelines.

b. Commission Regulation ((EU) 984/2013 of 14 October 2013) establishing a Network Code on **Capacity Allocation Mechanisms** in Gas Transmission Systems and Supplementing Regulation (EC) No 715/2009 ("CAM"). This seeks to create more efficient allocation of capacity at the Interconnection Points between adjacent TSOs. CAM introduced the revised 5:00am-5:00am Gas Day arrangements at Interconnection Points.

c. Commission Regulation ((EU) 312/2014 of 26 March 2014) establishing a Network Code on **Gas Balancing of Transmission Networks ("BAL")**. This includes network-related rules on nominations procedures at Interconnection Points, rules for imbalance charges and rules for operational balancing between TSOs. This also reflects the new Gas Day arrangements that are applicable across the Great Britain balancing zone via this code. It applied in Great Britain from 1 October 2015.

d. Commission Regulation ((EU) 703/2015 of 30 April 2015) establishing a Network Code on **Interoperability and Data Exchange Rules ("INT")**. This obliges TSOs to implement harmonised operational and technical arrangements in order to remove perceived barriers to cross-border gas flows and thus facilitate EU market integration. Implemented 1 May 2016.

e. Commission Regulation ((EU) 2017/240 of 16 March 2017) establishing a Network Code on **Harmonised Transmission Tariff Structures for Gas ("TAR")**. This introduces increased transparency of transmission tariff structures with a transparent reference price methodology that ensures a reasonable level of cost reflectivity and predictability but that also allows certain discounts to apply that facilitates security of supply and system flexibility. Phased implementation through to 31 May 2019.

f. Commission Regulation ((EU) 2017/459 of 16 March 2017), which amends CAM to introduce, for Interconnection Points only, a process for the release of incremental capacity, a process for capacity conversion, and amendments to the auction timetable.

g. Further legislative elements of the EU Third Energy Package concerning wholesale energy market integrity and transparency. This was taken forward by Regulation (EU) 1227/2011 and Regulation (EU) 1348/2014 (commonly known as **REMIT** and the **REMIT Implementing Regulation** respectively).

h. Revision of the Regulation on **Gas Security of Supply** ((EU) 2017/1938 of 25 October 2017) This replaces Regulation (EU) 2010/994 and introduces greater cooperation between Member States. It came into effect on 1 November 2017 with a phased implementation timetable through to 1 December 2018.

For more information on our activity to date and our future activity to comply with Third Energy Package EU legislation see Appendix 5.

Gas 2020 Package

The European Commission is now exploring further changes to the EU gas market rules, including a particular focus on decarbonisation of the gas networks to support achieving EU decarbonisation targets. This is known informally as the 'Gas 2020 Package', with several European studies under way to support this. We are feeding into this work through our involvement in ENTSOG and Gas Infrastructure Europe.

2.5 Asset health

The NTS is ageing and this means that asset health is becoming a more prominent issue. Asset health driven work accounts for over 40% of our capital plan. Over the RIIO-T1 period, we are planning to invest a total of £672m to maintain the health of our assets and to continue to deliver a safe and reliable network for our customers.

The NTS comprises 7,600km of pipeline, 24 compressor sites with 75 compressor units, 20 control valves and 530 above-ground installations (AGIs). 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, this means that over 70% of our network will be beyond its original life expectancy by the end of RIIO-T1. This isn't to say that all assets beyond their design life need replacing, but it does mean that careful management of these aging 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 our asset maintenance and asset health programmes to maintain the health of the NTS. Our 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.

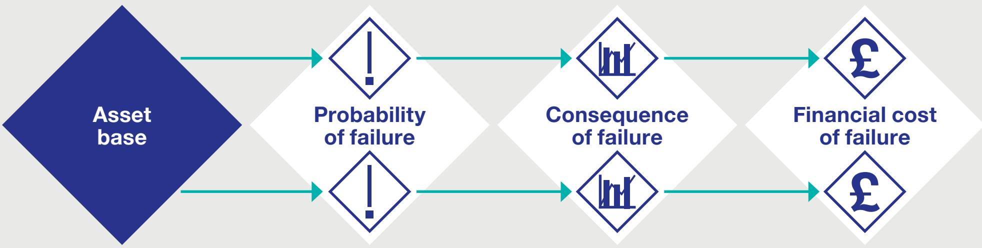
2.5.1 Developing our asset management approach

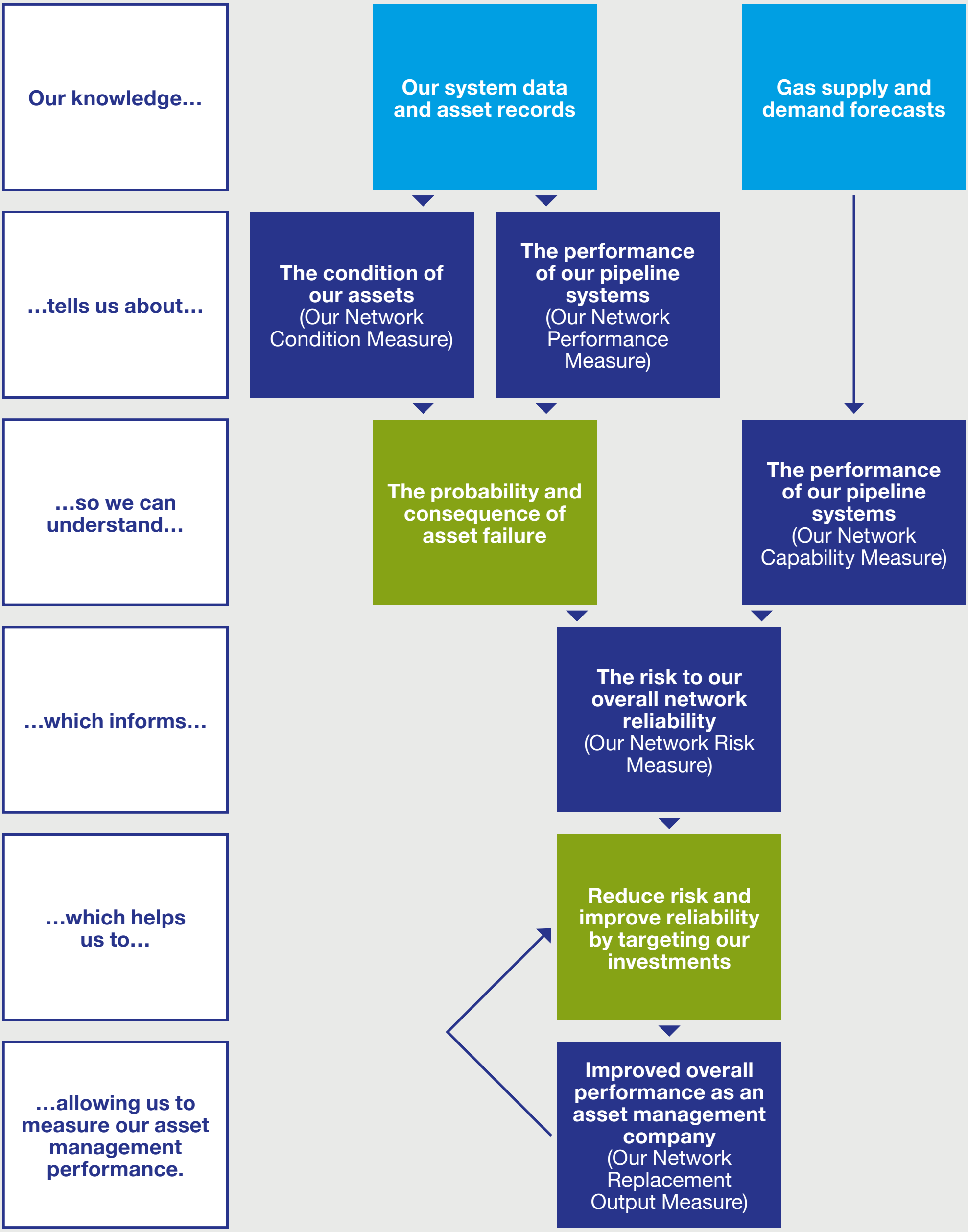
We manage our assets as efficiently as possible, however we recognise that our current approach is more reactive than we would like. Through our ISO55001 accreditation, we are continuously improving our asset management processes to ensure our asset strategies effectively manage network risk and deliver value for our customers. During 2017/18 we have been improving our asset management capability through investment in processes, data and technology systems.

A key aspect of this capability is the development of a monetised risk based approach to the planning and targeting of investments and the reporting of investment outcomes to Ofgem. During 2017/18 we have finalised a new NOMs methodology with Ofgem and key stakeholders.

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 greatest value to our customers and stakeholders.

We are currently progressing with the final stages of calibration, validation and testing (CVT) of this approach. This involves an expert review of the asset models and the results including sensitivity analysis and benchmarking outputs with similar industries in the UK and worldwide.




Our knowledge…
…tells us about…
…so we can understand…
…which informs…
…which helps us to…
…allowing us to measure our asset management performance.
Our system data and asset records
Gas supply and demand forecasts
The condition of our assets (Our Network Condition Measure)
The performance of our pipeline systems (Our Network Performance Measure)
The probability and consequence of asset failure
The performance of our pipeline systems (Our Network Capability Measure)
The risk to our overall network reliability (Our Network Risk Measure)
Reduce risk and improve reliability by targeting our investments
Improved overall performance as an asset management company (Our Network Replacement Output Measure)

2.6 RIIO T2

We know that the way we use and source our energy is changing and that, whilst the future is uncertain, gas is forecast to have a central role in the UK energy supply landscape up to and beyond 2050. We are planning the NTS against this uncertain future, and it is important that we don't lose the future optionality the NTS could provide to different energy futures, whilst continuing to provide a service that our customers and stakeholders rely on. We have listened to our stakeholders and are currently building our RIIO T2 plan aligned to industrial and domestic consumer priorities, highlighted in Figure 2.19.

Figure 2.19
Gas transmission stakeholder priorities

Industrial and domestic consumer priorities…

I want an affordable energy bill	I want to use energy as and when I want	I want you to minimise disruption to my life

…are delivered through our stakeholder priorities…

I want to take gas on and off the transmission system where and when I want	I want all the information I need to run my business, and to understand what you do and why	I want to connect to the transmission system	I want the gas system to be safe
I want you to protect the transmission system from cyber and external threats	I want you to care for communities and the environment	I want you to facilitate the whole energy system of the future – innovating to meet the challenge of an uncertain future	I want you to be efficient and affordable

…which were developed by consulting with…

Consumers	Landowners	Other networks	Customers
Think tanks and academics	Government	Industry bodies	Interest groups

Specific investments which are important to our stakeholders include:

- reducing our impact on the environment through continuing to invest to ensure our assets comply with emissions directives through our MCPD programme, as described in Section 2.4.1
- continuing to provide the safe and reliable service our customers expect through continuing to invest in the maintenance and replacement of existing assets
- ensuring that our assets are protected from external threats by continuing with our enhanced physical security (see Section 5.4) and a programme of works to improve our resilience to cyber threats
- improving resilience across the NTS by addressing potentially vulnerable areas of the NTS and undertaking cost-benefit analysis on viable physical and commercial options to reduce risk to our customers
- making the right decisions on decommissioning of redundant assets on the NTS. Where we no longer foresee a future requirement for an asset, we will investigate options to repurpose, reuse or recycle that asset before making decommissioning decisions
- accommodating changes in our customers' needs when flowing gas on or off the NTS, now and into the future
- reducing the cost and time to connect new customers who are contributing to improving energy security of supply or decarbonising UK energy supplies.

Chapter 3

System capability

System capability

This section outlines the current system capability of the NTS. Information is provided for entry and exit capacity. This chapter explores the Need Case stage of the NDP, which we use to establish NTS capability requirements.

We update you on current and future challenges which impact the way we plan and operate the NTS. We also discuss what we're doing to address them as the SO and TO. *GTYS* is used to provide information to help you to identify connection and capacity opportunities on the NTS.

Key insights

- We continue to provide information about lead times and capacity across different geographical areas and we aim to make our *GTYS* and our other publications more relevant to your needs.
- The future uncertainty of flows from St Fergus means we must be able to move gas south-to-north. We currently have limited capability to do this, but we do have time to assess potential solutions against the network changes. Flows are monitored and we expect to meet the necessary timescales to deliver any investments.

3.1 Introduction

System capability and the development of the NTS is managed through the NDP which we introduced in Chapter 1. Following on, Chapter 2 explored some of the triggers for this process.

This chapter describes what happens once we receive a 'trigger' and we enter the Need Case stage of the NDP. This is where we analyse the NTS's capability requirements. Included within this chapter are:
- Defining the Need Case
- Customer entry and exit capacity processes.

Understanding our system capability allows us to determine where rules, tools or asset solutions need to be found to meet our customer requirements.

3.2 NDP – defining the Need Case

Defining the 'Need Case' is the process through which we understand the implications of a change. We assess the level of risk to the NTS which allows us to determine the most credible method of addressing that risk. We articulate the cause of the problem or driver (the 'trigger') and consider any potential secondary drivers. This allows us to ensure we consider all opportunities and deliver the most efficient option.

An example of this could be a site with immediate asset health investment requirements. When assessing the health investment we would also consider rationalising the site to remove redundant equipment and incorporate the network's future requirements. We ask ourselves the following questions: What do we repair? What do we replace? What do we enhance? What do we remove? This allows us to make the most efficient longer-term investments and reduce the chance of stranded assets i.e. assets that are no longer required.

National Grid undertakes the role of SO for the NTS in Great Britain. Gas SO incentives are designed to deliver financial benefits to the industry and consumers by reducing the cost and minimising the risks of balancing the system.

Under RIIO, we are incentivised to think about Total Expenditure (TOTEX) as well as Capital Expenditure (CAPEX) and we need to demonstrate good value for money. We therefore focus on the need of the SO when considering asset and non-asset solutions. Our NDP allows us to articulate the change in risk of different options and present the SO need, both now and in the future.

We initially look at the 'counterfactual' option. This is the minimum or 'business-as-usual' action we could take ensuring compliance with relevant legislation. This may mean no investment or the minimum investment on a like-for-like basis to ensure safety and licence requirements are met. The change in risk is calculated and used to support the optioneering phase; these could be rules, tools or assets. Each option would then be assessed and either discounted if not feasible or fed into the cost-benefit analysis.

3.3 Customer capacity – exit

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 analyse our current system to assess what impact an increase in demand has on the current system capability. This allows us to identify and plan for any geographical constraints which may arise from increasing customer exit capacity demand in a particular area of the NTS. Where constraints to current system capability are encountered we use the NDP to identify options to meet our customers' needs in the most cost-effective and efficient way.

The following section provides Shippers, DNOs and Developers with information about the lead time for providing NTS entry and exit capacity. If unsold NTS exit (flat) capacity is available at an existing exit point then it can be accessed through the July application process for the following winter.

The obligated capacity level, less any already sold, is the amount of capacity that we make available through the application and auction processes. We can increase capacity above the obligated levels when system capability allows, through substitution and via funded reinforcement works.

If we identify reinforcement works or increased operational risk, we investigate substituting unsold capacity. Capacity substitution involves moving our obligation to make capacity available from one system point to another. This is intended to avoid the unnecessary construction of new assets. (Further information on substitution is available in the Transmission Planning Code (TPC)[3] and via the methodology statements[4]).

If substitution is not possible, we will consider whether a Need Case has been triggered and hence reinforcement works and contractual solutions will be investigated. Works on our existing sites, such as modification of compressors and above-ground installations (AGIs) may not require planning permission. This may result in shorter lead times. Significant new pipelines require a Development Consent Order (DCO), as a consequence of The Planning Act (2008). 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.

Figure 3.1
Capacity lead times

If capacity can be made available:		
without investment, for example by a contractual solution	with simple medium-term works or capacity substitution (non-planning act)	with more significant reinforcement works, including new pipelines and compression
<36 months	36 months	>36 months

[2] https://www.nationalgridgas.com/charging

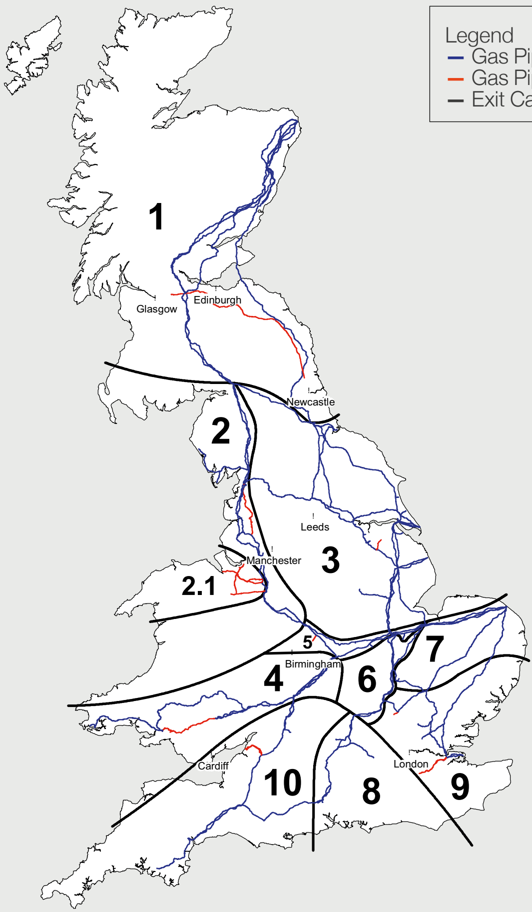
[3] http://www2.nationalgrid.com/uk/industry-information/gas-capacity-methodologies/

3.3.1 NTS capacity map

The NTS exit capacity map divides the NTS into zones based on key compressor stations, and multi-junctions. These zones are purely for information and were created for the Gas Ten Year Statement. Within these zones, any new connection and/or capacity request is likely to either be met through substitution within the zone or by a similar reinforcement project. It is likely that substitution within a zone will be close to a 1 to 1 basis. All 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.

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 EMR may have on interest in NTS connections and capacity.

Figure 3.2
NTS exit capacity map



Legend
- Gas Pipeline
- Gas Pipeline – Sensitive Area
- Exit Capacity Area

3.3.2 Available (unsold) NTS exit (flat) capacity

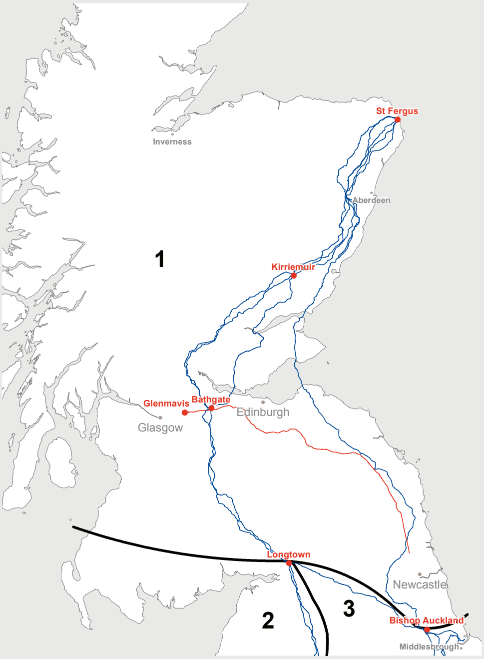
Table 3.1 includes the quantities of unsold NTS exit (flat) capacity in each zone that could be used to make capacity available at other sites through exit capacity substitution. The table also shows how unsold capacity has changed since the publication of the *2017 Gas Ten Year Statement*.

Table 3.1
Quantities of unsold NTS exit (flat) capacity

Region Number	Region	Obligated	Unsold		
		(GWh/d)	(GWh/d)	% of unsold capacity	% change from *GTYS* 2017
1	Scotland & the North	718	146	20	1
2	North West & West Midlands (North)	1,110	414	37	1
2.1	North Wales & Cheshire	315	202	64	1
3	North East, Yorkshire & Lincolnshire	1,573	433	28	-10
4	South Wales & West Midlands (South)	569	48	8	-6
5	Central & East Midlands	281	134	48	0
6	Peterborough to Aylesbury	126	29	23	0
7	Norfolk	367	119	32	0
8	Southern	526	312	59	16
9	London, Suffolk & the South East	1,504	470	31	-1
10	South West	461	98	21	3

Region 1 – Scotland and the North

Figure 3.3
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

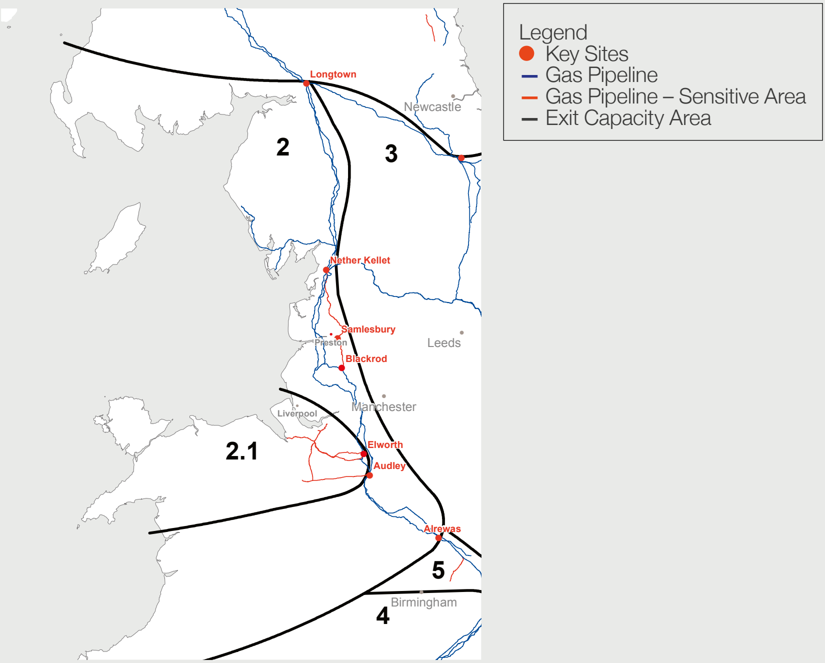
NTS/DN exit zones:
SC1, 2, 3, 4, NO1, 2

This region is sensitive to St Fergus flows.

