Gas System Operator

Gas Ten Year Statement 2019

nationalgrid

Gas Ten Year Statement
2019

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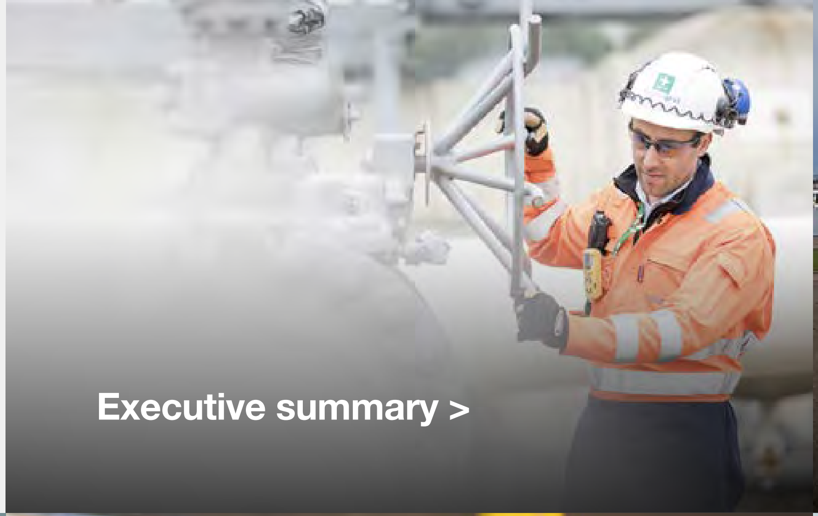

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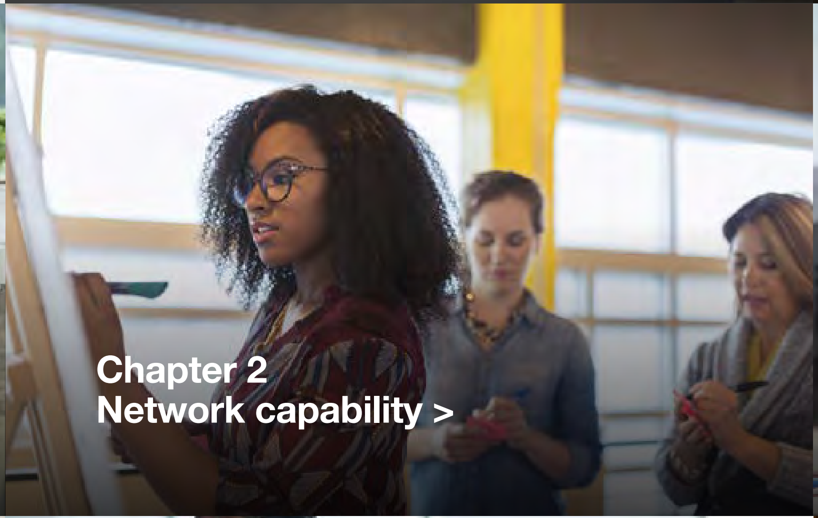

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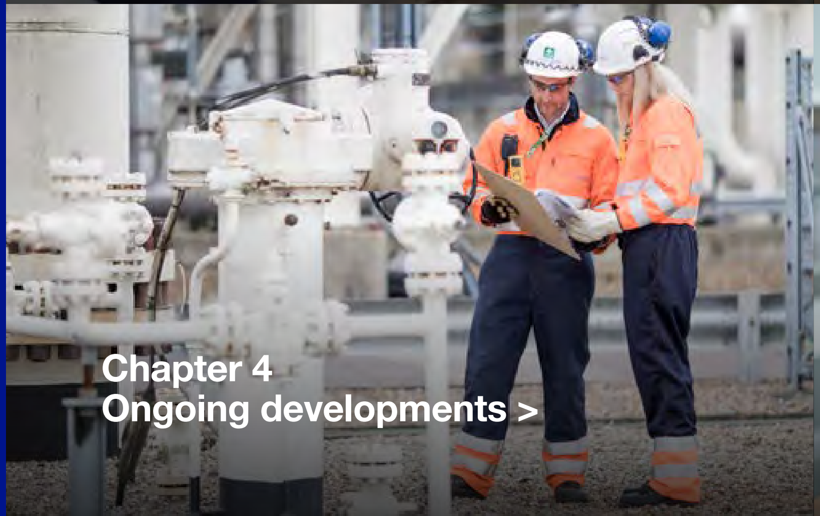

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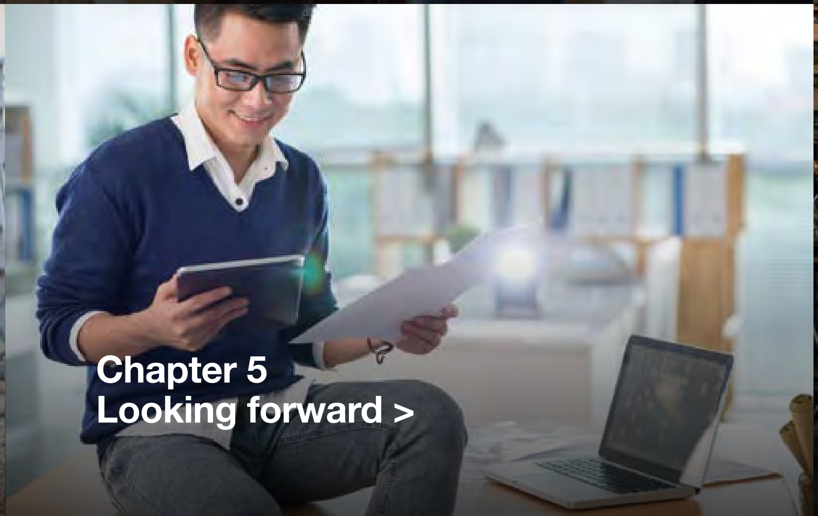

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Welcome

How to use this document

We have published the 2019 *Gas Ten Year Statement (GTYS)* as an interactive document.

Home

This will take you to the home page.

Arrows

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

'Defined' content

Words underlined are defined in the glossary at the back of this document.

Information

An information icon shows there is 'further information' included at the back of this document.

Enlarge/reduce

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

'Linked' content

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

Welcome
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 within this *GTYS* publication. Instead, our workbook is available online[1] and contains the following:

- All graphs and tables contained in the *GTYS 2019.*
- Actual demand for 2018 (TWh).
- Peak day, maximum and minimum physical NTS entry flows for gas year 2018–19.
- Peak day, maximum and minimum physical NTS exit flows for gas year 2018–19.
- Gas demand and supply volumes per scenario out to 2050.
- 1-in-20 peak day diversified demand per scenario out to 2050.
- 1-in-20 peak day undiversified demand per scenario out to 2050.
- 1-in-50 peak day diversified demand per scenario out to 2050.
- 1-in-50 peak day undiversified demand per scenario out to 2050.
- Annual LDZ demand per scenario.
- Peak and annual supply by terminal out to 2050.

Welcome
to our 2019 *Gas Ten Year Statement*

The economic landscape, developments in technology and consumer behaviour continue to change at a remarkable rate. This creates more opportunities than ever before for the gas industry. Our 2019 *Gas Ten Year Statement*, along with our other System Operator publications, aims to encourage and inform debate, leading to changes that ensure a safe, secure and sustainable energy future for everyone in Great Britain.

Our mission is to deliver reliable and affordable energy for all consumers and enable the transformation to a sustainable gas system. The latest *Future Energy Scenarios* further emphasise the importance of gas in Great Britain's energy mix. In all *Future Energy Scenarios*, gas will continue to play a pivotal role in heat, industry, and flexible power generation. As we transition to a net zero future, low-carbon gases such as hydrogen and biomethane could play a key role in decarbonising the energy sector.

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

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

Ian

Ian Radley
Head of Gas Operations

Executive summary

Executive summary
Overview

The *2019 Gas Ten Year Statement (GTYS)* provides you with an update on current and future changes that impact the way we plan and operate the gas National Transmission System (NTS). The *GTYS* outlines what we are doing to address these changes as the System Operator and Transmission Owner.

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

Our customers' immediate needs, alongside their long-term needs as articulated within the latest *Future Energy Scenarios*

Asset management

Legislative change

In addition, due to recent legislation that amended the UK's 2050 greenhouse gas emission target to net zero, we have included an additional driver of change in the *GTYS*:

Net zero (net zero greenhouse gas emissions) by 2050

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

Executive summary
Key messages

Customer needs

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

In response to our customers' changing needs, we launched an online gas connections portal in January 2019. This can facilitate all connection applications, as well as applications to reserve capacity through the Planning and Advanced Reservation of Capacity Agreement (PARCA) process. In addition, by providing a suite of standardised connection designs, we can facilitate smaller and faster-to-market connections at a lower cost than ever before.

We are already seeing increasing interest from non-traditional NTS customers. We are currently facilitating our first biomethane and Compressed Natural Gas (CNG) connections.

Legislative change

Legislative change, both in the UK and the EU, plays a significant role in how we utilise our assets, plan and operate the NTS.