High St Fergus flows mean exit capacity will be available. 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.

Region 2 – North West and West Midlands (North)

Figure 3.4
Region 2 – North West and West Midlands (North)



NTS location:

South of Longtown, north of Alrewas and east of Elworth

NTS/DN exit zones:

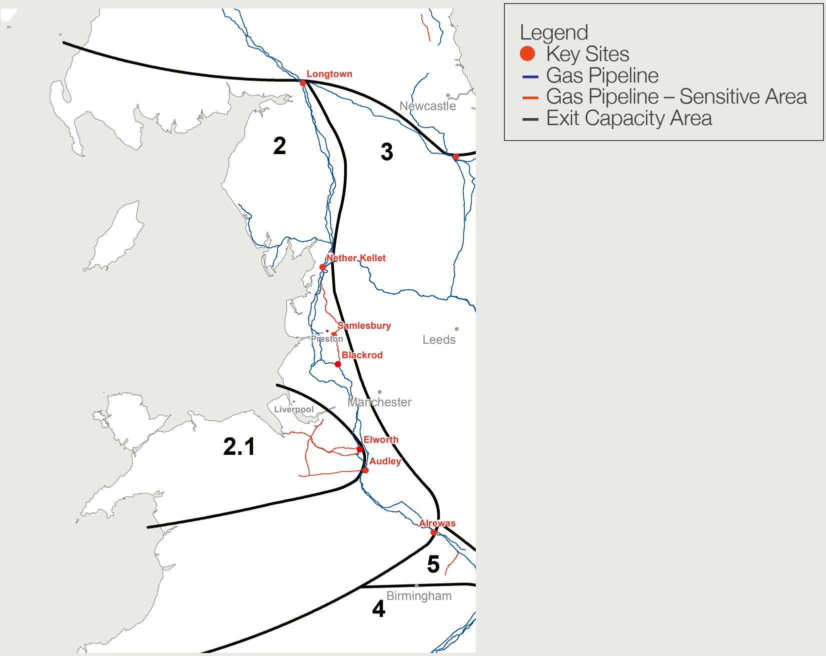
NW1, WM1

The 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 region around Samlesbury and Blackrod (North Lancashire and Greater Manchester).

Region 2.1 – North Wales and Cheshire

Figure 3.5
Region 2.1 – North Wales and Cheshire



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

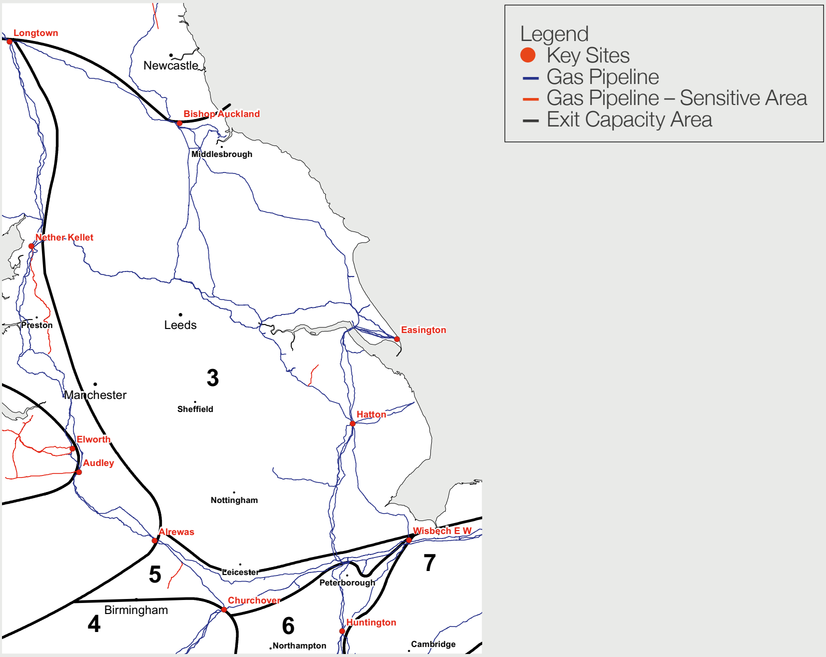
NTS/DN exit zones:
NW2, WA1

This is an extremity of the system with limited local supplies (Burton Point) but 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, but this is from direct connect offtakes where the capacity could 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.

Region 3 – North East, Yorkshire and Lincolnshire

Figure 3.6
Region 3 – North East, Yorkshire and Lincolnshire



NTS location:

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

NTS/DN exit zones:

NE1, 2, EM1, 2

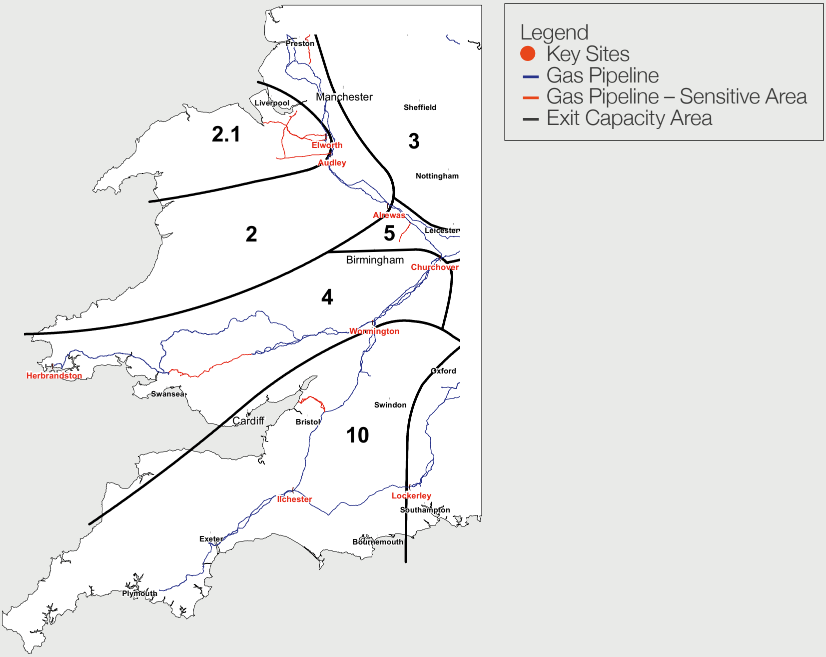
There are a number of power stations in this region and this may impact on future ramp rate agreements (the rate at which flows can increase at an offtake, as set out in the Network Exit Agreement – NExA).

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 Brigg (shown as a sensitive pipe).

Non-Planning Act reinforcements, including compressor modifications, could be carried out to make additional capacity available.

Region 4 – South Wales and West Midlands South

Figure 3.7
Region 4 – South Wales and West Midlands South



NTS location:
West of Churchover

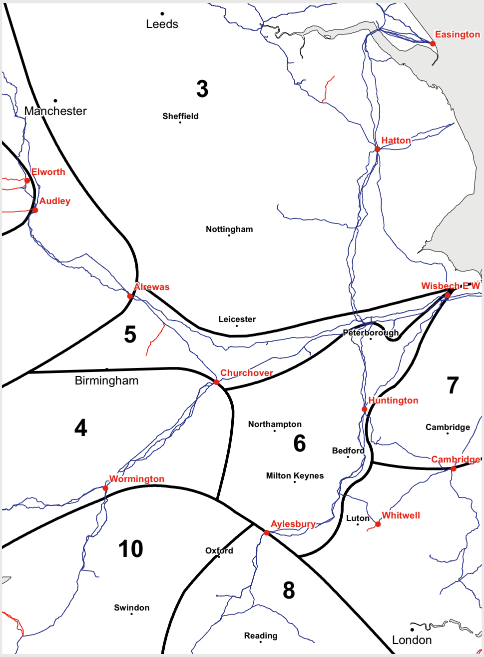
NTS/DN exit zones:
WM3, SW1, WA2

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, since the area south of Cilfrew is a sensitive area (shown in red) due to the different pressure ratings.

Region 5 – Central and East Midlands

Figure 3.8
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

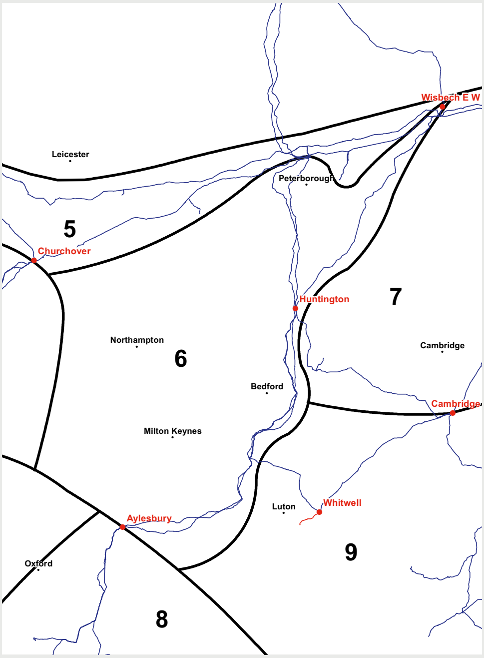
NTS/DN exit zones:

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, in particular for the sensitive area Austrey to Shustoke (shown in red).

Region 6 – Peterborough to Aylesbury

Figure 3.9
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

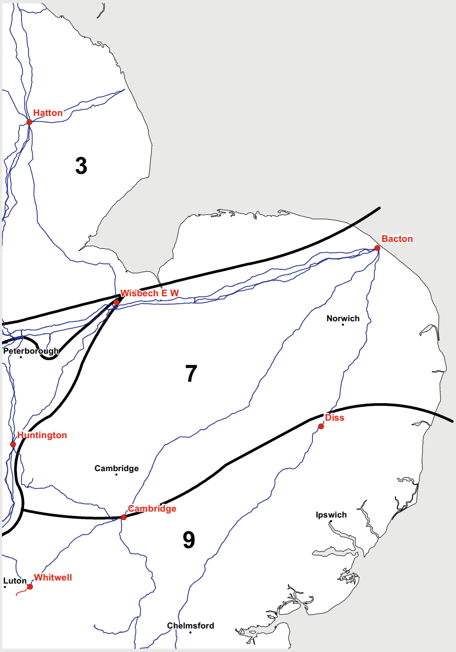
NTS/DN exit zones:

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.

Region 7 – Norfolk

Figure 3.10
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

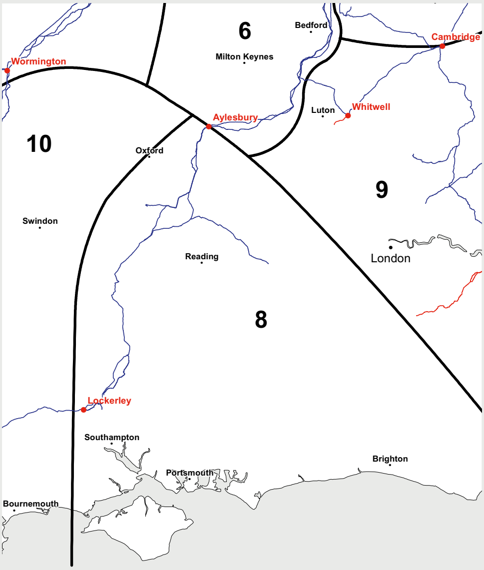
NTS/DN exit zones:
EA1, 2, 3

The 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.

Region 8 – Southern

Figure 3.11
Region 8 – Southern



Legend
Key Sites
Gas Pipeline
Gas Pipeline – Sensitive Area
Exit Capacity Area

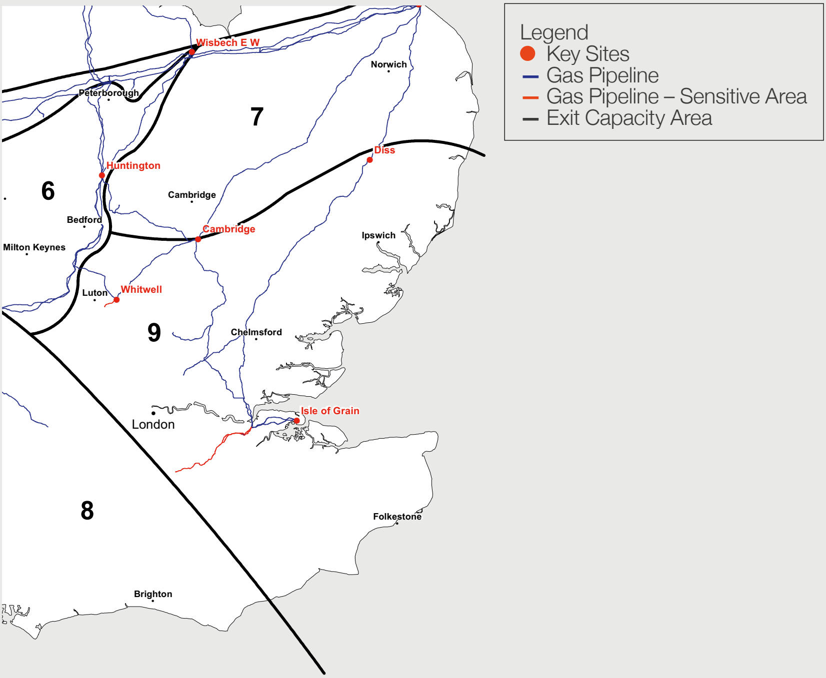
NTS location:
South of Aylesbury and north of Lockerley

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.

Region 9 – London, Suffolk and the South East

Figure 3.12
Region 9 – London, Suffolk and the South East



NTS location:

South Diss, Cambridge, east of Whitwell

NTS/DN exit zones:

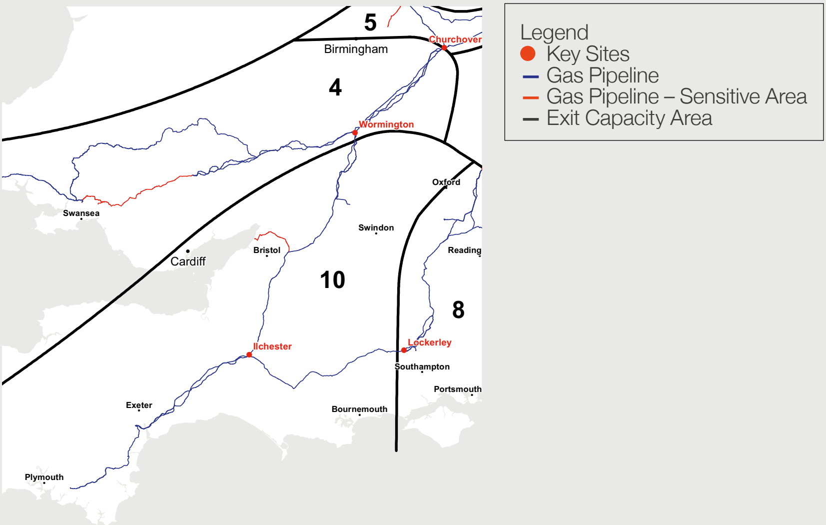
EA4, 5, NT1, 2, 3, SE1, 2

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 shown in red (Tatsfield, Peters Green).

The significant number of power stations in the region may impact on future ramp rate agreements (the rate at which flows can increase at an offtake, as set out in the Network Exit Agreement – NExA). Unsold capacity indicates a good chance that 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.

Region 10 – South West

Figure 3.13
Region 10 – South West



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 shown in red (west of Pucklechurch on the feeder 14 spur) due to small diameter pipelines. There is sensitivity to low Milford Haven flows.

3.3.3 Directly Connected exit points

Table 3.2 shows which region the current Directly Connected (DC) offtakes fall within. There are no such offtakes in region 8.

Table 3.2
Direct connect offtakes by region

Region	Offtake
1	Blackness (BP Grangemouth)
	Fordoun Industrial
	Glenmavis (Storage)
	Gowkhall (Longannet)
	Moffat Irish interconnector
	St Fergus (Peterhead)
	St Fergus (Shell Blackstart)
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
	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
	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

3.3.4 NTS/DN exit zones

Figure 3.14
NTS exit zones

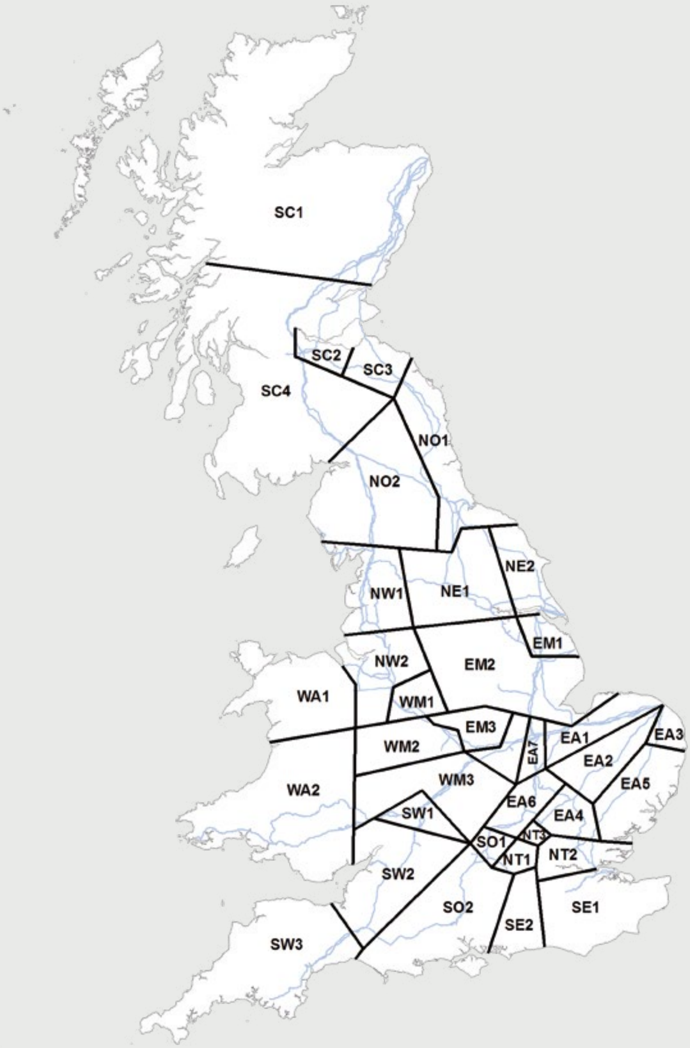


Figure 3.14 and Table 3.3 show which distribution network exit zones the current NTS/DN offtakes fall within.

Table 3.3
NTS/DN exit zones

Exit Zone	Offtake	Exit Zone	Offtake	Exit Zone	Offtake
EA1	Eye	NO1	Guyzance	SC4	Nether Howleugh
	West Winch		Cowpen Bewley		Lockerbie
	Brisley		Coldstream		Pitcairngreen
	Bacton Terminal		Bishop Auckland		Bathgate
EA2	Bacton Terminal		Corbridge		Stranraer
	Great Wilbraham		Thrintoft		Glenmavis
	Roudham Heath		Saltwick		Drum
			Humbleton	SE1	Tatsfield
EA3	Bacton Terminal		Little Burdon		Shorne
	Yelverton		Elton		Farningham
EA4	Matching Green	NO2	Wetheral	SE2	Winkfield (SE)
	Royston		Keld	SO1	Ipsden
	Whitwell		Melkinthorpe		Winkfield (SO)
			Tow Law	SO2	Mappowder
EA6	Hardwick	NT1	Winkfield (NT)		Braishfield
EM1	Thornton Curtis	NT2	Horndon	SW1	Fiddington
	Walesby		Luxborough Lane		Evesham
EM2	Kirkstead	NT3	Peters Green		Ross (SW)
	Sutton Bridge	NW1	Blackrod	SW2	Littleton Drew
	Silk Willoughby		Salmesbury		Easton Grey
	Gosberton		Lupton		Cirencester
	Blyborough	NW2	Mickle Trafford		Ilchester
EM3	Alrewas (EM)		Malpas		Pucklechurch
	Blaby		Warburton		Seabank
	Drointon		Weston Point	SW3	Kenn
	Tur Langton		Partington		Aylesbeare
EM4	Market Harborough		Holmes Chapel		Lyneham (Choakford)
	Caldecott		Ecclestone		Coffinswell
NE1	Towton		Audley (NW)	WA1	Maelor
	Rawcliffe	SC1	Careston	WA2	Dyffryn Clydach
	Baldersby		Balgray		Dowlais
	Pannal		Kinknockie		Gilwern
	Asselby		Aberdeen	WM1	Aspley
	Burley Bank		St Fergus		Audley (WM)
NE2	Ganstead		Mosside		Milwich
	Pickering	SC2	Broxburn	WM2	Shustoke
	Paull		Armadale		Austrey
		SC3	Hulme		Alrewas (WM)
			Soutra	WM3	Ross (WM)
					Rugby
					Leamington Spa
					Lower Quinton
					Stratford-Upon-Avon

3.4 Customer capacity – entry

As with exit capacity it is important for us to understand our customers' gas supply (entry capacity) requirements to the NTS to again allow us to plan and operate our system efficiently and effectively. When we receive an entry capacity request we analyse our current system to assess what impact an increase in supply in a particular part of our system has on the current capability. This allows us to identify and plan for any geographical constraints which may arise from an increase in customer entry capacity in a particular area of the NTS. Where constraints to current system capability are encountered, we use the NDP to identify options to meet our customers' needs in the most cost-effective and efficient way.

This section 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 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.

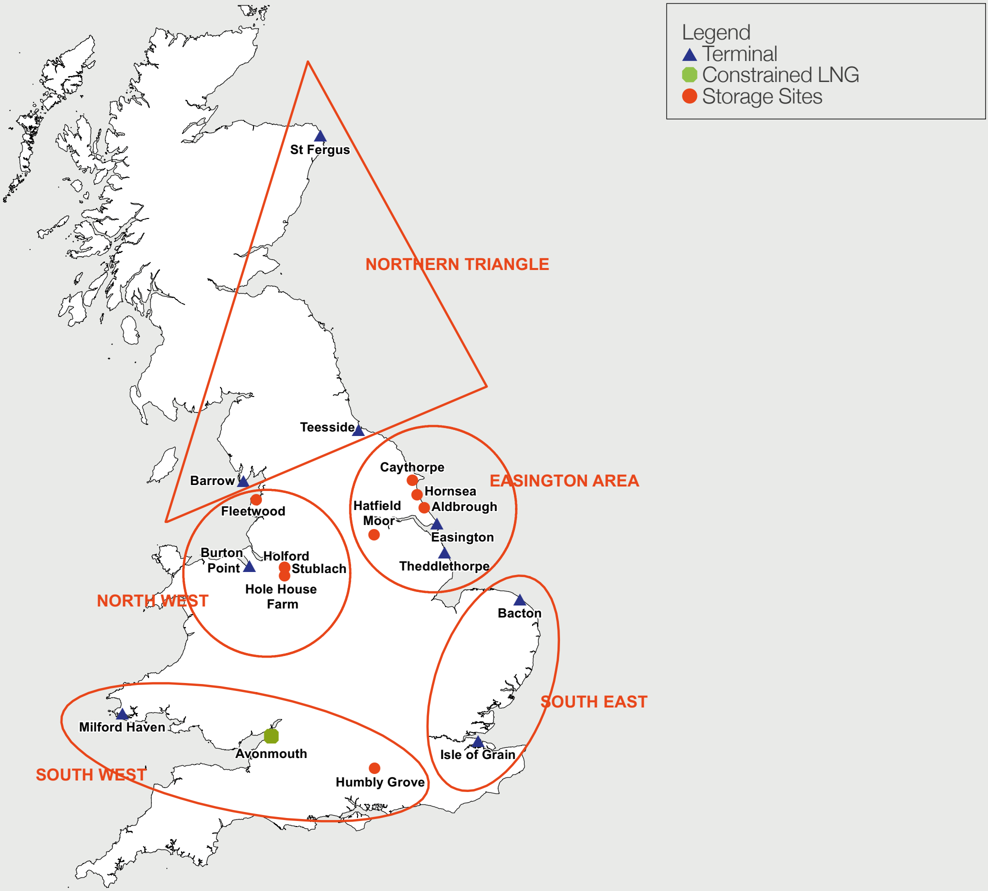
We aim to help you understand the likely lead time associated with new entry points. New entry points can result in significant changes to network flow patterns and we encourage you to approach our customer service team to discuss specific requirements. This information is just an indication; actual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

3.4.1 Entry planning scenarios

Chapter 2, Section 2.3.2 discussed the uncertainties in the future supply mix that arise from both existing supplies and potential new developments. The available supplies, in aggregate, are greater than peak demand. The supply uncertainty is further increased by the Gas Transporters Licence requirements for us to make obligated 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 *GFOP* work.

To help understanding of entry capability, we use the concept of entry zones which contain groups of ASEPs (Figure 3.15). These zones are discussed in further detail in Section 3.4.2. The entry points in each 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 which mean that interactions between supplies must also be determined when undertaking entry capability analysis. Examples are the interactions 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 3.15
Zonal grouping of interacting supplies



Key scenarios we examine through the planning process include:

- 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 these 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 this technique indicates that future requirements from the network are outside of current capability, we would investigate a range of possible solutions (regulatory, commercial and physical). This ensures that a broad spectrum of solutions is identified. Where investment in assets is the optimum solution, we would carry out further optioneering through the planning process.

3.4.2 Available (unsold) NTS entry capacity

Table 3.4 indicates the quantities of obligated and unsold NTS entry capacity at each ASEP within each entry zone.

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.

Table 3.4
Quantities of entry capacity by zone

Entry Zone	ASEP	Obligated Capacity GWh/day	Unsold Capacity 2018/2019 GWh/day	2022/2023 GWh/day	2025/2026 GWh/day
Northern Triangle	Barrow	340.01	200.7	280.46	340.01
	Canonbie	0	0	0	0
	Glenmavis	99	99	99	99
	St Fergus	1,670.70	1,445.55	1,635.89	1,666.94
	Teesside	445.09	321.05	414.52	444.37
North West	Burton Point	73.5	57.64	73.5	73.5
	Cheshire	542.7	28.59	28.59	28.59
	Fleetwood	350	350	350	350
	Hole House Farm	296.6	13.16	13.16	13.16
	Partington	215	215	215	215
Easington Area	Caythorpe	90	0	0	90
	Easington (incl. Rough)	1,407.15	106.2	138.28	647.48
	Garton	420	0	0	420
	Hatfield Moor (onshore)	0.3	0.3	0.3	0.3
	Hornsea	233.1	27.31	27.31	233.1
	Hatfield Moor (storage)	25	3	25	25
	Theddlethorpe	610.7	598.6	610.7	610.7
South West	Avonmouth	179.3	179.3	179.3	179.3
	Barton Stacey	172.6	82.6	172.6	172.6
	Dynevor Arms	49	49	49	49
	Milford Haven	950	0	150	150
	Wytch Farm	3.3	3.3	3.3	3.3
South East	Bacton IP	1,297.80	1,013.40	1,181.50	1,297.80
	Bacton UKCS	485.6	0	0	180.02
	Isle of Grain	699.64	35.34	35.34	277.04

Table 3.4 contains the ASEP names as defined in the NTS Licence. For clarity, the Garton ASEP contains the Aldborough storage facility, the Barton Stacey ASEP contains the Humbly Grove storage facility and the Cheshire ASEP contains the Hill Top Farm, Holford and Stublach gas storage facilities. More information on storage facilities can be found in Appendix 4.

Our Charts And Tables Workbook provides further information about the level of booked and obligated entry capacity at each ASEP, excluding those that are purely storage. The figures also provide data points representing historic maximum utilisation nd the range of future peak flow scenarios for these ASEPs. While all un-booked 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.

Entry Zone – Northern Triangle

ASEPs: Barrow, Canonbie, Glenmavis, St Fergus, Teesside (and Moffat)

These northern supplies need to be transported down either the east or west coast of England to reach major demand centres in the Midlands and south of the country.

The amount of unsold capacity in this region, combined with the reduced St Fergus forecast flows, indicates a high likelihood that capacity could be made available through entry capacity substitution. Potential non-Planning Act reinforcements, including compressor reverse flow modifications, could release further quantities of additional capacity.

Entry Zone – North West

ASEPs: Burton Point, Cheshire, Fleetwood, Hole House Farm, Partington

These five ASEPs use common infrastructure and the main west coast transportation route to move gas into the rest of the system.

The unsold capacity in this region indicates that some capacity could be made available via entry capacity substitution; however, entry capability will not necessarily match entry capacity and exchange rates may be greater than one to one. Potential non-Planning Act reinforcements, including compressor reverse flow modifications, could release additional capacity but significant pipeline reinforcement would then be required, resulting in long (Planning Act) timescales.

Entry Zone – South West

ASEPs: Avonmouth, Barton Stacey, Dynevor Arms, Milford Haven, Wytch Farm

This zone enables sensitivity analysis around potential LNG supplies from Milford Haven.

The quantity of unsold capacity in this zone is principally at the Avonmouth and Dynevor Arms ASEPs associated with the LNG storage facilities. Due to the short duration of deliverability of these facilities, it is unlikely that the capacity could be made available for entry capacity substitution other than for equivalent facilities. Significant pipeline reinforcement and additional compression would be required to provide incremental capacity resulting in long (Planning Act) timescales.

Entry Zone – South East

ASEPs: Bacton UKCS, Bacton IP, Isle of Grain
The ASEPs use common infrastructure away from the Bacton area

While there is a high degree of interaction between the Bacton (UKCS & IP) and Isle of Grain ASEPs, the quantity of unsold capacity in this zone cannot be interpreted as an indication of suitability for entry capacity substitution. This is due to constraints on the network in terms of the ability to transport gas south to north. Potential non-Planning Act reinforcements, including compressor reverse flow modifications, could release some additional capacity, but significant pipeline reinforcement would then be required resulting in long (Planning Act) timescales.

3.5 Needs Case review

Here we review all previous decisions and summarise the Need Cases completed over the last 12 months.

3.5.1 Asset health

A significant number of the Need Cases relate to asset health projects. These Need Cases look at the impact of removing the assets/sites from the network and assessing the potential impact. Optioneering is then completed looking at the full range of rules, tools or assets. More information on some of the bigger projects is detailed below.

Bacton

Bacton is a key gas entry point to the UK and will continue to be into the future. It was built in 1969 and is in a coastal environment which accelerates degradation such as corrosion. The site is a critical component of the gas transmission network. It is a key dynamic swing node for a large subset of the customer base at an interdependent part of the network. It bridges Great Britain with EU and controls flows into the South East, ensuring security of supply for London and the important west–east transit route for LNG to Europe.

There are plans to modify the BBL Interconnector to enable bi-directional flows. This, along with changing customer demands and a potential increase in LNG usage, could make it more challenging to meet our pressure obligations at some south-east offtakes from 2025. Numerous options are being considered to reduce these impacts, so we continue to meet our customers' needs.

The site manages a large volume of the nation's gas. In March 2013, a late cold snap when storage was low at the end of winter required record flows from Bacton. For the entire month of March 2013 Bacton supplied on average 33% of UK demand with a maximum flow of 139.1 mcm/d (40% of UK demand) on 21 March 2013.

Changing UK supplies and demand meant we should assess the future requirements of the site to efficiently invest in asset health. The site requirements have been defined and will be monitored continuously. A detailed cost-benefit assessment is in progress to determine what functionality needs to be retained as the site is rationalised. The finalised business case for the optimal solution for the site will form part of the RIIO T2 submission.

Plant without a Need Case

We are seeing a growing number of assets that are no longer required. There is currently no funding mechanism for us to cover the cost of removing these assets and return land back to greenfield if no longer required. We will be working with Ofgem, as part of the RIIO T2 submission, to develop a framework to cover the costs of these works. Examples of assets that no longer have a Need Case are:

- Wormington and Huntingdon compressor aftercoolers
- The Orenda compressor units at Churchover compressor station
- We're reviewing the implications of the closure of the Theddlethorpe entry terminal.

These assets have been isolated as part of other works on site.

3.5.2 Deferred asset investment

Here we detail how improvements in our planning process have helped us optimise when we commit to our investment decisions.

Avonmouth

The allowances to replace the operational service currently provided by the LNG storage facility at Avonmouth has been removed as part of RIIO-T1 mid-point review. Our analysis and work with stakeholders, most notably the Health and Safety Executive and Wales & West Utilities, determined that a physical build now is not in consumer interests.

In accordance with our Transmission Planning Code, we will continue to monitor the demand situation in the South West, however now there is not an investment requirement and Ofgem has reduced our load-related expenditure allowance.

Chapter 4

System operation

System operation

This chapter describes how we are investing in our capabilities as the SO to make the most of our network. These investments mean we can continue to plan to operate, and then operate, our network safely and efficiently.

The non-asset solutions, the 'rules and tools' we are developing, are triggered as part of the Establish Portfolio stage of our NDP; we discuss this progression in more detail.

Key insights

- As the SO we must provide a safe and reliable network. We know you want to flow gas using within-day profiles that meet your operational, commercial and contractual needs, and you want minimum restrictions.
- Our challenge is to make the most efficient investment decisions to make the most of our existing network before we build new assets.
- We are continuing to enhance our forecasting, analytical, decision support and reporting capabilities by improving our processes and investing in our systems and tools.
- In August 2018, Gas System Operation began publishing pressure forecasts (minimum, maximum, and average) to the industry for terminal entry points onto the NTS.
- We are increasingly sharing more information on our operational performance with you in the Operational and SO forums. We host the forum with Shippers and DNOs, and through documents that we publish, such as this.

4.1 Introduction

As SO, our responsibility is to transport gas from supply points to offtakes, providing a safe and reliable network. Where operational strategies cannot be used to maintain transportation of supply we need to make physical changes to our network. These physical changes are outlined in Chapter 5 (System Development). In Chapter 4 we discuss how we operate our current network.

The way we operate the NTS is affected by a number of obligations, unchanged since the *GTYS* 2017 publication.

Safety and system resilience:

- We must plan and develop the NTS to meet Pipeline System Security Standards.
- We must maintain NTS pressures within safe limits.
- We must maintain the quality of gas transported through the NTS to meet the criteria defined within the GS(M)R to comply with UK gas appliances.
- We must maintain network capabilities to effectively manage or mitigate a gas supply emergency.

Environment:

- We must minimise our environmental impact.

Facilitating efficient market operation:

- We must meet the pressures contractually agreed with our customers.
- We must provide you with information and data that you need to make effective and efficient decisions.
- We must make NTS entry and exit capacity available in line with our licence obligations and contractual rights.
- We must take commercial actions in the event that system capability is lower than contractual rights.
- We must manage gas quality (calorific value) at a zonal level to ensure consumers are fairly billed for the gas they use.
- We must optimise the use of NTS infrastructure.

You have told us that you value the ability to flow gas using within-day profiles to meet your operational, commercial and contractual needs, with minimal restrictions. You want us to maximise our performance in this area.

To do this, we are focusing on:

- operating the NTS effectively and efficiently to maximise its capability while meeting our statutory and commercial obligations
- developing methods (including analytical capabilities) to quickly identify, manage and mitigate any network issues to minimise the impact on you
- optimising, scheduling and managing access to the NTS for maintenance and construction activities to minimise the impact on you
- providing you with flexibility to flow gas at the most efficient profile for you, even where this flexibility exceeds contractual rights. As you would expect, we must make sure that this operational flexibility does not create unacceptable system risks or have a detrimental impact on our other customers.

So our challenge is to maximise value from our existing network by investing in our capabilities as the SO.

In this chapter we describe current and planned developments to our SO capabilities and explain how we make decisions between investing in our capabilities and installing new assets.

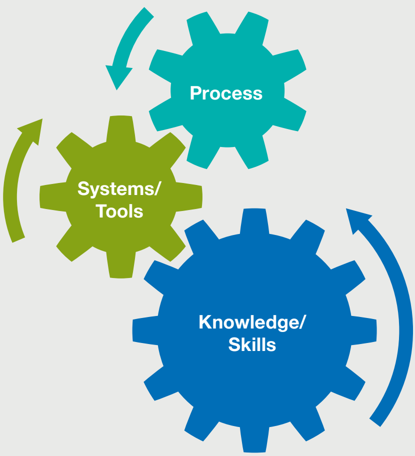
4.2 What are SO capabilities?

Our SO capabilities describe what we need to do to be able to produce outputs that, when combined, deliver the most value for you.

Figure 4.1
Examples of some of the inputs and outputs of our SO capability

To make sure our outputs are fit for purpose, each SO capability requires a combination of efficient business processes, effective technology (systems/tools), skilled and knowledgeable people (see Figure 4.2).

Figure 4.2
Key inputs required for our SO capabilities



4.3 Deciding between SO capabilities and assets?

We use our NDP to assess system capability requirements; this was introduced in Chapter 1. Here we discussed how we consider and improve the capability of the system and use the NDP to assess our capability as SO. Chapter 2 explored some of the triggers for this process and Chapter 3 described the Need Case stage of the NDP where we calculate the NTS's capability requirements.

Understanding our system capability and our capability as the SO allows us to determine where rules, tools or asset solutions need to be found to meet our customer requirements. This chapter will discuss where, as SO, we can better use rules and tools to make more efficient use of the system. Chapter 5 (Asset development) will follow on from this by discussing how the asset solutions are developed.

Under RIIO, we are incentivised to think about Total Expenditure (TOTEX) as well as Capital Expenditure (CAPEX). We need to demonstrate good value for money. We therefore focus on the need of the SO, both now and in the future, when considering the solutions to meeting our system capability requirements.

To ensure these solutions represent value for the consumer we assess them using a cost-benefit analysis (CBA). This involves calculating the net present value (NPV) for each solution. The present value (PV) of the project represents the total value in today's money. This is done using a technique called discounting[1], which values money in the future less than money today. The NPV compares the costs and benefits of a project.

For each project, we consider a range of solutions. These include both asset and non-asset solutions. Asset solutions are where we either install new assets or alter existing assets. Non-asset solutions are where we look to put in place commercial arrangements or change regulations. The CBA produces an NPV by considering a wide range of costs for each solution, such as: purchasing new assets, ongoing asset health, changes to site configuration, compressor fuel usage, constraint management costs, site operation and commercial contracts. Each solution has the costs calculated for the full duration of the assessment[2].

The NPV of a solution is not the only factor considered. To ensure a wider range of benefits are considered we also perform a qualitative assessment. This will include operational issues, impacts on maintenance and future flexibility. The solutions are progressed based on both their NPV and the qualitative assessment.

We actively work with our customers to ensure we understand their needs and that together we can make informed decisions that are right for end consumers. Later on in this chapter we will give some examples of work we are doing in this area.

We are constantly reviewing our current systems and processes in order to refine what we do and how we do it. This maximises the value we get from our existing network through improved forecasting, analysis, risk assessment and decision making (across all time horizons) before we invest in asset solutions.

[1] The rate used for discounting is the social time preference rate (STPR) as defined in the Treasury Green Book: https://www.gov.uk/government/publications/the-green-book-appraisal-and-evaluation-in-central-government

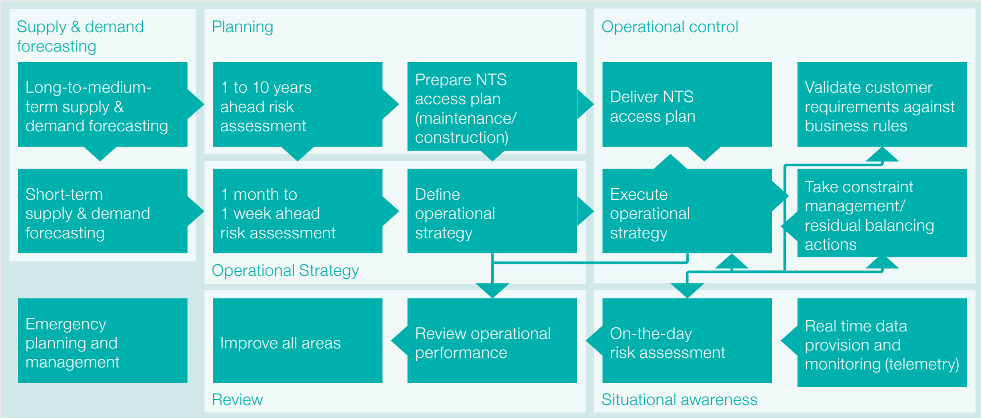
[2] The duration of the assessment is the same for all the solutions, this is usually set by lifetime of the asset solutions under consideration.

4.4 Investing in our SO capabilities

Our SO capabilities can be grouped into categories which have been summarised in Figure 4.3 below. Figure 4.3 gives an example of how information flows between our operational capabilities; it does not represent our organisational structure.

To make sure our outputs are fit for purpose, each SO capability requires a combination of efficient business processes, effective technology (systems/tools), skilled and knowledgeable people (see Figure 4.2).

Figure 4.3
Our SO operational processes



We use a combination of these capabilities to deliver our daily operational strategies and plans which make sure we provide a safe and reliable network for you.

We are committed to developing our people to make sure they have the right knowledge, skills and experience to drive efficiency and maximise our process and system performance to deliver a reliable network for our customers.

The following sections provide more detail on each of our key operational capabilities including how we are improving our processes and what investments we are making to develop our systems and tools.

4.4.1 Supply and demand forecasting

What is it?

- Effective and accurate forecasting of gas supply and demand is critical to our SO decision-making processes, particularly with increasingly uncertain future supply and demand patterns.
- Our supply and demand forecasts are based on *FES* (see Chapter 2) as well as the latest market information. Forecasts are produced annually, monthly, weekly and daily, depending on the activity being undertaken.
- The forecasts feed into Planning Network Access (one to ten years ahead), Planning and Procuring activities (one month to one week ahead), and real time Operational Control and Situational Awareness of the NTS (day ahead to within-day).
- We share our forecasts with you through our information provision systems to facilitate an efficient market[3], by helping you manage your supply/demand balance position.

How are we improving?

Process

Long to medium term

- We continuously improve our long-to-medium term supply and demand forecasts by ensuring we have an effective feedback loop from the operational and short-term teams back in to the longer-term forecasting teams, to capture and resolve any data gaps or inconsistencies quickly.

Short term

- We aim to maximise the efficiency of our current processes using our existing tools and systems. As we develop new forecasting tools, we revise and optimise our existing processes to make the most of the new technology.

Drivers for change

- Diversity of supply imports.
- Increased arbitrage through interconnectors.
- Changes in UK installed gas generation capacity and gas/coal forward spread.
- Price sensitive operation of fast cycle storage.

Systems/Tools

Long to medium term

- In 2017 we completed a project working with experts from the University of Warwick to investigate the latest data-mining tools to help us better understand possible long-term future supply and demand patterns. We worked with the Statistics Department at the university to consider several new methods for analysis of the data sets we use in risk assessments. An approach called cluster analysis was identified as one of the suitable tools. This is a mathematical technique that allows for automatic classification of supply and demand patterns that could lead to similar risks within the network. Broadening our analysis in this way means we can build a better understanding of where constraints are on our network. This will help us to improve safety, risk management and investment planning – and reduce the probability of network constraints. This should impact positively on all our key stakeholders and customers.

  For more information on this project, NTS Constraint Modelling, please visit the Smarter Networks Portal via the link provided below. **http://www.smarternetworks.org/project/nia_nggt0022**

Short term

- We continue to improve our short-term forecasting tools and then integrate them into our Gas Control Suite (GCS) which was commissioned in July 2016.