The Industrial Emissions Directive (IED) is the mandatory minimum emission standard that all European countries must comply with by 2023. The IED applies to 22 of our 24 NTS compressor sites. Work to ensure compliance has been ongoing during 2018–19. Further improvements to our compressor sites have been submitted as part of our RIIO-2 business proposal.

In addition, through our role in an industry working group established by the Institute for Gas and Engineering Management (IGEM), we are reviewing GB gas quality specifications. The gas quality specifications being developed will help to ensure we continue to facilitate a diverse mix of supply sources onto the gas network, which will become increasingly important as the GB supply mix continues to change.

Net zero by 2050

In June 2019, the UK Government set a new target requiring the UK to bring all greenhouse gas emissions to net zero by 2050. We recognise the urgent need to address climate change and we support the government's commitment to net zero by 2050. Gas has an important role to play in supporting the transition to a decarbonised energy future by providing the reliability and flexibility for low-carbon electricity, heat, industry and transport.

During 2018–19, we launched our Hydrogen in the NTS (HyNTS) programme. This is a programme of work that seeks to identify the opportunities and address the challenges that transporting hydrogen within the NTS presents. This will help to unlock the potential of hydrogen to support the UK's transition to a net zero future.

Asset management

It is vital that we comply with all safety legislation that applies to operating the NTS, whilst also maintaining the current level of network risk through maintenance and replacement. With so many ageing assets on our network, we have a growing asset health challenge. An ageing network needs more maintenance and we have to balance this with our customers' changing needs of the NTS.

A key aspect of our asset management approach going into the future includes the development of a new Methodology for Network Output Measures (NOMs). This monetised risk based approach to the planning and targeting of our asset investments, and the reporting of investment outcomes to Ofgem and key stakeholders, has been agreed provisionally by Ofgem in 2018–19.

Introduction

Introduction

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

The *GTYS* is published annually at the end of our annual planning cycle. We use the *GTYS* to provide you with updated information 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, as well as highlighting key developments that provide further information on our gas System Operator activities.

What do we do?

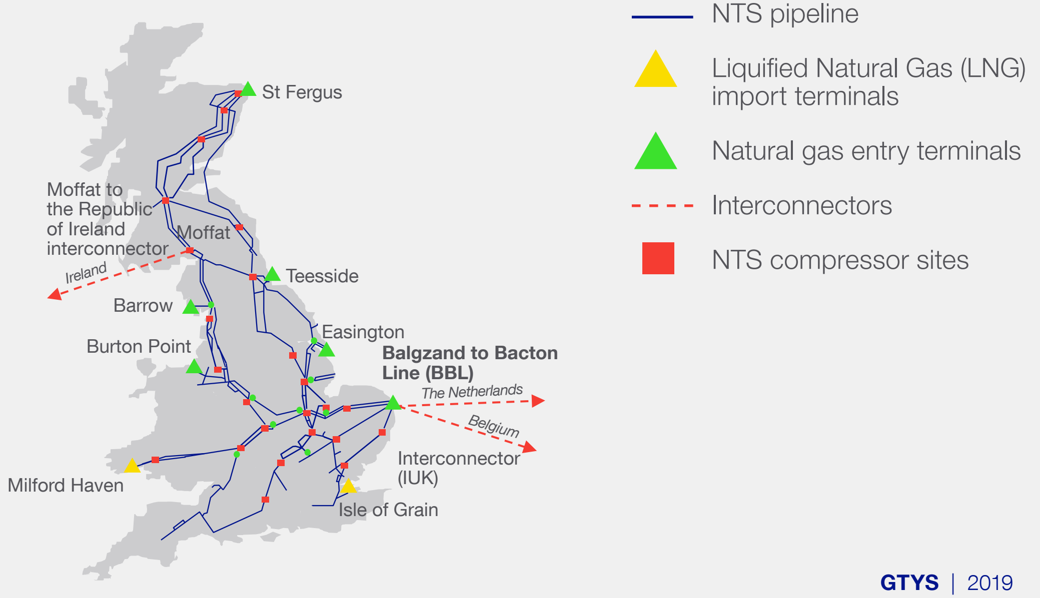
Our role

We are the System Operator and Transmission Owner 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. As System Operator, 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 System Operator, we are also responsible for identifying the long-term needs of the network. As Transmission Owner, 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 the facilitation of a competitive gas market. Our network includes approximately 7,660 km of pipelines, presently operated at pressures of up to 94 bar (see Appendix 1 for a detailed view of NTS maps). Our network transports gas from entry terminals and storage facilities to exit offtake points from the network. At exit offtake points, gas is transferred to four distribution networks (DNs) for onward transportation to domestic and industrial customers, or to directly connected customers including storage sites, power stations, large industrial consumers and interconnectors (figure 0.1).