[3] http://mip-prod-web.azurewebsites.net/PrevailingView/Index

4.4.2 Planning

What is it?

- Planning considers a time horizon of approximately one to ten years ahead. Analytical risk assessments (incorporating commercial and physical factors) are used to identify and quantify possible future system constraints, which may affect our system capability.
- We assess the capability of our system to operate safely while meeting our regulatory and contractual obligations, e.g. Assured Offtake Pressures (AOP), while continuing to deliver your anticipated flow profile requirements.
- If the network has insufficient capability we are able to use our SO constraint management tools, such as capacity substitution, bilateral contracts and on-the-day flow swaps as part of long-term commercial and operational strategies to deliver a reliable service for you.
- We consider whether variations to existing industry rules and our associated obligations would impact our network capability.
- Other outputs from this activity include our NTS Access Plan where we agree mutually acceptable timescales with the TO for maintenance and construction activities. This enables us to notify you when critical maintenance activities affecting your assets will be carried out.
- As described in Chapter 2, our focus on asset health means that we are likely to continue undertaking a large number of maintenance activities. Our aim is always to minimise the impact on you by effective works planning and clear communications.
- In Planning we also identify a Need Case for gas operating margins (OM) . We can use OM when there is an operational balancing requirement which cannot be satisfied by taking other system balancing actions or as a result of damage or failure on any part of the NTS.

Drivers for change

- Increased number of possible future supply and demand forecasts.
- Large day-to-day and within-day change in supply and demand.
- Our large programme of asset health works out to 2021.

How are we improving?

Process

- We continue to develop improved relationships and ways of working with our TO colleagues in National Grid Gas Transmission to ensure that construction and maintenance activities can be delivered without risking our ability to provide a safe and reliable network for you to supply or use gas.
- During 2017, we completed a project which proposed changes to our planning processes which will improve our ability to assess customer requirements, alongside others' needs, and will ensure that our planning processes reflect the operational conditions experienced by our control room. The proposals will also allow us to draw a clearer line of sight between what we are planning for, and how we are accounting for it in our processes. To formally implement these proposals we updated our Transmission Planning Code document and consulted on these changes during July and August 2017.
- These changes include how we deal with both foreseen and unforeseen events on the network. Foreseen events include supply and demand profiling, while unforeseen events include supply losses, sudden CCGT demand increase (due to generation requirements in the electricity market) and compressor trips. We also changed how we assess DN pressure requirements. We assess a level of pressure at DN offtakes, appropriate to the LDZ demand level, in addition to Assured Offtake Pressures. It is important to note that these changes do not affect the existing commercial and regulatory arrangements concerning Assured Offtake Pressures.

  For more information on the updates made to our Transmission Planning Code please visit **https://www.nationalgrid.com/uk/gas/charging-and-methodologies**

Systems/Tools

- Given the increasingly uncertain environment and the range of time horizons, the number of possible supply and demand forecasts that we need to consider has increased in recent years. The ability to effectively analyse this wide range of scenarios in order to understand the impact on system operation and capability is becoming increasingly vital to our operational and planning activities.
- We are continuing to develop our ability to undertake multi-scenario network analysis over both planning and operational timescales. Compared to existing analysis techniques and activities, this capability will allow us to better understand the operational impact of a greater number of forecast scenarios than we have previously been capable of with our current tools and processes.
- We can use the new multi-scenario analysis approach to assess future Need Cases and evaluate network access requests. When combined with the improvements in our long-to-medium term supply and demand forecasting capabilities, this enables us to develop more comprehensive, robust and probabilistic long-term commercial, investment and operational strategies, thereby minimising costs for the community.
- This can also allow us to develop a more informed NTS Access Plan with reduced risk of maintenance activities on your assets being cancelled or deferred as a result of operational constraints.

4.4.3 Operational strategy

What is it?

- Within our operational strategy activities we develop short-term plans to ensure that we can configure our network and associated assets in an optimum configuration to meet your flow and pressure requirements each Gas Day.
- These short-term plans are developed from approximately one month ahead of the Gas Day, through to week-ahead and end with on-the-day control room support. Our plans are based on our long-term risk assessments and are continually refined and optimised using up-to-date market and customer intelligence plus the latest supply and demand forecasts.
- Our short-term plans identify and mitigate risks for the safe and reliable operation of the system. We provide our control room with the latest up-to-date commercial and physical information, so that they can facilitate NTS access while maximising the capability of the network for you to use.
- We identify opportunities to perform against our SO incentives, which have been structured and agreed with the regulator to deliver value for our customers and stakeholders.

Drivers for change

- Large day-to-day and within-day change in supply and demand.
- Greater price sensitive operation.
- Shorter customer notice periods, particularly in response to changes in the electricity market.

How are we improving?

Process

- We regularly review and develop our short-term strategy processes to ensure efficiency and to confirm that we are continuing to deliver the needs of our control room, who, in turn, deliver for you.
- In August 2018, Gas System Operation began publishing pressure forecasts (minimum, maximum, and average) to the industry for terminal entry points onto the NTS.

Systems/Tools

- The multi-scenario network analysis enhancements described earlier in this chapter can also be used to realise benefits in our planning and procurement activities. These analysis enhancements allow us to target our efforts into more detailed, in-depth analysis for areas at higher risk of impacting our ability to meet customer requirements or where there are system improvement opportunities for the SO.
- When combined with the ongoing improvements in short-term supply and demand forecasting, and improved systematisation and visualisation of results from the analysis, it will allow us to provide more informed and optimised plans to the control room to mitigate the risk of your operation being affected.

4.4.4 Situational Awareness

What is it?

- Situational Awareness is the first of our operational capabilities that relates to the real-time operation of the NTS.
- During day-to-day operation, our control room must be aware of the level of operational risk and how this affects our ability to meet our daily customer requirements. Real-time information allows us to make informed decisions to ensure that we efficiently operate the system so that you can flow gas safely.
- We monitor and assess both the current and predicted status of assets, flows, pressures, linepack, gas quality parameters and national energy balance.
- Both Situational Awareness and Control (outlined later in this chapter) could be considered as a single activity. In Situational Awareness we receive, process, and interpret real-time data to determine current and future operational risks. In Control we resolve any system issues to maintain safe and efficient operation.

Drivers for change

- Within-day change in supply and demand.
- Price sensitive operation.
- Increasing range of quality of gas (within GS(M)R limits).

How are we improving?

Process

- In line with the replacement of our existing operational systems, new fit-for-purpose processes will be developed and implemented where appropriate.

Systems/Tools

- In July 2016 we replaced our core control room and support systems with the new GCS, which provides enhanced telemetry and data analytics functionality to the control room and support teams. GCS is a modular system, allowing us to continually review and revise functionality, to optimise use throughout the SO.
- We continue to integrate the real-time version of our network analysis software, SIMONE (Online), into GCS. SIMONE (Online) is connected to our Supervisory Control and Data Acquisition (SCADA) systems and receives your flow notifications as well as our telemetered data. SIMONE (Online) allows us to undertake current state and predicted future operational risk assessments which include current and predicted status of assets, flows, pressures, linepack, gas quality parameters and national energy balance.
- We are also changing the way we work by automating previously manually delivered processes, improving efficiency and allowing us to focus our efforts on areas of value for our customers.

4.4.5 Operational control

What is it?

- Our activities within Control use inputs from all of our other operational capabilities, to ensure that our control room can make informed and efficient decisions when operating the network.
- The processes and systems that we use in this function enable us to operate NTS assets, react to unplanned events, validate customer flow notifications against commercial rules, take commercial actions such as energy balancing or constraint management and engage effectively with customers to initiate third-party actions.
- As gas flows and our customers' behaviours continue to evolve, more control actions will be required to ensure:
  – our system operates safely
  – we maintain a national energy balance and
  – we meet our customers' daily needs.

The tools and communication methods we currently use are fit for purpose. However, as the complexity of the actions required and the levels of risk being managed increase we may need to develop these tools and systems to ensure they continue to be fit for purpose in the future.

Drivers for change

- Within-day change in supply and demand.
- Price sensitive operation.
- Increasing range of quality of gas (within GS(M)R limits).

How are we improving?

Process

- In line with the replacement of our existing operational systems, including those mentioned in Section 4.4.4, new fit-for-purpose processes will be developed and implemented when appropriate.

Systems/Tools

- In GCS, we use data visualisation and analytics software to allow us to bring together relevant information from all other operational capabilities, and external data sources, to ensure that the control room makes operational decisions and takes control actions based upon the most up-to-date data and analysis. This will now enable us to mitigate issues to minimise the risk of your operation being affected.

4.4.6 Review

What is it?

- We are continuously improving how we operate our network to ensure we are providing the best service for you.
- As we take on a more active role in managing and balancing the network, the number of commercial and operational actions that we make will inevitably increase. The amount of review, validation and analysis will therefore also increase as we are required to take more actions.
- Given the changing, increasingly uncertain supply and demand environment, we will not be able to rely on our past experiences of operating our network. As a result, this places greater emphasis on the development of effective feedback loops from this area into both the Planning and Operational Control activities.
- We increasingly need to monitor our customers' compliance with contractual obligations and technical standards. We provide feedback to those parties that may be operating outside their obligations, particularly if their operation has a knock-on effect on us being able to deliver a reliable service for you.

Drivers for change

- Evolving customer requirements and supply/demand environment.
- Anticipated increased number of control actions.

How are we improving?

Process

- We want to continue to improve our relationships and ways of working with our customers and stakeholders. When customer compliance incidents occur, particularly those which affect your ability to operate, we always review and, where possible, share any lessons learnt to reduce the risk of repeat occurrences.
- We are increasingly sharing more information on our operational performance with you in the Operational and SO forums. We host the forum with Shippers and DNOs, and through documents that we publish, such as this.

Systems/Tools

- Our new systems, in particular the data visualisation and analytics software embedded within GCS, will help us to draw conclusions more quickly, ensuring that effective learning is developed and fed back into our other operational processes and systems so that we continuously improve our service to you.

Chapter 5

System development

System development

This chapter considers the most efficient way of delivering current and future network needs where asset investment has been identified as the preferred option. It sets out sanctioned National Transmission System reinforcement projects, projects under construction in 2017/18 and potential future investment options as a result of the Industrial Emissions Directive and our asset health review. These are assessed against the scenarios and sensitivities in our *FES* publication. This chapter also explores the Establish Portfolio stage of our Network Development Process.

Key insights

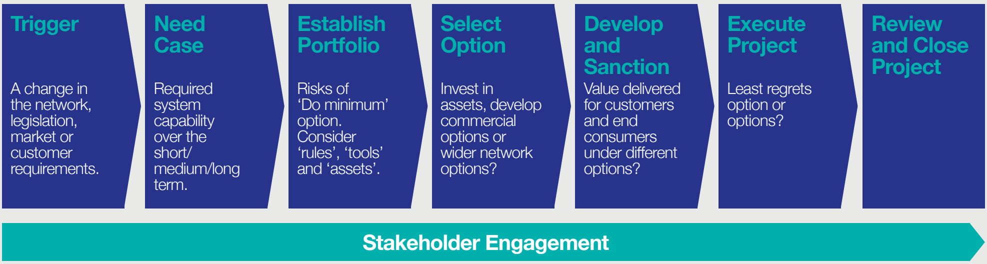
- The Humber Pipeline Replacement project (Feeder 9 project) is an important project as the pipeline is the most heavily used in Britain. Typically carrying around 20% of the country's gas supplies and, thus, there is a long-term requirement for it. Pipeline replacement will enhance security of supply, reducing the risk of failure and the likely damaging spikes in gas prices and potential supply constraints which would follow. A reopener was submitted to Ofgem in May 2018 with £111m of funding allocated for this project.
- Our reopener submission to address the impact of the Industrial Emissions Directive on our compressor fleet was largely rejected by Ofgem. We will continue to work with the appropriate regulations to agree a way forward in order to deliver compliance with the legislation while maintaining an appropriate level of service to our customers.
- The NTS is subject to a multitude of security threats, including a rapidly growing threat to Industrial Control Systems (ICS) from cyber-attacks. Since the level, nature and response to such threats is evolving, two Physical Security Upgrade Programme reopeners, one in May 2015 and one in May 2018, have been submitted during the T1 period.
- Delivering asset health work is a key measure of RIIO, in terms of allowances and output. Over the next three years we will continue to make effective asset management decisions so we can deliver the right levels of network performance for our customers and stakeholders.
- In innovation, Project GRAID (Gas Robotic Agile Inspection Device) has pioneered the development of the first high pressure inspection robot. GRAID is capable of internally inspecting pipelines, including those not accessible by pipeline inspection gauges (PIG).

5.1 Introduction

In this section, we expand on the asset solution element of the 'Establish Portfolio' stage (see Figure 5.1). This stage is only reached if a solution to a trigger cannot be found within the existing capabilities of the system.

The aim of this stage is to establish a portfolio of physical investment options that address the Needs Case. A range of options are investigated during the analysis phase, including a 'Do minimum' option. This allows for the comparison of options both in terms of effectiveness at meeting the Need Case requirements and overall cost. Stakeholder engagement workshops give us the opportunity to receive direct feedback from customers. Options are then narrowed down to identify the preferred choice which not only addresses the Needs Case but delivers a legally compliant solution. This provides the best value for customers, as we continue to operate the NTS safely and efficiently.

Figure 5.1
Network Development Process



5.2 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 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.

5.3 The Asset Investment Programme

Where intervention is required asset health works are bundled into campaigns of work to ensure cost-effective work delivery. During 2017/18 we have delivered more asset health work than ever before, investing £126m in the health of our assets, to keep our network running safely and reliably. We can simplify scopes of work for our contractors, use standard designs and streamline project documentation to drive down costs. This approach makes better use of system outages to ensure that work delivery isn't constrained or customers unnecessarily impacted.

Our current asset health campaigns are as follows:

Campaign	Description
St Fergus	Critical entry point to the NTS commissioned in the early 1970s requiring significant investment to re-life for continued operation.
Bacton	Critical entry point to the NTS commissioned in the late 1960s requiring significant investment due to an important asset health challenge to re-life for continued operation.
AGI Renovation	Renovation of valves, above-ground pipework and supporting structures at sites across the NTS.
Compressor Overhauls	Overhaul of gas turbines across the compressor fleet.
Pipelines	In-line inspection and remediation of buried pipelines and refurbishment of ancillaries such as corrosion prevention assets.
Peterborough	Critical asset health works to support the replacement of compressor units under the IED.
Huntingdon	Critical asset health works to support the replacement of compressor units under the IED.
Electrical	Refurbishment of electrical distribution boards, uninterruptable power supplies (UPS) and backup generators.
Pressure Systems	Inspection and remediation of pressurised vessels to comply with Pressure Systems Safety Regulations (PSSR).
Cab Infrastructure	Refurbishment of compressor cabs and associated assets such as exhaust stacks and safety systems.
Control Systems	Replacement of the industrial control systems on compressor units.
Gas Quality & Metering	Replacement of gas analysers and metering equipment required to comply with Gas Safety Management Regulations (GSMR).
Pre-heating	Replacement of unreliable gas preheating systems typically required at Power Station offtakes.

Feeder 9 Project – Humber Crossing

The Humber Pipeline Replacement project is part of our programme of work to care for our NTS and keep gas flowing for our customers, now and in the future – making sure it runs safely, efficiently and reliably. This is an important project as the pipeline (Feeder 9) is the most heavily used in Britain and is one of the most critical pipelines on the NTS. It carries typically around 20% of the country's gas supplies which is between 70 mcm/d and 100 mcm/d of gas, and plays a pivotal role in the provision of entry capacity in the Easington area and the UK gas market.

There are continuing concerns over the integrity of the pipeline due to rapid and unpredictable estuary movements. Currently the pipeline is laid in a shallow trench just below the river bed and is at risk of being exposed by shifting tides.

We have put temporary measures in place to keep it buried, but the Humber Pipeline Replacement project offers a long-term solution to replace the pipeline in the tunnel. It is also the most credible long-term solution. A reopener was submitted to Ofgem in May 2018 with £111m of funding allocated for this project.

The Humber estuary is the third largest shipping complex in Britain with almost 25% of the UK's seaborne trade passing through one of the fastest growing trading areas in Europe. With over 30,000 ship movements and half a million passengers each year, this was a key factor in the decision to replace the pipeline outside the volatile estuary environment. Pipeline replacement will enhance security of supply, reducing the risk of failure and the likely damaging spikes in gas prices and potential supply constraints which would follow.

In April 2018, a 160m long, 510-tonne tunnel boring machine started to excavate a 5.4km tunnel under the River Humber to house the Feeder 9 replacement pipeline. It has started its year-long journey under the river from the south bank at Goxhill to emerge on the north bank at Paull in 2019. It will leave a 3.65m diameter tunnel in its wake, around 35m below the river bed. Once the tunnel is finished, we will place a 42" diameter gas pipeline inside to replace the existing one, to secure the future of the NTS. You can track progress of the project on our website, **http://riverhumberpipeline.com/**

Scotland 1-in-20

The lower gas supply through St Fergus is making it increasingly difficult to meet our 1-in-20 winter demand obligations for customers. This is consistent across all four Future Energy Scenarios. To secure Scotland under our 1-in-20 obligation we have continued to assess the Need Case for the Scotland 1-in-20 suite of projects.

During 2017 the step change in the flows through the St Fergus terminal continued but at a reduced level with supplies peaking at 106 mcm/d; 6 mcm/d less than the previous period. The average flow through St Fergus reduced to 89 mcm/d, from 93 mcm/d in 2016/17.

The high level of uncertainty of flows from the St Fergus terminal remains. The current levels could remain or decline to a level that it is no longer possible to maintain the current Assured Operating Pressures (AOPs) in Scotland. We are currently exploring asset options to mitigate this risk – potentially modifying one or more of our compressor stations to move gas south to north.

Updated analysis to assess the capability against the *2018 FES* has been carried out over 2017/18 and has shown the risk of not meeting the AOPs in Scotland has moved out 6 years from 2021 to 2027. However, this analysis doesn't take account of a supply loss at a St Fergus sub-terminal. If the flows declined along the low case scenario from the 2018 *FES*, in 2020 it would not be possible to meet AOPs with the loss of the largest sub-terminal. There is a limited ability to set up Operating Margin contracts with only the St Fergus terminal for supply contracts and only a small number of Direct Connects with insufficient volume available. This would require contracts with the DNs or the Irish interconnector, neither of which have been done before, but this option has not been discounted at this stage. An option of bringing forward the 1-in-20 investment to increase the network resilience in the event of a supply loss is being considered within the optioneering in progress.

In 2017/18 it was not possible to complete a second trial with SGN to reduce some of the higher AOPs in Scotland during this winter. This was due to issues on their network requiring contracted pressures to be available.

A cost-benefit analysis (CBA) will be completed following the optioneering to resolve the supply loss risk and a decision is expected in 2018/19 on how best to proceed.

Impact of the IED reopener decision

Further to the reopener submission as detailed in the *GTYS* 2017, and Ofgem's response to our submission on the 28 September 2018[1], an update on the impact of the decision on the individual sites is provided:

Kirriemuir compressor

At Kirriemuir, we originally proposed to enter Unit D (RB211) into the Limited Life Derogation (LLD). Unfortunately, due to an operational failure this machine has now been disconnected from the network as it is uneconomical to repair. We requested funding to decommission the unit to plinth level. This request was rejected and as such the works will be deferred and funds requested as part of our submission in the upcoming price control review (RIIO-T2).

[1] Ofgem's final decision can be found here https://www.ofgem.gov.uk/ofgem-publications/139439

St Fergus compressor

At St Fergus, we are proposing to reduce our fleet emissions in accordance with IPPC and address the LCPD requirements. Units 2A and 2D have entered the LLD, in line with the Scottish Environmental Protection Agency (SEPA) guidelines. Our submission requested funding for either Selective Catalytic Reduction (SCR) on one Avon unit to ensure compliance with IPPC and SCR and Oxidation Catalyst on the RB211 Unit 2D under the LCP directive, or a new Avon-sized unit on the empty 2C berth for IPPC compliance and SCR and Oxidation Catalyst on the RB211 Unit 2D under the LCP directive. We continue to work with Ofgem to provide greater confidence of the final solution and agree funding during 2019.

Hatton compressor

Two of the existing units at the site have been entered into LLD and the remaining gas-fired unit has been entered into the 500 hours derogation. This decision is based on the positive progress of the electric VSD unit which was operationally accepted in early 2016. The submission requested funding to invest in one large unit at Hatton. As with St Fergus we will work with Ofgem to finalise the solution and funding for the site.

Carnforth compressor

One of the RB211 units, previously on LLD, has since been removed from operation and it has been deemed uneconomical to repair. The second RB211 unit is to remain on 500 hours use in line with the derogation obtained from the Environment Agency. The recommended option was to decommission Units A and B, and provide partial integration with the Nether Kellet site. Following Ofgem's decision, the decommission works are being deferred until RIIO-T2 and the merger of the site is being considered as part of wider asset health works at the 2 sites.

Moffat compressor

The two units at this site are to remain on 500 hours use in line with derogations obtained from the Environment Agency. Our submission requested funding to maintain these units until the end of RIIO-T1. Following Ofgem's decision, the options are being reviewed and will be confirmed in the next few months.

Warrington compressor

The two units at site are to remain on 500 hours use in line with derogations obtained from the Environment Agency. The submission requested funding to decommission the site to plinth level. Following Ofgem's decision, the decommissioning works will be deferred until RIIO-T2.

Wisbech compressor

The Maxi Avon unit has already been replaced with an IED-compliant Avon unit. The RB211 unit is to remain on 500 hours use in line with derogation obtained from the Environment Agency. Following Ofgem's decision, the level of asset health investment until the end of RIIO-T1 is being reviewed and will be decided over the next few months.