Figure 0.1
The National Transmission System



Introduction

Our regulatory framework

The RIIO (Revenue = Incentives + Innovation + Outputs) regulatory framework was implemented by the Office of Gas and Electricity Markets (Ofgem) in 2013–14. RIIO uses incentives to drive innovation in order to develop and deliver more sustainable energy.

We are currently within the RIIO-1 period (2013–21); under this framework, we have set outputs which have been agreed with our stakeholders. We deliver these outputs in return for an agreed revenue allowance from Ofgem. You can find more information on our delivered outputs for RIIO-1 in Our Performance[1] publication.

RIIO-2 — Spotlight

We are currently finalising our business plan for the RIIO-2 period (2021-2026), and will submit our final plan to Ofgem by the end of 2019.

To build our business plan, we carried out our most extensive listening exercise to understand stakeholder priorities and future requirements.

We sought stakeholder views through a three stage engagement process that included:

- establishing stakeholder priorities
- building the details of our business plan with our stakeholders
- checking our plan will deliver what our stakeholders need.

Our draft business plan submission is now available online. The final business plan will be submitted to Ofgem in December 2019.

Our key gas SO publications

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

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

The *Gas Future Operability Planning (GFOP)* describes how our changing customer and stakeholder needs may affect the future operability of the National Transmission System (NTS).

The *GFOP* acts as a vehicle for our customers and stakeholders to assess their future needs of the NTS out to 2050, with the aim of setting the direction for solutions that benefit all market participants.

Introduction

To see how the *GTYS* fits in with other National Grid and National Grid ESO publications, you may also be interested in the following documents:

Future Energy Scenarios
July
A range of credible pathways for the future of energy from today to 2050. Scenarios are unconstrained by network issues.

The *ETYS* and *GTYS* take the unconstrained scenarios in *FES* to develop requirements for planning and operating the electricity and gas transmission systems over the next 10 years.

Needs case

Electricity Ten Year Statement
November
The likely future transmission requirements on the electricity system.

Gas Ten Year Statement
November
How the gas network is planned and operated, with a ten-year view.

Options

Network Options Assessment
January
The options available to meet reinforcement requirements on the electricity system.

Ten Year Network Development Plan
Overview of the European gas and electricity infrastructure and its future developments.

The operability publications consider the unconstrained scenarios in *FES* to explore operability risks and associated requirements of the transmission networks and services.

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

Gas Future Operability Planning
How the changing energy landscape will impact the operability of the gas system.

Ad-hoc, insights -led productions and reports

Operability Strategy Report
Highlights the challenges we face in maintaining an operable electricity system, and summarises the work we are undertaking to ensure we meet those challenges.

Future Gas Supply Patterns
How variability in supply pattern seasonally and day-to-day has changed, and could change in the future.

Ad-hoc reports that develop shorter-term plans for more specific elements of operational assets and services, where the need arises.

System Needs and Product Strategy
Our view of future electricity system needs and potential improvements to balancing services markets.

Product Roadmap for Restoration
Our plan to develop restoration products.

Transmission Thermal Constraints Management
Our plan for the management of thermal constraints.

Wider Access to the Balancing Mechanism Roadmap
Our plan to widen access to the balancing mechanism.

Product Roadmap for Reactive Power
Our plan to develop reactive power products.

Annual short-term reports that explore any security of supply or operational challenges anticipated over the summer and winter periods.

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

Summer Outlook Report
April
Our view of the gas and electricity systems for the summer ahead.

Winter Outlook Report
October
Our view of the gas and electricity systems for the winter ahead.

Electricity Capacity Report
Capacity Market auctions for delivery in a year ahead and four years ahead.