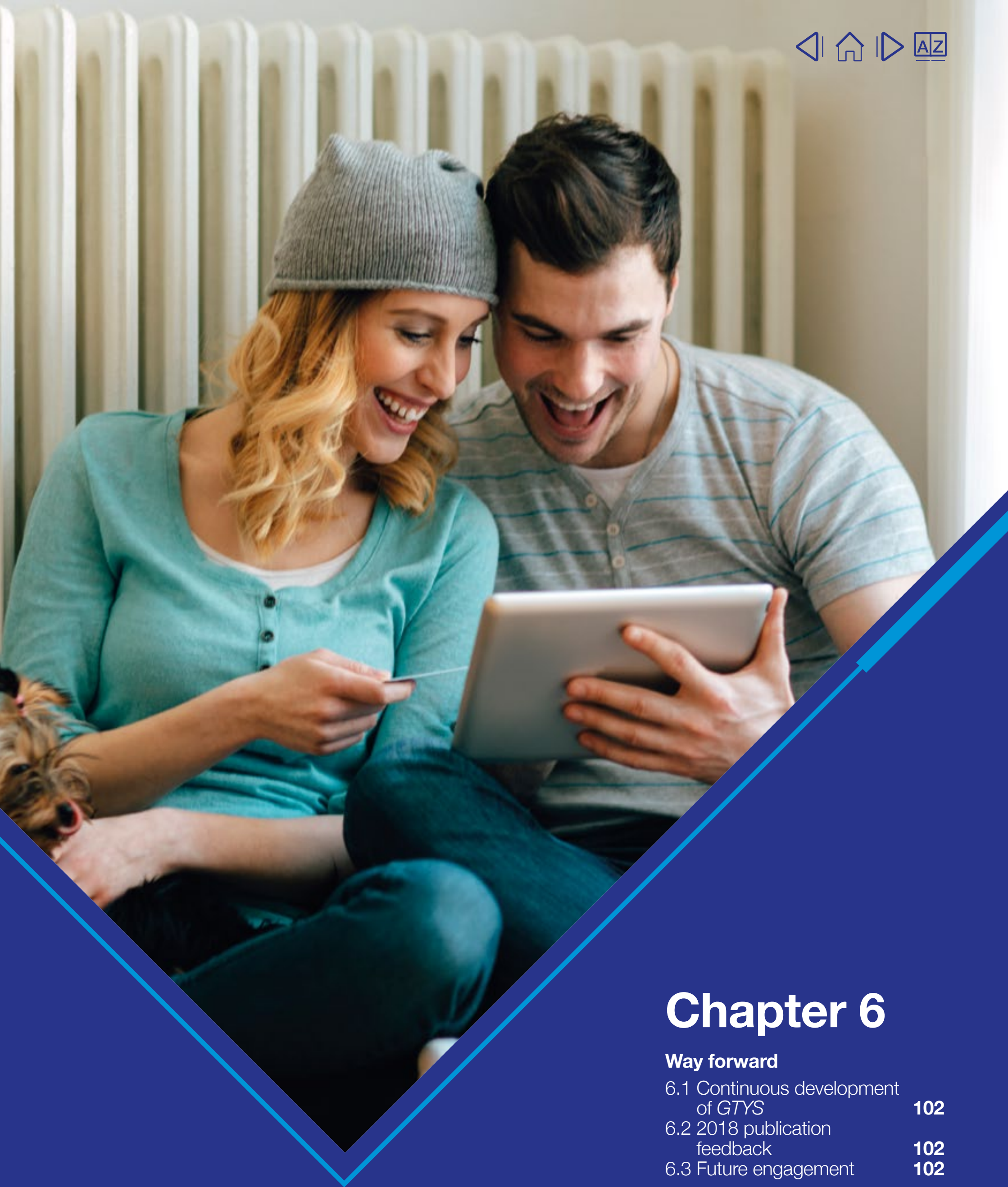
5.4 Protecting our assets from external threats

The NTS is subject to a multitude of security threats, which are ever-changing and often increasing in sophistication and persistence. This includes a rapidly growing threat to Industrial Control Systems (ICS) from cyber-attacks from a range of hostile forces. In recent years, there have been several high-profile cyber-attacks on a wide range of systems and installations around the world which have caused extensive disruption. As well as preparing for the increased threat from cyber-attacks, there is a need to ensure our sites are always physically secure.

Since the level, nature and response to such threats is evolving and inherently uncertain, two Physical Security Upgrade Programme reopeners, one in May 2015 and one in May 2018, have been submitted during the T1 period. An Enhanced Security costs reopener, relating to IT systems, was also submitted in May 2018. We have reviewed the costs for complying with such enhanced security requirements, in line with government standards.

5.5 Innovation

Project GRAID (Gas Robotic Agile Inspection Device) has pioneered the development of the first high pressure inspection robot. GRAID is capable of internally inspecting pipelines, including those not accessible by Pipeline Inspection Gauges (PIG), at normal operating gas pressures. Full video capture provides high resolution images to assist in informing future maintenance regimes. For more information, please see the Network Innovation Allowance Annual Summary 2017/18 and the Embedding Innovation Value Mid-term Report 2017, both available at: **https://www.nationalgrid.com/uk/investment-and-innovation/innovation/gas-transmission-innovation**



Chapter 6

Way forward

Way forward

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 insights

- We use this document to highlight any challenges that we see facing our future operation and planning of the NTS.
- We would like to involve you in our decision-making process.

6.1 Continuous development of *GTYS*

GTYS is an opportunity for us to outline our current operational and asset-based plans for developing the NTS to ensure we continue to meet the needs of our customers and stakeholders. We use this document to highlight any challenges that we see facing our future operation and planning of the NTS.

We want to continue to engage with you, by involving you in our decision-making process, 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:
- We seek to identify and understand the views and opinions of all our customers and stakeholders.
- We provide opportunities for engagement throughout the *GTYS* process, enabling constructive debate.
- We create an open and two-way communication process around assumptions, drivers and outputs.
- We respond to all customer and stakeholder feedback and demonstrate how this has been considered.

6.2 2018 publication feedback

We welcome your feedback and comments on this edition of *GTYS* as it helps us to tailor the document to areas you value. Over 2017/18, we are keen to hear your views on the following areas of our gas transmission business:
- Asset health
- Industrial Emissions Directive
- Network Development Policy
- System Flexibility.

6.3 Future engagement

We welcome your feedback on the following.

- Whether the *GTYS*:
  - explains the process we follow in order to develop the NTS?
  - illustrates the future needs and development of the NTS in a coordinated and efficient way?
  - provides information to assist you in identifying opportunities to connect to the NTS?
- Which areas of the *GTYS* are of most value to you?
- Which areas of the *GTYS* can we improve?
- Is there any additional information you would like to see included in the *GTYS*?

If you would like to provide feedback please contact us at: **Box.SystemOperator.GTYS@nationalgrid.com**. We look forward to hearing from you.

Appendix

Appendix 1 National Transmission System maps

Figure A1.1
Scotland (SC) – NTS

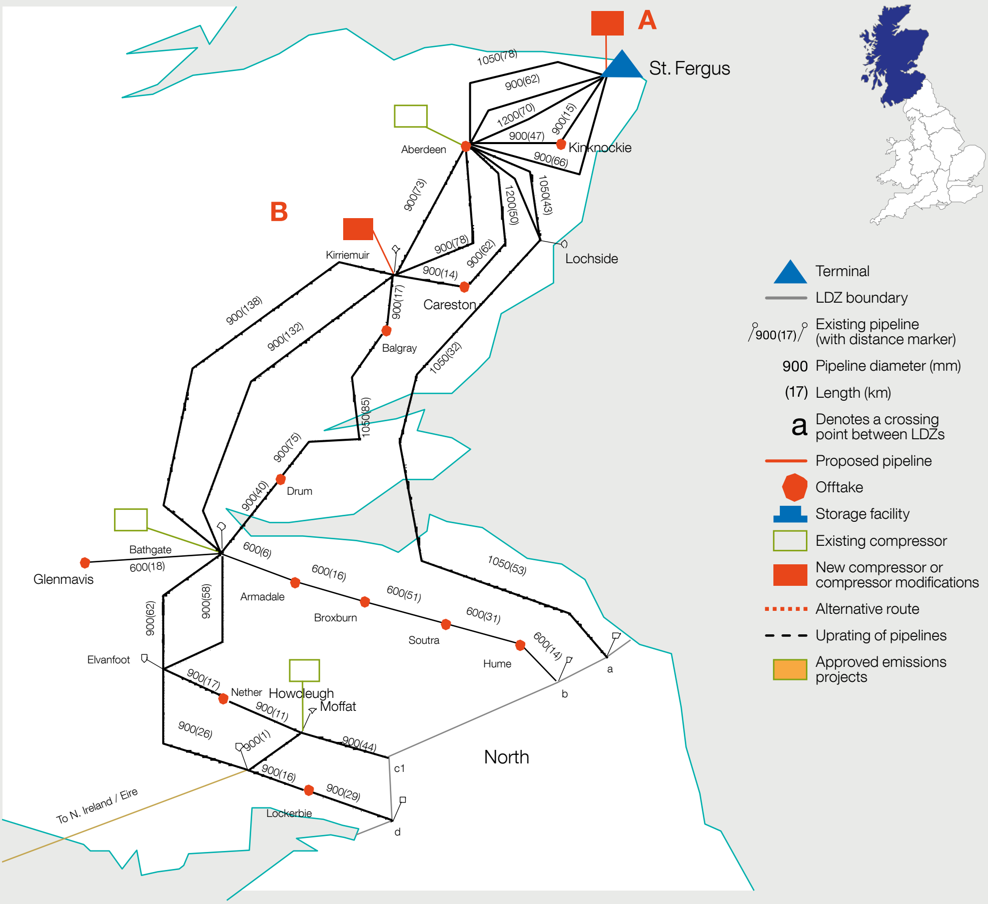
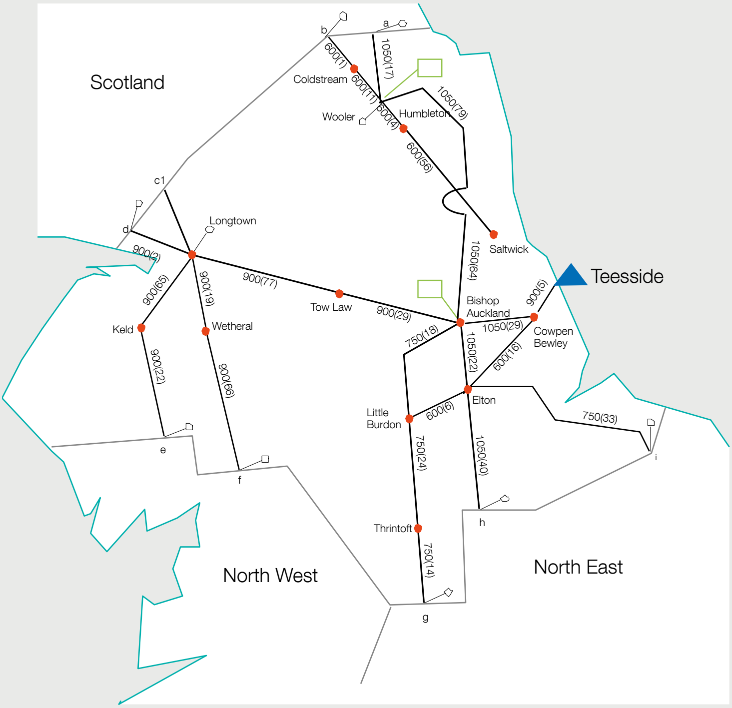
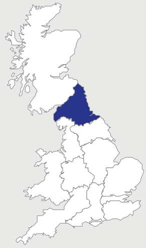


Figure A1.2
North (NO) – NTS





- Terminal
- LDZ boundary
- 900(17) Existing pipeline (with distance marker)
- 900 Pipeline diameter (mm)
- (17) Length (km)
- a Denotes a crossing point between LDZs
- Proposed pipeline
- Offtake
- Storage facility
- Existing compressor
- New compressor or compressor modifications
- Alternative route
- Uprating of pipelines
- Approved emissions projects

Figure A1.3
North West (NW) – NTS

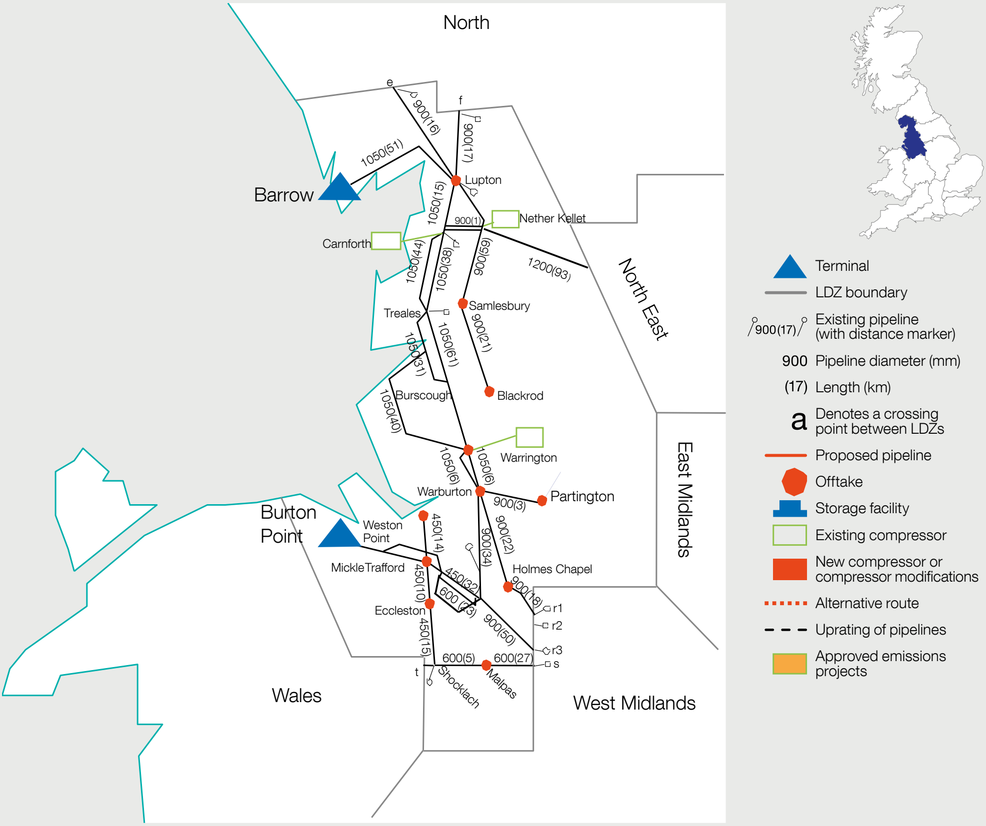


Figure A1.4
North East (NE) – NTS

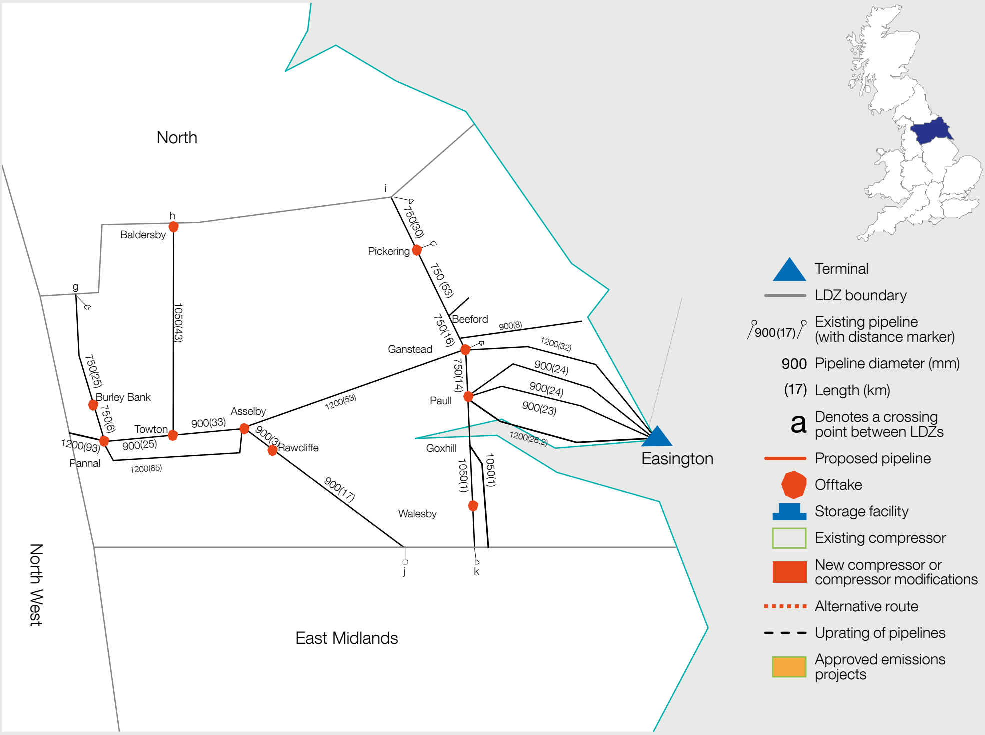


Figure A1.5
East Midlands (EM) – NTS

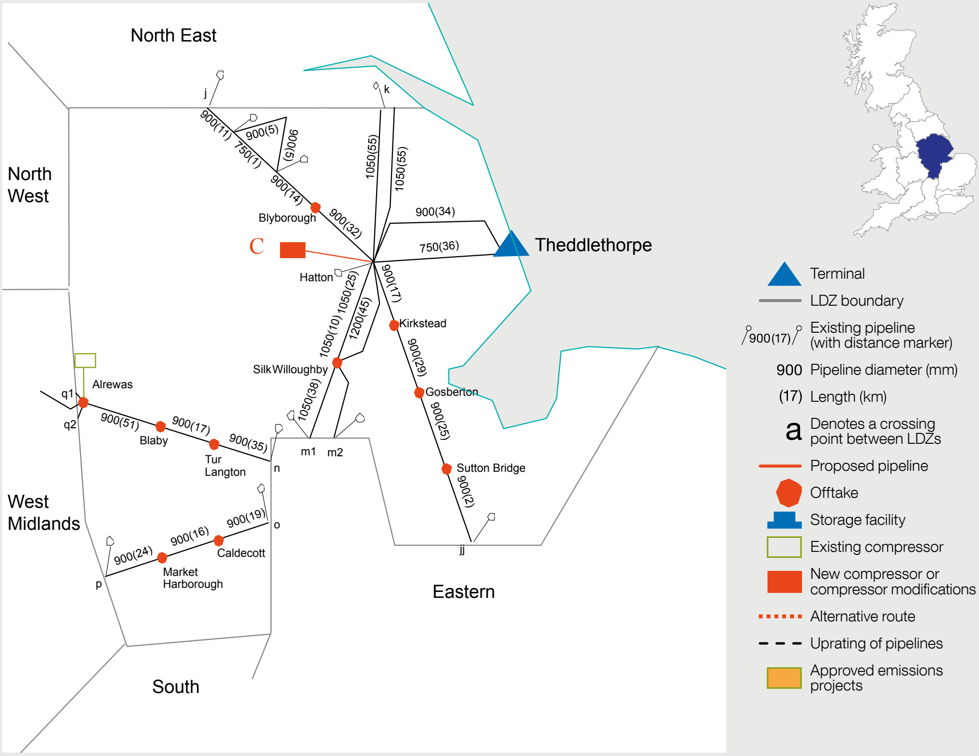
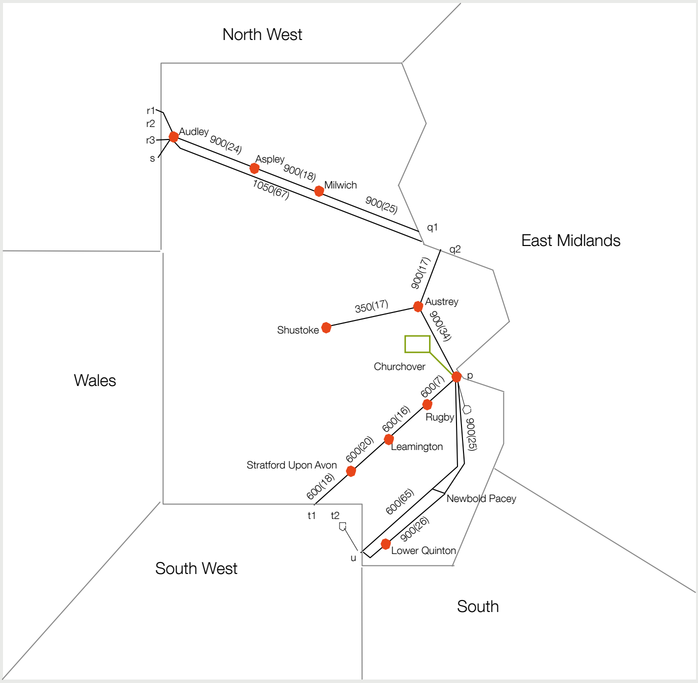


Figure A1.6
West Midlands (WM) – NTS



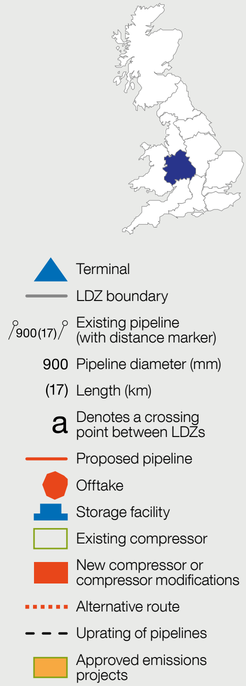
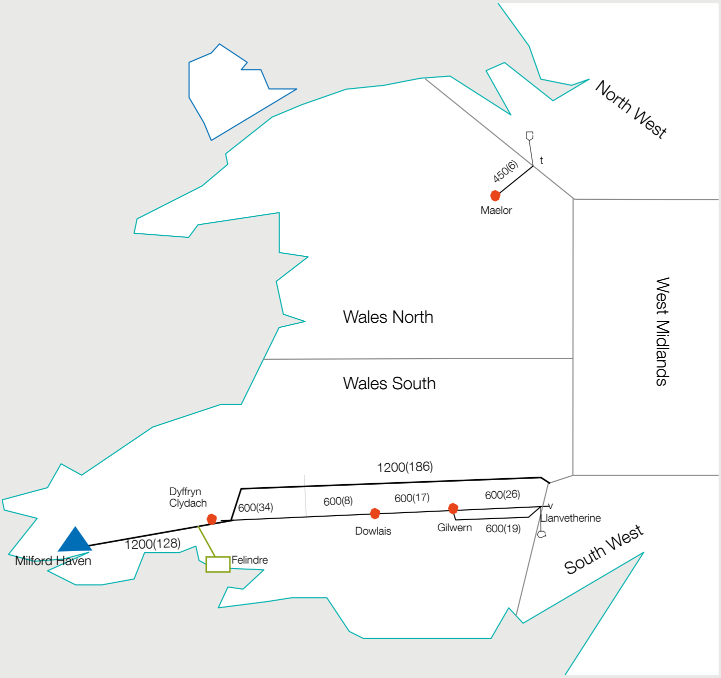


Figure A1.7
Wales (WN & WS) – NTS



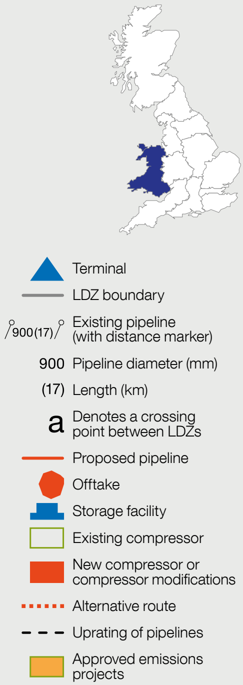


Figure A1.8
Eastern (EA) – NTS

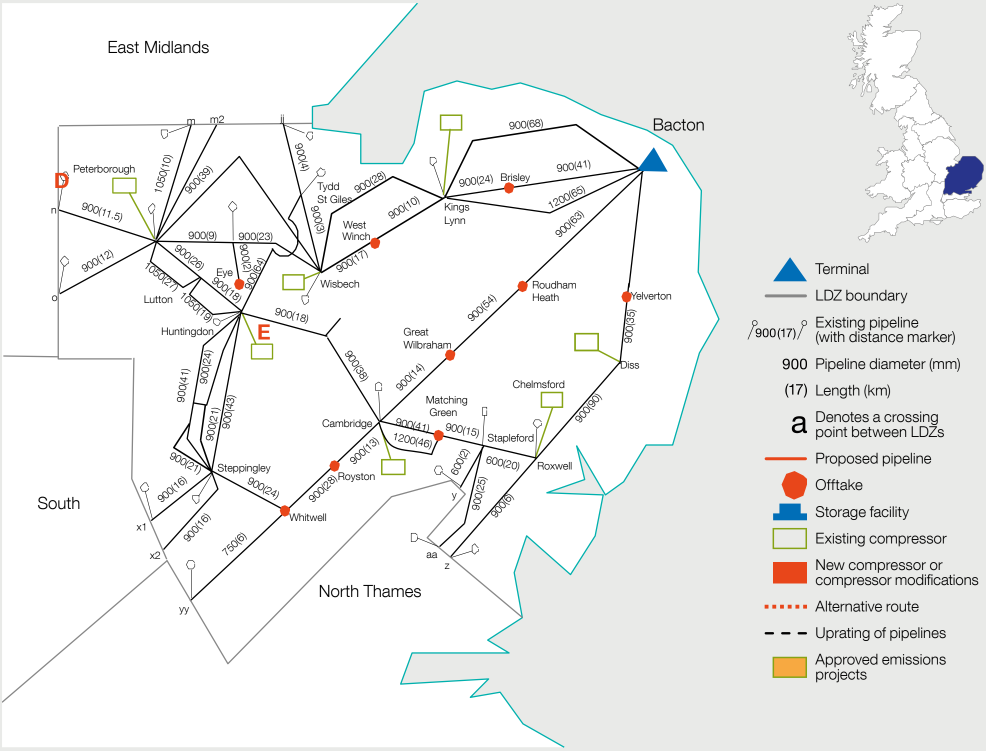


Figure A1.9
North Thames (NT) – NTS

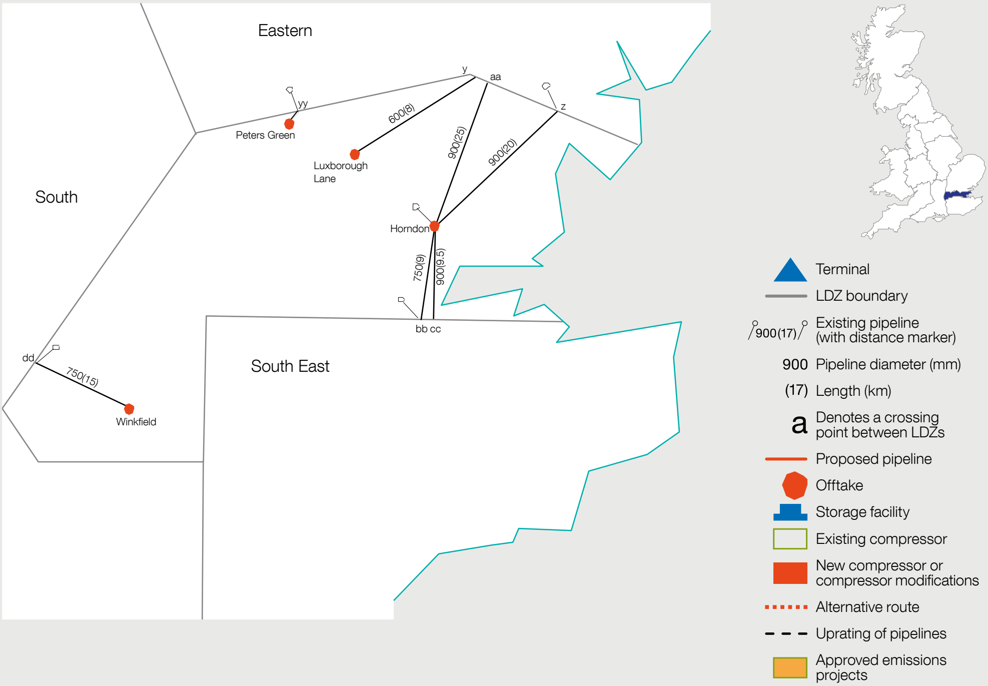


Figure A1.10
South East (SE) – NTS

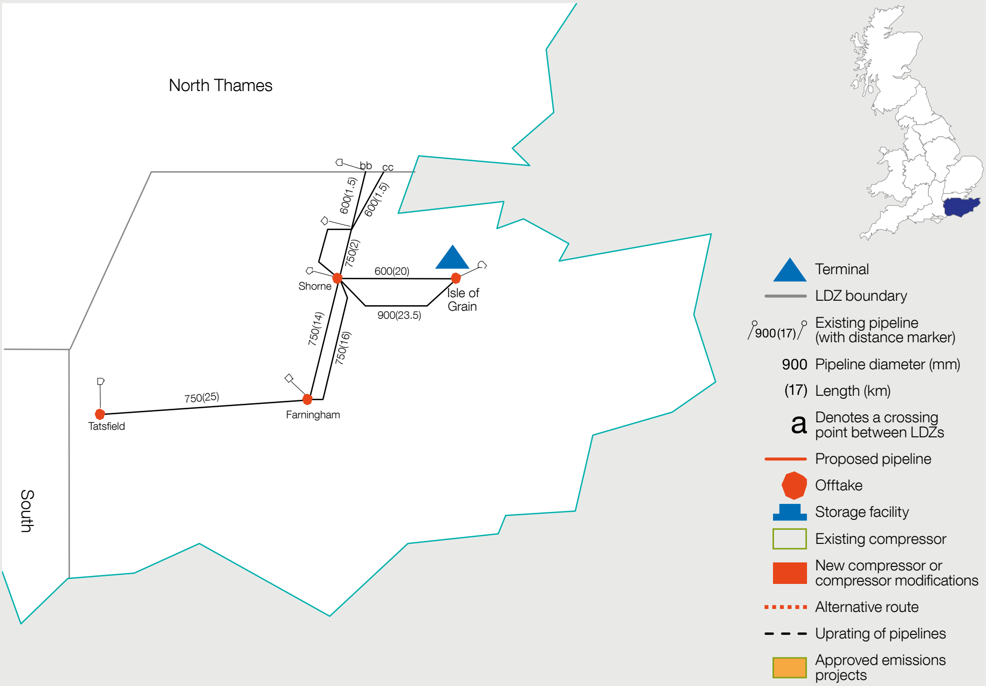


Figure A1.11
South (SO) – NTS

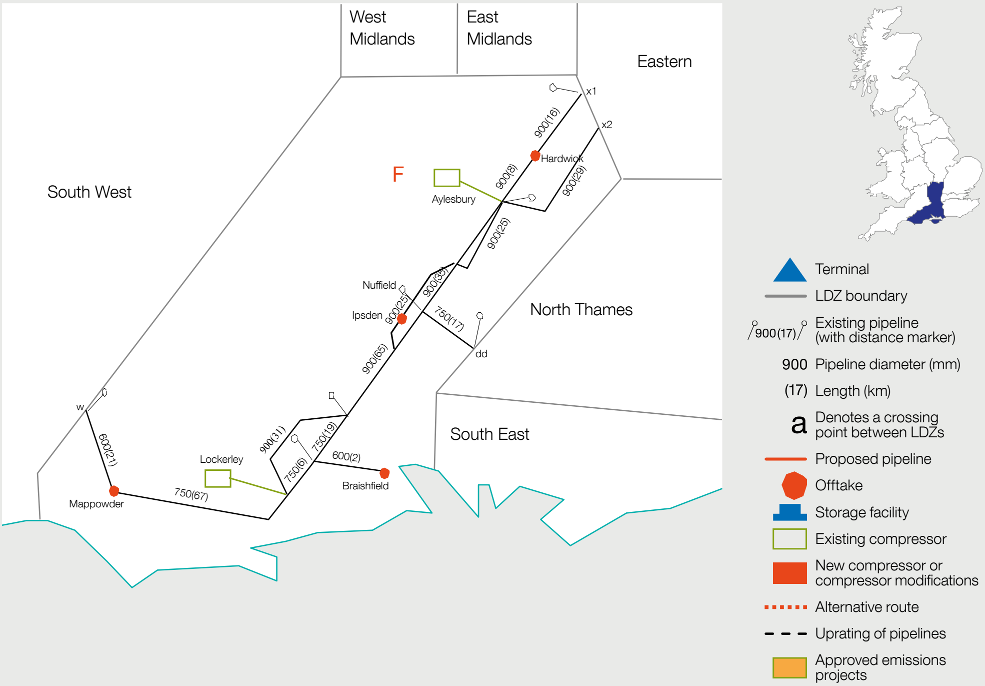
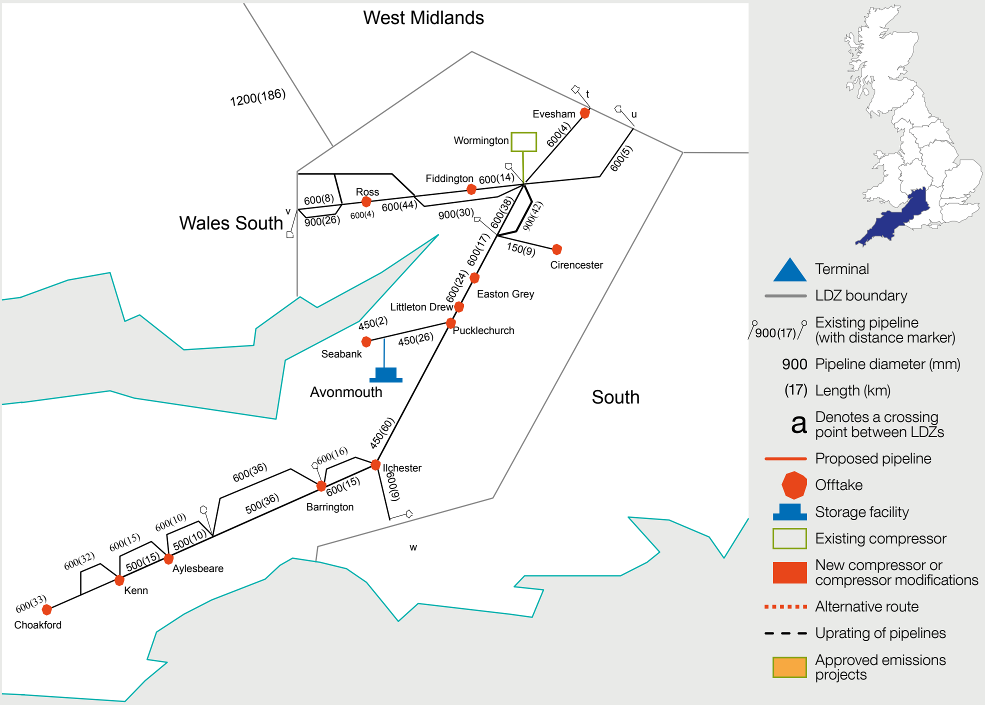


Figure A1.12
South West (SW) – NTS



Appendix 2 Customer connections and capacity information

2.1 Additional information specific to system entry, storage and interconnector connections

We require a network entry agreement, storage connection agreement or interconnection agreement, as appropriate, with the respective operators of all delivery, storage and interconnector facilities. These agreements establish, among other things, the gas quality specification, the physical location of the delivery point and the standards to be used for both gas quality and the measurement of flow.

2.1.1 Renewable gas connections

We are committed to environmental initiatives that combat climate change. During the last year, an increasing number of customers have asked about entry into our pipeline system for biomass-derived renewable gas. We have also received requests for gas entry from non-traditional sources, such as coal bed methane.

We welcome these developments and would like to connect these supply sources to the NTS. To facilitate this, we will consider any request for increased oxygen content above the current NTS specification of 10ppm up to the GS(M)R specification of 2,000ppm, on a case by case basis.

For further information on how we are reducing the time and cost of new connections to the NTS, please see Chapter 2, Section 2.2 regarding NIC-funded Project CLoCC.

2.1.2 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 GS(M)R
- the implications of the proposed gas composition on system running costs
- the implications of the new gas supply on our ability to continue 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 is not limited to, the statutory requirements set out in the GS(M)R.

Table A2.1
Gas quality specifications

Gas Element	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)
Containments	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. GS(M)R states transmission or distribution of odoured gas is not permitted 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
*Requests for higher limits will be considered	

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/m3). CV shall normally be in the range of 36.9MJ/m3 to 42.3MJ/m3 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.

2.1.3 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. Whilst the application of the standard to Member States is voluntary, the EC stated its intention to make it legally binding via an amendment to the EU Interoperability Network Code and in 2016 asked ENTSOG to lead an initiative with stakeholders to examine the impacts and issues associated with doing so. ENTSOG's work concluded that the standard should not be made binding, which the EC agreed with at the Madrid Forum in October 2016. However, the EC also invited CEN to continue its work on a harmonised Wobbe Index for inclusion in the standard and stated that it would revisit harmonisation again upon the conclusion of this work, which is likely to be around 2020. The Sector Forum Gas committee within CEN established a number of taskforces to achieve this and while there is no direct Great Britain representation, National Grid is currently able to monitor developments, contribute via ENTSOG and provide progress updates to the industry via the Transmission Workgroup meeting.

Great Britain developments

The Institute of Gas Engineers and Managers (IGEM) has established an industry working group to explore changes to the Great Britain gas specifications in the GS(M)R. This group is investigating whether the upper Wobbe Index limit can be increased; this has been recommended by SGN following the conclusion of Opening up the Gas Market (OGM). OGM involved a year-long field trial of wider Wobbe gas injected and utilised within Oban, one of the Scottish Independent Undertakings (SIUs). More information about OGM can be found on the SGN website **https://www.sgn.co.uk/oban/**. This working group is also considering whether the gas quality specification contained in the GS(M)R can be transferred to an IGEM standard.

Within Great Britain, UNC Modification 0607 received direction to be implemented from Ofgem in February 2018, which facilitated an increase in the carbon dioxide limit at the North Sea Midstream Partners sub-terminal at St Fergus from 4.0mol% to 5.5mol%.

In October 2017, we issued a separate consultation to the industry about the likelihood of future requests to widen gas quality specifications, review the current change process and explore any demand for National Grid gas quality services in the longer term[1]. As a result, we intend to bring forward a UNC modification proposal which obliges us to open a time window akin to the PARCA process when our ability to accommodate a gas quality parameter is scarce, enables us to charge parties who wish to amend gas quality limits to levels outside GTYS and facilitates greater transparency in the gas quality limits that we agree with new NTS entry connections. We also intend to further explore the issues associated with National Grid offering gas quality blending services at NTS entry points.

The development of shale gas is still in its infancy in the UK and at present there is uncertainty over the quality of such gas until wells are drilled. We will continue to work with customers and monitor developments in this area.

2.2 The PARCA Framework process

The PARCA Framework is split into four logical phases: Phase 0 to Phase 3. This phased structure gives the customer natural decision points where they can choose whether to proceed to the next phase of activities.

Regardless of these natural decision points the PARCA process is flexible enough to allow the customer to leave the process at any time before full financial commitment to the capacity through capacity allocation.

[1] http://www.talkingnetworkstx.com/gas-quality-consultation.aspx

2.2.1 Overview of the four phases

Phase 0 – Bilateral discussions (no defined timescales)

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

This phase is a bilateral discussion phase between the customer and National Grid with no defined timescales. It allows the customer and National Grid to understand each other's processes and potential projects before the customer decides whether to formally enter the PARCA process.

If the customer wants to proceed into the PARCA process after these discussions, they must submit a valid PARCA application form and pay a PARCA application fee. Our PARCA application form can be found at: **https://www.nationalgridgas.com/connections/reserving-capacity-parca-and-cam**

Phase 1 – Works and PARCA contract (up to six months)

Phase 1 Up to 6 months → National Grid confirm receipt of the application within 2 business days → National Grid provides formal acceptance of a competent application to the customer within 6 business days → National Grid initiate Phase 1 Works → Within 10 business days National Grid may trigger a PARCA window and an adhoc QSEC capacity auction → National Grid will issue the customer with the Phase 1 Output Report & the PARCA contract

When we receive a valid PARCA application form and payment of the application fee from the customer, we will tell them their PARCA application has been successful and Phase 1 of the PARCA process will begin. During Phase 1 we will publish relevant information to the industry and, through the opening of a PARCA window, invite PARCA applications from other customers.

We will then explore a number of ways of delivering the capacity. This may be wholly through (or a combination of) existing network capability, substitution of capacity, a contractual solution or physical investment in the NTS. We will complete these works within six months of the start of Phase 1.

We also release long-term NTS capacity through established UNC capacity auction and application processes, more specifically:

- Long-term NTS entry capacity that is sold in quarterly strips through the Quarterly System Entry Capacity auction (QSEC) held annually in March.
- Long-term NTS exit capacity that is sold as an enduring (evergreen) product through the Enduring Annual NTS Exit Application process held annually in July.

So it's important to bear in mind that existing system capacity that could be used to fully or partly satisfy a PARCA request may also be requested by our customers through those processes detailed above. As such it may not be appropriate to initiate the Phase 1 works of a PARCA while the QSEC or enduring annual processes are running because it may not be clear how much existing capacity will be available to satisfy a PARCA request for the purposes of the Phase 1 studies.

The timetable below (Figure A2.1) shows the annual QSEC auction and enduring exit capacity application and potential periods where we decide not to start Phase 1 PARCA works.

Figure A2.1
Annual entry and exit capacity application windows

Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Annual QSEC Auction		QSEC invitation	QSEC bid window	Allocaton of QSEC bids								
Entry Capacity PARCA Annual		Phase 1 of an entry capacity PARCA may not be initiated if there is an interaction with the ongoing annual QSEC auction process										
Enduring Exit Application						Exit invitation	Exit capacity window	Allocation of exit capacity				
Exit Capacity PARCA						Phase 1 of an entry capacity PARCA may not be initiated if there is an interaction with the ongoing annual exit capacity application window						

PARCA window

The purpose of the PARCA window is to encourage those customers considering applying for a PARCA to submit their application at this time, so that we can assess how to meet their capacity needs alongside other potential projects.

For any PARCA application deemed competent outside a relevant PARCA window, within 10 business days of the initiation of the Phase 1 works of that PARCA we will open (where a window is not already open) either a PARCA entry or exit window. A notice will be published on our PARCA webpages, which can be at: **https://www.nationalgridgas.com/connections/reserving-capacity-parca-and-cam**

We guarantee to consider together all PARCA applications submitted and deemed competent within this window. However, it is important to note that if you wish to be considered for capacity alongside other PARCA applications, in order to ensure we can conduct our competency check within the PARCA window timescales, please endeavour to submit your application as early as practically possible. Figure A.2.2 outlines the PARCA window timeline.

Figure A2.2
PARCA window timeline

Number of days from initiation of Phase 1	1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40
PARCA entry window opens	Opened within 10 days; Further applications received
PARCA entry window closes	Closes 40 business days after the window was opened
	Closes 20 business days after the window was opened if no further entry applications received
PARCA exit window opens	Opened within 10 days; Further applications received
PARCA exit window closes	Closes 40 business days after the window was opened
	Closes 20 business days after the window was opened if no further exit applications received

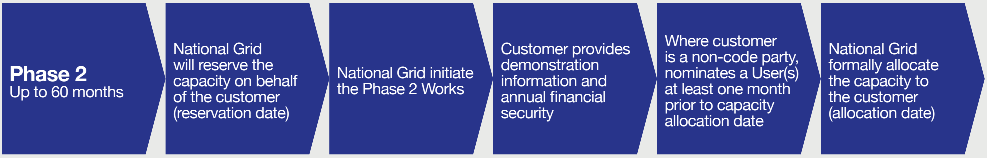
The PARCA window is open for a maximum of 40 consecutive business days but will close after 20 consecutive business days if no further PARCA applications have been received within that time. There are two types of PARCA window:

- Entry window – triggered if a PARCA requests NTS entry capacity.
- Exit window – triggered if a PARCA requests NTS exit capacity.