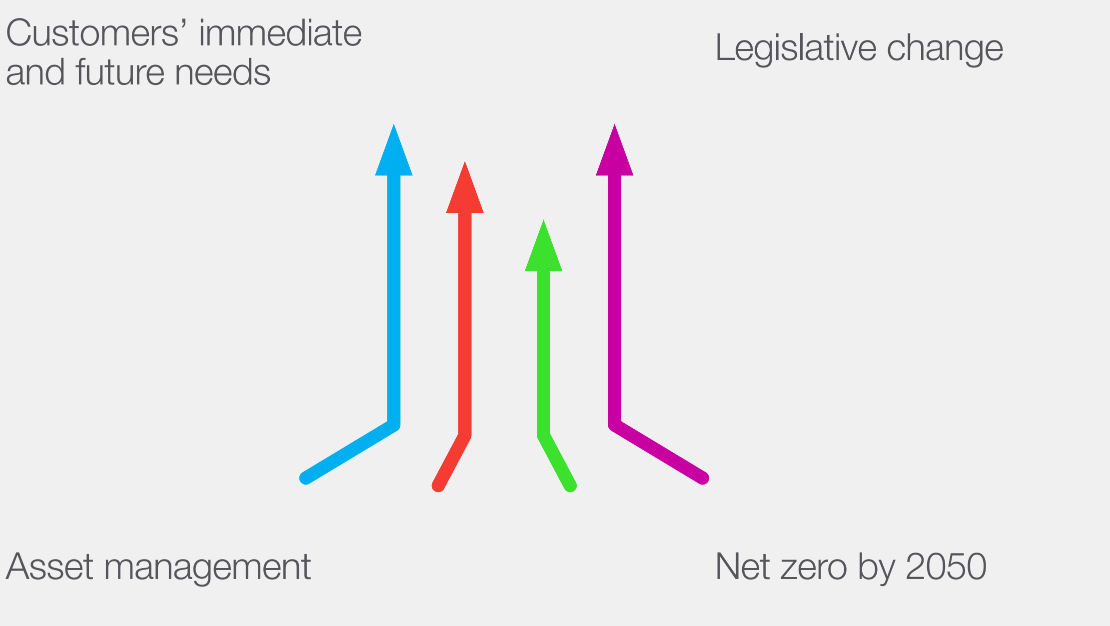
1>Drivers of change

Drivers of change

1.1 Introduction

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

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



Key messages

Certain drivers of change can trigger our NDP because they affect our current network capability and future system operability. We articulated these drivers in the introduction of this *GTYS* and they include: our customers' immediate and future needs, asset management, legislative change, and net zero by 2050.

Drivers of change

1.2 Network Development Process: stage 1

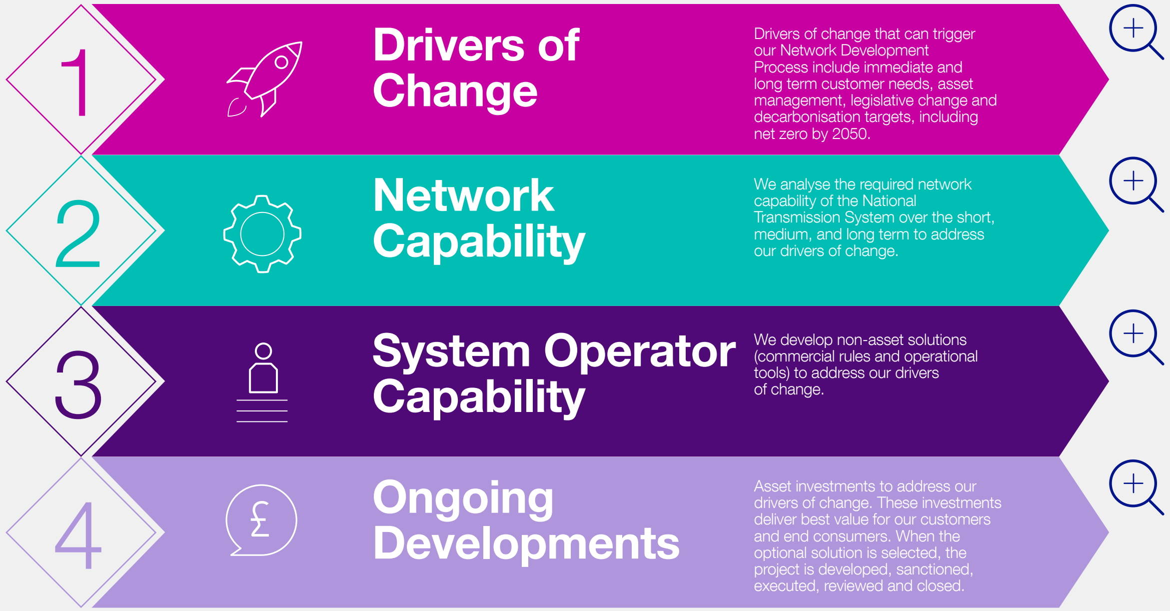
In the *GTYS,* we aim to make our investment decision process as transparent as possible by outlining the initial stages of our Network Development Process (NDP) as shown in figure 1.2.

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

In the *GTYS,* we focus on the first three stages of the NDP (Drivers of Change, Network Capability and System Operator Capability) as these outline our internal decision-making process. The final stage of the NDP details asset investment options that have been identified as the preferred option to meet our stakeholders' needs, and these are discussed in chapter 4 – Ongoing Developments.