Only one entry and/or exit PARCA window can be open at any one time. So if a PARCA application requesting entry/exit capacity is deemed competent within an open entry/exit PARCA window, an additional PARCA window will not be triggered.

On completion of Phase 1 we will provide the customer with a output report, which will include a Need Case report (establishes and documents the potential Need Case for investment, a technical options report and a PARCA contract).

Phase 2 – (up to 60 months)



When the contract is counter-signed, we will reserve the capacity on the customer's behalf, from the date provided in the Phase 1 output report.

If the output report shows that physical reinforcement of the NTS is needed to provide the customer with their capacity, we will start the statutory planning consent at this stage; either the Planning Act or Town & Country Planning. If no physical reinforcement is needed we will continue to reserve the capacity in accordance with the timelines provided as part of the Phase 1 output report.

Phase 2 ends when the reserved capacity is allocated to the customer or, where the customer is a non-code party, a nominated code party(s). Once allocated and the capacity is financially committed to, the PARCA contract ends and we begin the capacity delivery phase (Phase 3).

Phase 3 – (up to 24 months)

Once the capacity is formally allocated, the PARCA contract expires and the capacity delivery Phase 3 is initiated. This is where we carry out necessary activities, such as reinforcing the NTS to deliver the allocated capacity. Please note that on allocation of any reserved NTS capacity, the Uniform Network Code (UNC) user commitment applies.

The PARCA allows you to reserve capacity but it does not provide you with an NTS connection.

Appendix 3 Meet the teams

3.1 Our Gas Customer Account Management team

Our role within the Gas Customer Account Management team is to effectively manage business relationships with all our industry customers and stakeholders through ownership of the overall customer experience.

We coordinate a consistent customer approach across all value streams and transportation operations.

We deliver customer intelligence and represent the voice of our customers within our business to help shape and inform key business decisions through a deeper understanding of your business requirements.

Our dedicated Customer Account Management team will be your first point of contact:

The Gas Customer Account team – **box.marketoutlook@nationalgrid.com**

Elliot Dunn

Gas Customer Account Manager

Carrie Bury

Gas Customer Manager

3.2 Our Gas Contract Management team

Our role within the Gas Contract Management team is to manage and deliver all commercial aspects of your connection, diversion and/or PARCA processes by understanding and developing solutions that meet your needs.

We deliver all commercial and contractual changes including modifications to your connection as well as distribution network offtake arrangements, associated operator agreement changes, framework changes and manage the UNC customer lifecycle processes and obligations.

Our dedicated Contract Management team will manage your connection, diversions and all PARCA applications:

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

Eddie Blackburn

Gas Contract Portfolio Manager

Belinda Agnew

Gas Connections Contract Manager

Claire Gumbley

Gas Connections Contract Manager

Louise McGoldrick

Gas Connections Contract Manager

Richard Hounslea

Gas Connections Contract Manager

Steven Ruane

Gas Connections Contract Manager

Jeremy Tennant

Gas Connections Support Assistant

3.3 Our Operational Liaison team

The Operational Liaison team acts as an overall relationship management function for customers and stakeholders, on behalf of Transmission Gas Operations. Get in touch with us for any queries where you aren't sure who to speak to, anything you think should be escalated, or to attend any of our meetings. We also facilitate the provision of operational data on our website, and will manage any queries related to the data.

The Operational Liaison Team manages and delivers a wide range of customer and stakeholder facing meetings/forums, including:

- Gas Operational Forum – An industry-wide forum to discuss key operational topics with the gas community. This is typically attended by a wide variety of customers and stakeholders, including Shippers, terminal operators, storage sites, power stations, transmission operators, and industrial sites.
- Annual Liaison Meetings – These help us sustain a positive relationship with connected sites by formally meeting face to face for individually tailored operational discussions, such as gas quality and maintenance.

To find out more about our operational forums, access operational data, find the latest operational news, or access our directory for any gas queries, please visit the following link: **https://www.nationalgrid.com/uk/gas/market-operations-and-data**

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

Karen Thompson
Operational Liaison Manager

Martin Cahill
Operational Liaison Lead

Hayley Johnson
Operational Liaison Analyst

Claire O'Grady
Operational Liaison Analyst

Dally Powar
Liaison Support Assistant

Appendix 4 Import and storage infrastructure

4.1 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)[2] and LNG (49 bcm/year).

Table A4.1 shows existing import infrastructure and Table A4.2 shows proposals for further import projects.

Table A4.1
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	7.6
Langeled	Gassco	Pipeline	Easington	26.3
Vesterled	Gassco	Pipeline	St Fergus	14.2
Tampen	Gassco	Pipeline	St Fergus	9.8
Gjoa	Gassco	Pipeline	St Fergus	6.2
			Total	**148.8**

Source: National Grid

Table A4.2
Proposed import projects[3]

Project	Operator / Developer	Type	Location	Start-up	Capacity (bcm/year)	Status
Isle of Grain 4	National Grid	LNG	Kent	~	~	Open Season
Norsea LNG	ConocoPhillips	LNG	Teesside	~	~	Planning Granted, no FID. Currently on Hold
Port Meridian	Port Meridian Energy	LNG	Barrow, Cumbria	~	5	Open Season
Amlwch	Halite Energy	LNG	Anglesey	~	~30	Approved
GasPort	Trafigura	LNG	Teeside	~		Approved

Source: National Grid

[2] Norwegian import capacity through Tampen and Gjoa is limited by available capacity in the UK FLAGS pipeline.
[3] This list is no way exhaustive; other import projects have at times been detailed in the press.

4.2 Storage infrastructure

In the last 12 months no proposals have attained a 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 A4.3
Existing storage sites

Site	Operator / Developer	Location	Space (bcm)	Approximate max delivery (mcm/d)
Aldbrough	SSE/Statoil	East Yorkshire	0.3	40
Hatfield Moor	Scottish Power	South Yorkshire	0.07	2
Holehouse Farm	EDF Trading	Cheshire	0.02	–
Holford	Uniper	Cheshire	0.2	22
Hornsea	SSE	East Yorkshire	0.2	12
Humbly Grove	Humbly Grove Energy	Hampshire	0.3	7
Hill Top Farm	EDF Energy	Cheshire	0.05	12
Stublach*	Storengy	Cheshire	0.2	30
		Total	**1.36**	**125**

*The space at Stublach is expected to increase to 0.4 bcm by January 2020. Source: National Grid

Note, due to operational considerations, the space and deliverability may not be consistent with that used for operational planning as reported in our 2018/19 *Winter Outlook* report.

Some medium-range storage has been developed in the last three years, but on the other hand one site has been taken out of commercial service for the foreseeable future. The economics, and particularly the winter to summer price spread, are very challenging for the development of new storage sites. Nevertheless, many new storage sites have been proposed over the last ten years and there are currently plans for nearly 9 bcm of space, both for medium-range fast-cycle facilities and for long-range seasonal storage.

In January 2018 the former long-range storage site at Rough was reclassified as a producing field and is now included in our UKCS forecasts.

EDF Trading announced in July 2018 that Holehouse Farm would not be returned to service for the foreseeable future.

Over the last few years, a number of projects have been put on hold or cancelled. These include Aldbrough 2, Baird, Caythorpe, Gateway and Portland. Table A4.4 shows other proposed storage sites.

Table A4.4
Proposed storage projects[4]

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

Please note Tables A4.1, A4.2, A4.3 and A4.4 represent the latest information available to National Grid at time of going to press. Developers are welcome to contact us to add or revise this data.

[4] This list is in no way exhaustive; other storage projects at times have been detailed in the press.

Appendix 5 EU activity

5.1 Our activity to date

In Chapter 2.4.2 we discussed the European Union (EU) Third Energy Package of legislation which was introduced in 2009. Since then, we have worked with the European Network of TSOs for Gas (ENTSOG), the European Commission, the Agency for the Cooperation of Energy Regulators (ACER), Ofgem, the UK Government, other TSOs and the industry to enable the development of several EU gas Network Codes: Capacity Allocation Mechanisms (CAM); Balancing (BAL); Interoperability and Data Exchange (INT); and Tariffs (TAR). We have also supported the UK Government through the development of the revision to the Regulation on Gas Security of Supply.

We have influenced the EU Code developments and supported the Great Britain industry and our customers through a process of extensive dialogue involving stakeholder working sessions, technical workshops and several consultations. We have also worked closely with other TSOs at Bacton (connecting to Belgium and the Netherlands) and at Moffat (connecting Northern Ireland and the Republic of Ireland to Great Britain) to put in place the necessary technical and commercial arrangements to ensure we comply with EU legislation. 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.

From 7 April 2016, we began reporting information on nominations and primary capacity allocations for the Great Britain system in accordance with the requirements of the Implementing Regulation for the Regulation on Wholesale Market Integrity and Transparency (REMIT).

On 2 December 2017, we started publishing tariffs for Interconnection Points on the ENTSOG Transparency Platform in accordance with the TAR code. We have carried out extensive work with Great Britain Shippers to review Great Britain charging arrangements under UNC Modification 0621 (and its various alternatives) in accordance with the harmonised tariff arrangements required under the TAR code – the compliance date for this TAR code obligation is 31 May 2019 for the following tariff year, i.e. for Great Britain this therefore applies for Gas Year 2019/20 onwards.

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 have jointly developed a proportionate implementation plan with BEIS and Ofgem which does not require licence changes or UNC modifications. The solidarity principles are the last element to be implemented by 1 December 2018.

With the current European Commissioners' term of office ending in December 2019, the Commission's forward thinking is now focused on future gas market improvements from 2020, which will improve market liquidity across all Member States and be fit for purpose to support the EU's decarbonisation agenda. As members of both ENTSOG and Gas Infrastructure Europe (GIE), we have been supporting the increasingly important input these organisations have in shaping these potential future market developments, known informally as the 'Gas 2020' package.

To date, the UNC modifications to implement the EU Codes and Guidelines are:

a. 0449 (Introduction of Interconnection Points and new processes and transparency requirements to facilitate compliance with the EU Congestion Management Procedures). Implemented with effect from 6:00am on 1 October 2013; it is superseded by text introduced under 0500.
b. 0461 (Changing the UNC Gas Day to Align with Gas Day under EU Network Codes). Implemented with effect from 5:00am on 1 October 2015.
c. 0485 (Introduction of long-term use-it-or-lose-it mechanism to facilitate compliance with EU Congestion Management Procedures). Implemented with effect from 6:00am on 30 September 2014; it is superseded by text introduced under 0500.
d. 0489 (EU Gas Balancing Code – Information Provision changes required to align the UNC with the EU Code). Implemented with effect from 5:00am on 1 October 2015.
e. 0493 (EU Gas Balancing Code Daily Nominations at Interconnection Points (IP)). Implemented with effect from 6:00am on 19 June 2015.
f. 0494 (Imbalance Charge amendments required to align the UNC with the Network Code on Gas Balancing of Transmission Networks). Implemented with effect from 5:00am on 1 October 2015.
g. 0500 (EU Capacity Regulations Capacity Allocation Mechanisms with Congestion Management Procedures). Implemented with effect from 6:00am on 19 June 2015.
h. 0501V (Treatment of Existing Entry Capacity Rights at the Bacton ASEP to comply with EU Capacity Regulations). Implemented with effect from 6:00am on 21 July 2015. The process established by this modification (for allocation of capacity held by Shippers between the new ASEPs at Bacton) was completed on 28 August 2015.
i. 0510V (Reform of Gas Allocation Regime at Great Britain Interconnection Points). Implemented with effect from 5:00am on 1 October 2015.
j. 0519 (Harmonisation of Reference Conditions at Interconnection Points). Implemented with effect from 5:00am on 1 October 2015.
k. 0525 (Enabling EU-compliant Interconnection Agreements). Implemented with effect from 5:00am on 1 October 2015.
l. 0546S (Reduction of the Minimum Eligible Quantity (100,000kWh) for European IP capacity).
m. 0547S (Corrections to the EID arising from implementation of Modifications 0493/0500).
n. 0562FT (Amendment to the Effective Date of Modification 0519 'Harmonisation of Reference Conditions at Interconnection Points). Implemented with effect from 5:00am on 6 November 2015.
o. 0567S (Amendment to Reference Temperature Conditions within the National Grid – IUK Interconnection Agreement). Implemented with effect from 5:00am on 12 February 2016.
p. 0597 (Rules for the Release of Incremental Capacity at Interconnection Points). Implemented with effect from 5:00am on 6 April 2017.
q. 0598S (Amendments to Capacity Allocation Mechanisms to comply with EU Capacity Regulations). Implemented 5:00am on 6 April 2017.
r. 0611S (Amendments to the Firm Capacity Payable Price at Interconnection Points). Implemented with effect from 5:00am on 11 August 2017.
s. 0616 (Capacity Conversion Mechanism for Interconnection Points). Implemented with effect from 5:00am on 01 January 2018.
t. 0621/A/B/C/D/E/F/G/H/J/K/L (Amendments to Gas Transmission Charging Regime). Sent bythe UNC Panel to Ofgem for decision on 19 July 2018.
u. 0662 (Revenue Recovery at Combined ASEPs). Raised 12 June 2018 and currently under development, this modification proposal seeks to apply the TAR code to charges for storage at combined ASEPs.

5.2 Our future activity

Over the next two years, we will be working on the following key topic areas in relation to the EU:

- Implementation of the remaining TAR code obligations in line with Ofgem's pending decision on UNC 0621 for 2019/20 tariffs and the progress of UNC 0662;
- Ongoing input into discussions on the Gas 2020 package and the work of ENTSOG and GIE to support this, in line with the findings of our Future of Gas report published in March 2018; and
- Preparations for EU exit.

Appendix 6
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.

	GWh	mcm	Million therms	Thousand toe
GWh	1	0.091	0.034	0.086
mcm	11	1	0.375	0.946
Million therms	29.307	2.664	1	2.520
Thousand toe	11.630	1.057	0.397	1

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 metre cubed

Appendix 7 Glossary

Acronym	Term	Definition
	Annual power demand	The electrical power demand in any one fiscal year. Different definitions of annual demand are used for different purposes.
ACS	Average cold spell	Average cold spell: defined as a particular combination of weather elements which gives rise to a level of winter peak demand which has a 50% chance of being exceeded as a result of weather variation alone. There are different definitions of ACS peak demand for different purposes.
AGI	Above-ground installation	To support the safe and efficient operation of the pipeline, above-ground installations (AGIs) are needed at the start and end of the cross-country pipeline and at intervals along the route.
ANOP	Anticipated Normal Operating Pressure	A pressure that we may make available at an offtake to a large consumer connected to the NTS under normal operating conditions. ANOPs are specified within the NExA agreement for the site.
AOP	Assured Offtake Pressure	A minimum pressure at an offtake from the NTS to a DN that is required to support the downstream network.
AQ	Annual Quantity	The AQ of a supply point is its annual consumption over a 365-day year.
ARCA	Advanced Reservation of Capacity Agreement	This was an agreement between National Grid and a Shipper relating to future NTS pipeline capacity for large sites in order that Shippers can reserve NTS exit capacity in the long term. This has been replaced by the PARCA process. (See also PARCA)
ASEP	Aggregate System Entry Point	A system entry point where there is more than one, or adjacent Connected Delivery Facilities; the term is often used to refer to gas supply terminals.
	Bar	The unit of pressure that is approximately equal to atmospheric pressure (0.987 standard atmospheres). Where bar is suffixed with the letter g, such as in barg or mbarg, the pressure being referred to is gauge pressure, i.e. relative to atmospheric pressure. One millibar (mbarg) equals 0.001 bar.
BAT	Best Available Technique	A term used in relation to Industrial Emissions Directive (IED) 2010. In this context BAT is defined as Best Available Technique and means applying the most effective methods of operation for providing the basis for emission limit values and other permit conditions designed to prevent and, where that is not practicable, to reduce emissions and the impact on the environment as a whole.
BBL	Balgzand–Bacton Line	A gas pipeline between Balgzand in the Netherlands and Bacton in the UK. **http://www.bblcompany.com**. This pipeline is currently uni-directional and flows from the Netherlands to the UK only.
	Baseload electricity price	The costs of electricity purchased to meet minimum demand at a constant rate.
bcm	Billion cubic metres	Unit or measurement of volume, used in the gas industry. 1 bcm = 1,000,000,000 cubic metres.
	Biomethane	Biomethane is a naturally occurring gas that is produced from organic material and has similar characteristics to natural gas. **http://www.biomethane.org.uk/**
	Boil-off	A small amount of gas which continually boils off from LNG storage tanks. This helps to keep the tanks cold.
BEIS	Department of Business, Energy & Industrial Strategy	A UK Government department. The Department of Business, Energy & Industrial Strategy (BEIS) works to make sure the UK has secure, clean, affordable energy supplies and promote international action to mitigate climate change. These activities were formerly the responsibility of the Department of Energy and Climate Change (DECC), which closed in July 2016.
BRef	BAT Reference Documents	BAT Reference Documents draw conclusions on what the BAT is for each sector to comply with the requirements of IED. The BAT conclusions drawn as a result of the BRef documents will then form the reference for setting permit conditions.
	Capacity	Capacity holdings give NTS Users the right to bring gas onto or take gas off the NTS (up to levels of capacity held) on any day of the Gas Year. Capacity rights can be procured in the long term or through shorter-term processes, up to the Gas Day itself.

Acronym	Term	Definition
CCGT	Combined Cycle Gas Turbine	Gas turbine that uses the combustion of natural gas or diesel to drive a gas turbine generator to generate electricity. The residual heat from this process is used to produce steam in a heat recovery boiler which, in turn, drives a steam turbine generator to generate more electricity. (See also OCGT)
CCS	Carbon capture and storage	Carbon capture and storage (CCS) is a process by which the CO_2 produced in the combustion of fossil fuels is captured, transported to a storage location and isolated from the atmosphere. Capture of CO_2 can be applied to large emission sources like power plants used for electricity generation and industrial processes. The CO_2 is then compressed and transported for long-term storage in geological formations or for use in industrial processes.
CEN	Comité Europeén de Normalisation	European committee for standardisation concerned with the development, maintenance and distribution of standards and specifications.
CfD	Contract for Difference	Contract between the Low Carbon Contracts Company (LCCC) and a low carbon electricity generator designed to reduce its exposure to volatile wholesale prices.
CHP	Combined heat and power	A system whereby both heat and electricity are generated simultaneously as part of one process. Covers a range of technologies that achieve this.
CLNG	Constrained LNG	A service available at some LNG storage facilities whereby Shippers agree to hold a minimum inventory in the facility and flow under certain demand conditions at National Grid's request. In exchange Shippers receive a transportation credit from National Grid.
CM	Capacity Market	The Capacity Market is designed to ensure security of electricity supply. This is achieved by providing a payment for reliable sources of capacity, alongside their electricity revenues, ensuring they deliver energy when needed.
CNG	Compressed natural gas	Compressed natural gas is made by compressing natural gas to less than 1 percent of the volume it occupies at standard atmospheric pressure.
CO_2	Carbon dioxide	Carbon dioxide (CO_2) is the main greenhouse gas and the vast majority of CO_2 emissions come from the burning of fossil fuels (coal, natural gas and oil).
CO_2e	Carbon dioxide equivalent	A term used relating to climate change that accounts for the 'basket' of greenhouse gases and their relative effect on climate change compared to carbon dioxide. For example, UK emissions are roughly 600m tonnes CO_2e. This constitutes roughly 450m tonnes CO_2 and less than the 150m tonnes remaining of more potent greenhouse gases such as methane, which has 21 times more effect as a greenhouse gas, hence its contribution to CO_2e will be 21 times its mass.
	Compressor station	An installation that uses gas turbine or electricity-driven compressors to boost pressures in the pipeline system. Used to increase transmission capacity and move gas through the network.
CSEP	Connected System Exit Point	A point at which natural gas is supplied from the NTS to a connected system containing more than one supply point. For example, a connection to a pipeline system operated by another Gas Transporter.
CV	Calorific Value	The ratio of energy to volume measured in megajoules per cubic metre (MJ/m^3), which for a gas is measured and expressed under standard conditions of temperature and pressure.
CWV	Composite Weather Variable	A measure of weather incorporating the effects of both temperature and wind speed. We have adopted the new industry-wide CWV equations that took effect on 1 October 2015.
DC	Directly Connected (offtake)	Direct connection to the NTS typically to power stations and large industrial users. I.e. the connection is not via supply provided from a distribution network.
DCO	Development Consent Order	A statutory order under The Planning Act (2008) which provides consent for a development project. Significant new pipelines require a DCO to be obtained, and the construction of new compressor stations may also require DCOs if a new HV electricity connection is required.
DFN	Daily Flow Notification	A communication between a Delivery Facility Operator (DFO) and National Grid, indicating hourly and end-of-day entry flows from that facility.
DFO	Delivery Facility Operator	The operator of a reception terminal or storage facility, who processes and meters gas deliveries from offshore pipelines or storage facilities before transferring the gas to the NTS.