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

Figure 1.2
Our Network Development Process



Drivers of change
1.3 Customer needs

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

Anyone who wants to connect to the NTS can arrange for a connection directly with us and we can reserve capacity for them. However, a shipper must buy and hold capacity for a customer. Our Gas Transporters Licence stipulates we can only enter transportation arrangements with shippers and Gas Distribution Network Operators, as detailed in the Uniform Network Code (UNC).

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

1.3.1 Connection and capacity application process

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

If you have any queries about our connection or capacity processes, please contact the gas customer team directly, you can find their contact details in Appendix 4.

Drivers of change
1.3 Customer needs

1.3.2 Evolving our connection process

Historically, connection requests to the NTS were typically required to support large scale entry and exit connections or facilitate storage. However, more recently, we have been approached by customers aiming to connect smaller projects. These projects are fundamentally different to traditional NTS customers, as they are generally fast to market and the associated costs for a connection represent a significant portion of their total project budgets.

These non-traditional customers see value in connecting to the NTS because of the system location and/or the benefits of a higher pressure network. This emerging customer base includes those developing non-traditional gas sources, for example, biomethane. Our spotlight on facilitating flexible connections includes more information on how we are engaging with these new customers and beginning to facilitate these new connections to the NTS.

You can find out more information on how we are evolving our connection process by viewing our new online NTS gas connections portal[1] that we launched in January 2019.

Facilitating flexible connections for gas customers

Spotlight

The outputs of our innovation project Project CLoCC (Customer Low Cost Connections) simplified the process of connecting to the NTS for a new generation of gas customers by reducing the cost and time to connect to the NTS.

Project CLoCC closed on 29 October 2018 and delivered its innovation outputs to the National Grid business for implementation. In July 2019, Ofgem agreed to award 100 per cent of Successful Delivery Reward Criteria, reflecting the fact that National Grid Gas Transmission had delivered the CLoCC project to a satisfactory standard, on time and under budget.

We are continuing our work to evolve gas transmission connections – creating many firsts for the NTS in the process. Read the two examples on this page to find out more about this work.

Biocow – first biomethane connection

Fordoun – first Compressed Natural Gas (CNG) connection

The future for gas connections

The new gas connections portal is now live and customers are able to register to use the portal to generate cost estimates and apply for a gas connection online. Interest in using the portal has been high, we currently have 66 companies registered to use it.

We have a number of new connections in discussion and are looking to build on the work that Project CLoCC started to make further improvements for customers. This will include reviewing the services we offer to our increasingly diverse customer base, and reviewing our costs, on a regular basis.

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

Drivers of change
1.3 Customer needs

1.3.3 Capacity at Interconnection Points

The UK currently has three direct gas pipelines (gas interconnectors) connecting the NTS to other states (figure 1.3). These include:

- Moffat to the Republic of Ireland
- Balgzand to Bacton Line (BBL) to the Netherlands
- Interconnector UK (IUK) to Belgium.

You can find a detailed description of our capacity application process for interconnectors in Appendix 3.

In July 2019, the interconnector BBL developed capability for two-way flow. Please see our spotlight on BBL to find out more information.

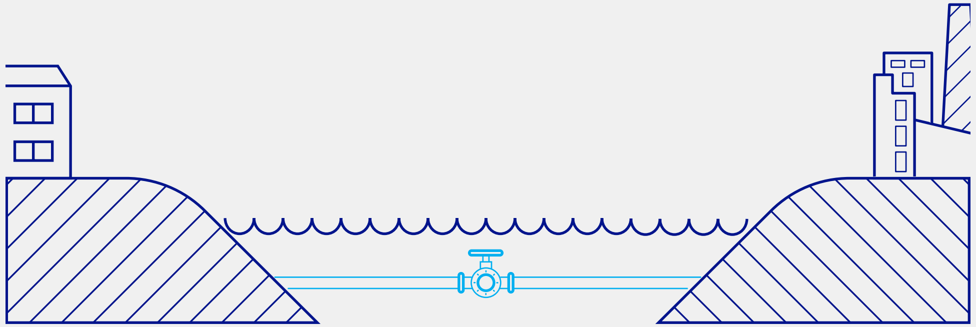
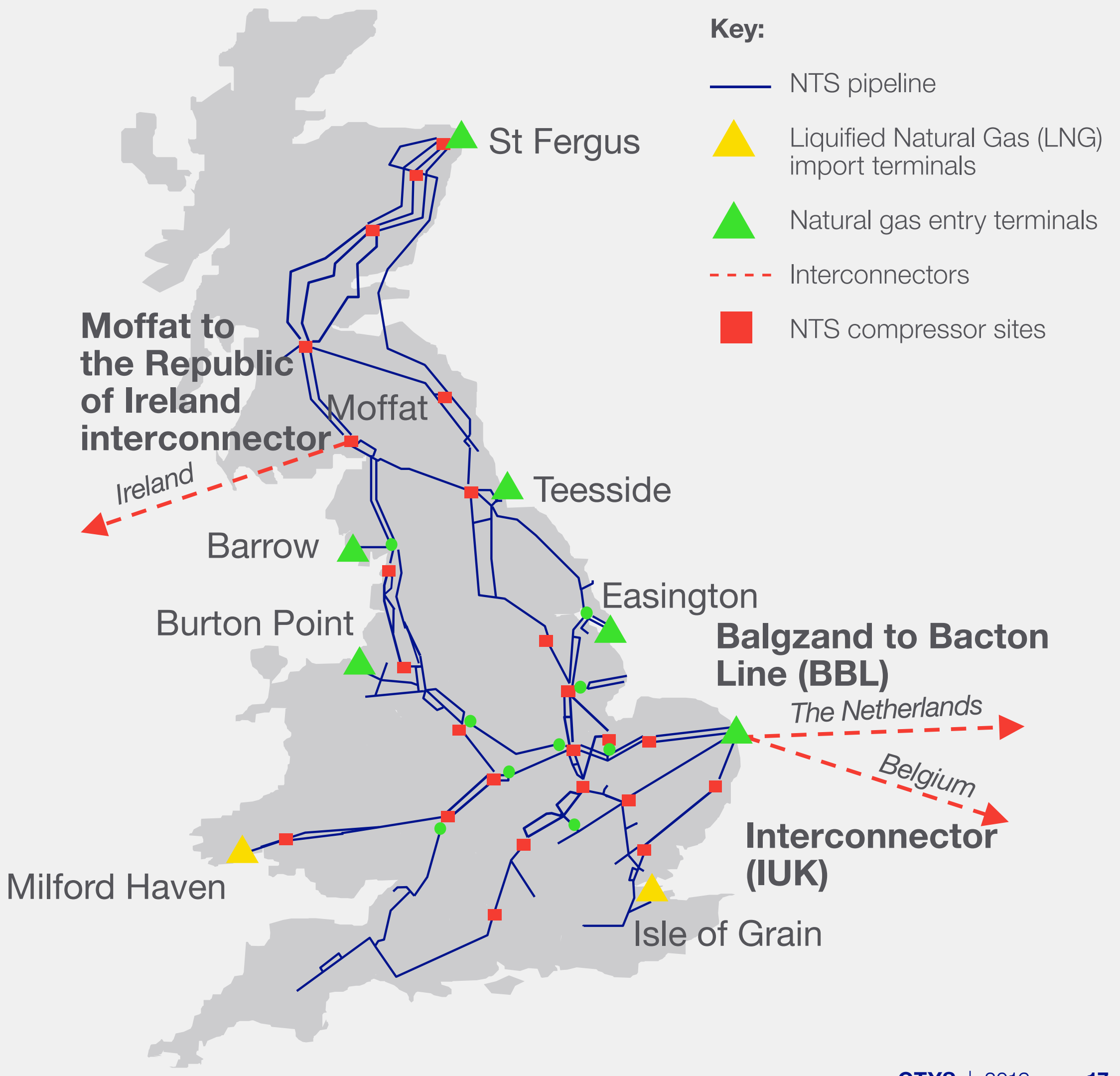


Figure 1.3
Map of the UK highlighting interconnector infrastructure



Bacton Balgzand Line (BBL)
Facilitating modifications to existing customer connections

Spotlight

Increasingly, our customers are choosing to modify existing connections.

Bacton Balgzand Line (BBL) Reverse flow project

BBL is the operator of the interconnector between the UK (Bacton, Norfolk) and the Netherlands (Balgzand) commissioned in 2006. BBL initially operated only in physical forward flow from the Netherlands to the UK.

In 2017, BBL approached National Grid to discuss the potential for the addition of physical reverse flow capability from UK to the Netherlands with a target date to be in operation by autumn 2019.

1. **There were significant challenges for us to overcome.**
2. **We completed studies and network analysis to explore our ability to facilitate BBL's request.**
3. **We engaged with a wide range of customers and stakeholders to understand their views and priorities.**
4. **We identified solutions, including (subject to maintenance and network capability) releasing daily exit interruptible exit capacity at BBL to facilitate additional flow out from Bacton.**

Following approval from Ofgem, as of July 2019, the revised Interconnector Agreement is now in place and consequently BBL have the contractual rights to physically offtake gas from the NTS.