Appendix 7 Glossary

Acronym	Term	Definition
	Distribution System	A network of mains operating at three pressure tiers.
	Diurnal Storage	Gas stored for the purpose of meeting, among other things, within-day variations in demand. Gas can be stored in special installations, such as in the form of linepack within transmission, i.e. >7 barg, pipeline systems.
DM	Daily Metered Supply Point	A supply point fitted with equipment, for example a datalogger, which enables meter readings to be taken on a daily basis.
DN	Distribution Network	A gas transportation system that delivers gas to industrial, commercial and domestic consumers within a defined geographical boundary. There are currently eight DNs, each consisting of one or more Local Distribution Zones (LDZs). DNs typically operate at lower pressures than the NTS.
DNO	Distribution Network Operator	Distribution Network Operators own and operate the distribution networks that are supplied by the NTS.
EIA	Environmental Impact Assessment	Environmental study of proposed development works as required under EU regulation and the Town and Country Planning (Environmental Impact Assessment) Regulations 2011. These regulations apply the EU directive "on the assessment of the effects of certain public and private projects on the environment" (usually referred to as the Environmental Impact Assessment Directive) to the planning system in England.
ELV	Emission Limit Value	Pollution from larger industrial installations is regulated under the Pollution Prevention and Control regime. This implements the EU directive on Integrated Pollution Prevention and Control (IPPCD) (2008/1/EC). Each installation subject to IPPCD is required to have a permit containing emission limit values and other conditions based on the application of Best Available Techniques (BAT) and set to minimise emissions of pollutants likely to be emitted in significant quantities to air, water or land. Permit conditions also have to address energy efficiency, waste minimisation, prevention of accidental emissions and site restoration.
EMR	Electricity Market Reform	A government policy to incentivise investment in secure, low-carbon electricity, improve the security of Great Britain's electricity supply, and improve affordability for consumers. The Energy Act 2013 introduced a number of mechanisms. In particular: • A Capacity Market, which will help ensure security of electricity supply at the least cost to the consumer. • Contracts for Difference, which will provide long-term revenue stabilisation for new low carbon initiatives. Both will be administered by delivery partners of the Department of Business, Energy & Industrial Strategy (BEIS). This includes National Grid Electricity Transmission (NGET).
ENA	Energy Networks Association	The Energy Networks Association is an industry association funded by gas or transmission and distribution licence holders.
ENTSOG	European Network of Transmission System Operators for Gas	Organisation to facilitate cooperation between national gas transmission system operators (TSOs) across Europe to ensure the development of a pan-European transmission system in line with European Union energy goals.
ETYS	*Electricity Ten Year Statement*	The *ETYS* illustrates the potential future development of the National Electricity Transmission System (NETS) over a ten-year (minimum) period and is published on an annual basis.
	Exit Zone	A geographical area (within an LDZ) that consists of a group of supply points that, on a peak day, receive gas from the same NTS offtake.
FEED	Front End Engineering Design	The FEED is basic engineering which comes after the conceptual design or feasibility study. The FEED design focuses on the technical requirements as well as an approximate budget investment cost for the project.
FES	Future Energy Scenarios	The FES is a range of credible futures which has been developed in conjunction with the energy industry. They are a set of scenarios covering the period from now to 2050, and are used to frame discussions and perform stress tests. They form the starting point for all transmission network and investment planning, and are used to identify future operability challenges and potential solutions.

Acronym	Term	Definition
	Gas Deficit Warning	The purpose of a Gas Deficit Warning is to alert the industry to a requirement to provide a within-day market response to a physical supply/demand imbalance.
	Gasholder	A vessel used to store gas for the purposes of providing diurnal storage.
	Gas Supply Year	A twelve-month period commencing 1 October, also referred to as a Gas Year.
GB	Great Britain	A geographical, social and economic grouping of countries that contains England, Scotland and Wales.
GFOP	*Gas Future Operability Planning*	This publication describes how changing requirements affect the future capability of the NTS out to 2050. It also considers how these requirements may affect NTS operation and our processes. The *GFOP* may highlight a need to change the way we respond to you or other market signals. This, in turn, may lead us to modify our operational processes and decision making. This publication helps to make sure we continue to maintain a resilient, safe and secure NTS now and into the future.
GS(M)R	Gas Safety (Management) Regulations 1996	Regulations which apply to the conveyance of natural gas (methane) through pipes to domestic and other consumers and cover four main areas: (a) the safe management of gas flow through a network, particularly those parts supplying domestic consumers, and a duty to minimise the risk of a gas supply emergency (b) arrangements for dealing with supply emergencies (c) arrangements for dealing with reported gas escapes and gas incidents (d) gas composition. Gas Transporters are required to submit a safety case to the HSE detailing the arrangements in place to ensure compliance with GS(M)R requirements.
	Gas Transporter	Formerly Public Gas Transporter (PGT), GTs, such as National Grid, are licensed by the Gas and Electricity Markets Authority (GEMA) to transport gas to consumers.
GTYS	*Gas Ten Year Statement*	The *Gas Ten Year Statement* is published annually in accordance with National Grid Gas plc's obligations in Special Condition 7A of the Gas Transporter Licence relating to the National Transmission System and to comply with Uniform Network Code (UNC) requirements.
GW	Gigawatt	1,000,000,000 watts, a measure of power.
GWh	Gigawatt hour	1,000,000,000 watt hours, a unit of energy.
gCO_2/kWh	Gram of carbon dioxide per kilowatt hour	Measurement of CO_2 equivalent emissions per kWh of energy used or produced.
HSE	Health and Safety Executive	The HSE regulates the onshore pipeline operators to maintain and improve the health and safety performance within the industry.
IEA	International Energy Agency	An intergovernmental organisation that acts as energy policy advisor to 28 member countries.
IED	Industrial Emissions Directive	The Industrial Emissions Directive came into force on January 2013. The directive has recast seven existing directives related to industrial emissions into a single clear, coherent legislative instrument, including the IPPCD and Large Combustion Plant Directives.
IGMS	Integrated Gas Management Control System	Used by National Grid, the System Operator, to control and monitor the gas transmission system, and also to provide market information to interested stakeholders within the gas industry.
	Interconnector	A pipeline transporting gas to another country. The Irish interconnector transports gas across the Irish Sea to both the Republic of Ireland and Northern Ireland. The Belgian Interconnector (IUK) transports gas between Bacton and Zeebrugge. The Belgian Interconnector is capable of flowing gas in either direction. The Dutch Interconnector (BBL) transports gas between Balgzand in the Netherlands and Bacton. It is currently capable of flowing only from the Netherlands to the UK.

Appendix 7 Glossary

Acronym	Term	Definition
IPPCD	Integrated Pollution Prevention & Control Directive 1999	Emissions from our installations are subject to EU-wide legislation; the predominant legislation is the Integrated Pollution Prevention & Control Directive (IPPCD) 1999, the Large Combustion Plant Directive (LCPD) 2001 and the Industrial Emissions Directive (IED) 2010. The requirements of these directives have now been incorporated into the Environmental Permitting (England and Wales) (Amendment) Regulations 2013 (with similar regulations applying in Scotland).The IPPCD aims to reduce emissions from industrial installations and contributes to meeting various environment policy targets and compliance with EU directives. Since 31 October 2000, new installations are required to apply for the IPPCD permit. Existing installations were required to apply for the IPPCD permit over a phased timetable until October 2007.
IUK	Interconnector (UK)	A bi-directional gas pipeline between Bacton in the UK and Zeebrugge Belgium. **http://www.interconnector.com**
KWh	Kilowatt hour	A unit of energy used by the gas industry. Approximately equal to 0.0341 therms. One Megawatt hour (MWh) equals 1,000 kWh, one Gigawatt hour (GWh) equals 1,000 MWh, and one Terawatt hour (TWh) equals 1,000 GWh.
LCPD	Large Combustion Plant Directive	The Large Combustion Plant Directive (LCPD) is a European Union Directive which introduced measures to control the emissions of sulphur dioxide, oxides of nitrogen and dust from large combustion plant, including power stations.
LDZ	Local Distribution Zone	A gas distribution zone connecting end users to the (gas) NTS.
	Linepack	The volume of gas within the National or Local Transmission System at any time. (See also: PCLP)
LNG	Liquefied natural gas	LNG is formed by chilling gas to -161˚C so that it occupies 600 times less space than in its gaseous form.
	Load Duration Curve (1-in-50 Severe)	The 1-in-50 severe Load Duration Curve is that curve which, in a long series of years, with connected load held at the levels appropriate to the year in question, would be such that the volume of demand above any given demand threshold (represented by the area under the curve and above the threshold) would be exceeded in one out of fifty years.
	Load Duration Curve (Average)	The average Load Duration Curve is that curve which, in a long series of winters, with connected load held at the levels appropriate to the year in question, the average volume of demand above any given threshold, is represented by the area under the curve and above the threshold.
LTS	Local Transmission System	A pipeline system operating at >7 barg that transports gas from NTS/LDZ offtakes to distribution system low pressure pipelines. Some large Users may take their gas direct from the LTS.
LTSEC	Long-Term System Entry Capacity (LTSEC)	NTS entry capacity available on a long-term basis (up to 17 years into the future) via an auction process. This is also known as Quarterly System Entry Capacity (QSEC).
m^3	Cubic metre	The unit of volume, expressed under standard conditions of temperature and pressure, approximately equal to 35.37 cubic feet. One million cubic metres (mcm) are equal to 106 cubic metres, one billion cubic metres (bcm) equals 109 cubic metres.
mcm	Million cubic metres	Unit or measurement of volume, used in the gas industry. 1 mcm = 1,000,000 cubic metres
	Margins Notice	The purpose of the Margins Notice is to provide the industry with a day-ahead signal that there may be the need for a market response to a potential physical supply/demand imbalance.
MCPD	Medium Combustion Plant Directive	The Medium Combustion Plant Directive (MCPD) will apply limits on emissions to air from sites below 50 MW thermal input. The MCPD is likely to come into force by 2020.
MRS	Medium-Range Storage	Typically, these storage facilities have very fast injection and withdrawal rates that lend themselves to fast day-to-day turn rounds as market prices and demand dictate.
MWh	Megawatt hour	1,000,000 watts, a measure of power usage or consumption in 1 hour.
NBP	National balancing point	The wholesale gas market in Britain has one price for gas irrespective of where the gas comes from. This is called the national balancing point (NBP) price of gas and is usually quoted in price per therm of gas.

Acronym	Term	Definition
NCS	Norwegian Continental Shelf	The Norwegian Continental Shelf (NCS) comprises those areas of the sea bed and subsoil beyond the territorial sea over which Norway exercises rights of exploration and exploitation of natural resources. NCS gas comes into the UK via St Fergus and Easington terminals.
NDM	Non-daily metered	A meter that is read monthly or at longer intervals. For the purposes of daily balancing, the consumption is apportioned, using an agreed formula, and for supply points consuming more than 73.2 MWh pa, reconciled individually when the meter is read.
NDP	Network Development Process	NDP defines the method for decision making, optioneering, development, sanction, delivery and closure for all National Grid gas projects. The aim of the NDP is to deliver projects that have the lowest whole-life cost, are fit for purpose and meet stakeholder and RIIO requirements.
NEA	Network Entry Agreement	A NEA is signed by the gas Shipper prior to any gas flowing on to the system. Within the NEA the Gas Transporter sets out the technical and operational conditions of the connection such as the gas quality requirements, the maximum permitted flow rate and ongoing charges.
NExA	Network Exit Agreement	A NExA is signed by a gas Shipper or Distribution Network Operator prior to any gas being taken off the system. Within the NExA the Gas Transporter sets out the technical and operational conditions of the offtake such as the maximum permitted flow rate, the assured offtake pressure and ongoing charges.
NGGT	National Grid Gas Transmission	NGGT refers to teams within both the SO and TO areas of National Grid, involved in gas transmission activities.
NGSE	Network Gas Supply Emergency	A NGSE occurs when National Grid is unable to maintain a supply–demand balance on the NTS using its normal system balancing tools. A NGSE could be caused by a major loss of supplies to the system as a result of the failure of a gas terminal or as the result of damage to a NTS pipeline affecting the ability of the system to transport gas to consumers. In such an event the Network Emergency Coordinator (NEC) would be requested to declare a NGSE. This would enable National Grid to use additional balancing tools to restore a supply–demand balance. Options include requesting additional gas supplies be delivered to the NTS or requiring gas consumers, starting with the largest industrial consumers, to stop using gas. These tools will be used, under the authorisation of the NEC, to try to maintain supplies as long as possible to domestic gas consumers.
NOM	Network Output Measure	RIIO has introduced Network Output Measures (NOMs) (previously Network Replacement Outputs) as a proxy for measuring the health and thus level of risk on the gas network. There are specific targets which are related to the condition of the NTS which must be met. Asset health is a key RIIO measure in terms of allowances and output. The targets cover an eight-year period from 2013 to 2021.
NOx	Nitrous oxide	A group of chemical compounds, some of which are contributors to pollution, acid rain or are classified as greenhouse gases.
NTS	National Transmission System	A high-pressure gas transportation system consisting of compressor stations, pipelines, multi-junction sites and offtakes. NTS pipelines transport gas from terminals to NTS offtakes and are designed to operate up to pressures of 94 bar(g).
	National Transmission System Offtake	An installation defining the boundary between NTS and LTS or a very large consumer. The offtake installation includes equipment for metering, pressure regulation, odourisation equipment etc.
NWE	North West European (Hub)	The wholesale gas market in North West Europe has one price for gas irrespective of where the gas comes from. This is called the North West European (NWE) hub price of gas and is usually quoted in price per therm of gas.
	Oil & Gas UK	Oil & Gas UK is a representative body for the UK offshore oil and gas industry. It is a not-for-profit organisation, established in April 2007. **http://www.oilandgasuk.co.uk**
OCGT	Open Cycle Gas Turbine	Gas turbines in which air is first compressed in the compressor element before fuel is injected and burned in the combustor. (See also CCGT)
OCM	On the Day Commodity Market	This market constitutes the balancing market for Great Britain and enables anonymous financially cleared on the day trading between market participants.

Appendix 7 Glossary

Acronym	Term	Definition
	Odourisation	The process by which the distinctive odour is added to gas supplies to make it easier to detect leaks.
Ofgem	Office of Gas and Electricity Markets	The UK's independent national regulatory authority, a non-ministerial government department. Its principal objective is to protect the interests of existing and future electricity and gas consumers.
OM	Operating Margins	Gas used by National Grid Transmission to maintain system pressures under certain circumstances, including periods immediately after a supply loss or demand forecast change, before other measures become effective and in the event of plant failure, such as pipe breaks and compressor trips.
OUG	Own Use Gas	Gas used by National Grid to operate the transportation system. Includes gas used for compressor fuel, heating and venting.
pa	Per annum	Per year
PARCA	Planning and Advanced Reservation of Capacity Agreement	A solution developed in line with the enduring incremental capacity release solutions which have been developed following the implementation of the Planning Act (2008). PARCAs were implemented on 1 February 2015 and replace the functions of PCAs and ARCAs. (See also ARCA & PCA)
PCA	Planning Consent Agreement	Planning Consent Agreements were made in relation to NTS entry and exit capacity requests and comprised a bilateral agreement between National Grid and Developers, DNOs or Shippers whereby National Grid assessed the Need Case for NTS reinforcement and would undertake any necessary planning activities ahead of a formal capacity signal from the customer. Where a Need Case was identified, the customer would underwrite National Grid NTS to undertake the required statutory Planning Act activities such as strategic optioneering, Environmental Impact Assessment, statutory and local community consultations, preparation of the Development Consent Order (DCO) and application. This has now been replaced by the PARCA process. (See PARCA)
PCLP	Projected Closing Linepack	Linepack is the volume of gas stored within the NTS. Throughout a Gas Day linepack levels fluctuate due to imbalances between supply and demand over the day. National Grid, as residual balancer of the UK gas market, need to ensure an end-of-day market balance where total supply equals, or is close to, total demand. The Projected Closing Linepack (PCLP) metric is used as an indicator of end-of-day market balance. (See also Linepack)
	Peak Day Demand	The 1-in-20 peak day demand is the level of demand that, in a long series of winters, with connected load held at levels appropriate to the winter in question, would be exceeded in one out of 20 winters, with each winter counted only once.
QSEC	Quarterly System Entry Capacity	NTS entry capacity available on a long-term basis (up to 17 years into the future) via an auction process. Also known as Long-Term System Entry Capacity (LTSEC).
	RIIO-T1	RIIO relates to the current Ofgem price control period which runs from 1 April 2013 to 31 March 2021. For National Grid Transmission this is referred to as RIIO-T1.
	Safety Monitors	Safety Monitors in terms of space and deliverability are minimum storage requirements determined to be necessary to protect loads that cannot be isolated from the network and also to support the process of isolating large loads from the network. The resultant storage stocks or monitors are designed to ensure that sufficient gas is held in storage to underpin the safe operation of the gas transportation system under severe conditions. There is now just a single safety monitor for space and one for deliverability. These are determined by National Grid to meet its Uniform Network Code requirements and the terms of its safety case. Total shipper gas stocks should not fall below the relevant monitor level (which declines as the winter progresses). National Grid is required to take action (which may include use of emergency procedures) in order to prevent storage stocks reducing below this level.
SEAL	Shearwater Elgin Area Line	The offshore pipeline from the Central North Sea (CNS) to Bacton.
SEPA	Scottish Environment Protection Agency	The environmental regulator for Scotland.

Acronym	Term	Definition
	Shale gas	Shale gas is natural gas that is found in shale rock. It is extracted by injecting water, sand and chemicals into the shale rock to create cracks or fractures so that the shale gas can be extracted. **https://www.gov.uk/government/publications/about-shale-gas-and-hydraulic-fracturing-fracking**
	Shipper or Uniform Network Code (Shipper) User	A company with a Shipper Licence that is able to buy gas from a producer, sell it to a supplier and employ a GT to transport gas to consumers.
	Shrinkage	Gas that is input to the system but is not delivered to consumers or injected into storage. It is either Own Use Gas or Unaccounted for Gas.
SHQ	Supply Hourly Quantity	The maximum hourly consumption at a DM Supply Point.
SNCWV	Seasonal Normal Composite Weather Variable	The seasonal normal value of the CWV is the smoothed average of the values of the applicable CWV for that day in a significant number of previous years. (See also CWV)
	System operability	The ability to maintain system stability and all of the asset ratings and operational parameters within pre-defined limits safely, economically and sustainably.
SO	System Operator	An entity entrusted with transporting energy in the form of natural gas or power on a regional or national level, using fixed infrastructure. Unlike a TSO, the SO may not necessarily own the assets concerned. For example, National Grid operates the electricity transmission system in Scotland, which is owned by Scottish Hydro Electricity Transmission and Scottish Power.
SOQ	Supply Offtake Quantity	The maximum daily consumption at a supply point.
SOR	Strategic Options Report	Output of the PCA, ARCA and PARCA statutory Planning Act activities reporting to the customer on the findings of optioneering analysis by National Grid in relation to the customer request for NTS entry or exit capacity.
SRS	Short-Range Storage	These are commercially operated sites that have shorter injection/withdrawal times so can react more quickly to demand, injecting when demand or prices are lower and withdrawing when higher.
	Substitution	Capacity substitution is the process of moving unsold capacity from one or more system points to another, where demand for that capacity exceeds the available capacity quantities for the relevant period. This avoids the construction of new assets or material increases in operational risk.
	Supplier	A company with a supplier's licence contracts with a Shipper to buy gas, which is then sold to consumers. A supplier may also be licensed as a Shipper.
	Supply Point	A group of one or more meter points at a site.
	Therm	An imperial unit of energy. Largely replaced by the metric equivalent: the kilowatt hour (kWh). 1 therm equals 29.3071 kWh.
TO	Transmission Owner	National Grid owns the gas National Transmission System (NTS) in Great Britain. As the TO National Grid must make sure all assets on the NTS are fit for purpose and safe to operate. Effective maintenance plans and asset replacement schedules are developed and implemented to keep the gas flowing.
TPC	Transmission Planning Code	The Transmission Planning Code describes National Grid's approach to planning and developing the NTS in accordance with its duties as a Gas Transporter and other statutory obligations relating to safety and environmental matters. The document is subject to approval by the Gas and Electricity Markets Authority (GEMA).
TSO	Transmission System Operator	Operator of a Gas Transmission Network under licence issued by the Gas and Electricity Markets Authority (GEMA) and regulated by Ofgem.
TWh	Terawatt hour	1,000,000,000,000 watt hours, a unit of energy.
UAG	Unaccounted for Gas	Gas 'lost' during transportation. Includes leakage, theft and losses due to the method of calculating the Calorific Value.

Appendix 7 Glossary

Acronym	Term	Definition
UK	United Kingdom of Great Britain and Northern Ireland	A geographical, social and economic grouping of countries that contains England, Scotland, Wales and Northern Ireland.
UKCS	United Kingdom Continental Shelf	The UK Continental Shelf (UKCS) comprises those areas of the sea bed and subsoil beyond the territorial sea over which the UK exercises sovereign rights of exploration and exploitation of natural resources.
UNC	Uniform Network Code	The Uniform Network Code is the legal and commercial framework that governs the arrangements between the Gas Transporters and Shippers operating in the UK gas market. The UNC comprises different documents including the Transportation Principal Document (TPD) and Offtake Arrangements Document (OAD).
VSD	Variable Speed Drives	Compressor technology where the drive speed can be varied with changes in capacity requirement. Variable speed drive compressors compared to constant speed compressors are more energy efficient and operate more quietly by varying speed to match the workload.
	Weather corrected	The actual demand figure that has been adjusted to take account of the difference between the actual weather and the seasonal normal weather.
WLP	Whole Life Prioritisation	The WLP provides the criteria used to prioritise all of the options considered as part of the NDP. The scoring from the WLP Model aids the decision-making process by discounting unsuitable options at an early stage of the NDP.

Disclaimer

This statement is produced for the purpose of and in accordance with National Grid Gas plc's obligations in Special Condition 7A3 of its Gas Transporter Licence relating to the NTS and Section O4.1 of the Transportation Principal Document of the Uniform Network Code in reliance on information supplied pursuant to section O of the Transportation Principal document of the Uniform Network Code. Section O1.3 of the Transportation Principal document of the Uniform Network Code applies to any estimate, forecast or other information contained in this statement.

For the purpose of the remainder of this statement, National Grid Gas plc will be referred to as National Grid.

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