This has enhanced UK connectivity with Europe by fully linking the UK with one of the largest markets in Europe for the first time, with thebenefit of strengthening the UK's security of supply.

We shall accommodate gas to BBL, where possible, by utilising existing capacity products and being flexible in our approach, whilst maintaining our obligations to customers. We will continue to assess and facilitate modifications to connections to our network.

For more information on gas connections and modifications, please get in touch with the Gas Contract Management Team via email or via the online gas connections portal.

Drivers of change
1.3 Customer needs

1.3.4 *Future Energy Scenarios*

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

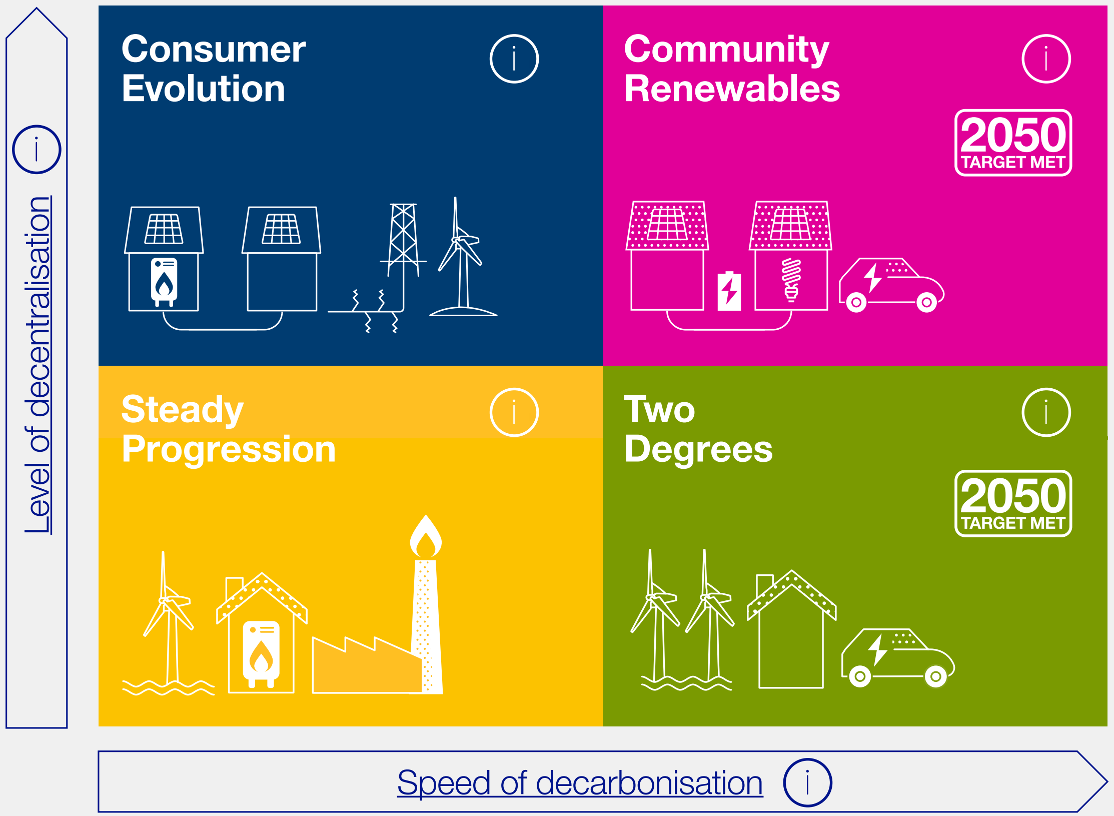
The *FES* are produced each year to identify a range of credible scenarios for the next 30 years and beyond (figure 1.4). These scenarios consider how much energy might be needed and where it could come from. They look at what the potential changes over this time period might mean for the industry and for its customers.

Note

At the time the 2019 *FES* scenarios were developed, the legally binding target included an 80 per cent reduction in greenhouse gas emissions compared to the 1990 levels. This has now moved to a target of net zero greenhouse gas emissions by 2050. To reflect this, sensitivity analysis was carried out for a net zero pathway in addition to the four scenarios in *FES* 2019.

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

Figure 1.4
The *FES 2019* scenario matrix



*Please note, in response to stakeholder feedback, our *GTYS* charts and tables workbook now also includes the data from the *FES* out to 2050.

Drivers of change

1.3 Customer needs

1.3.5 Gas demand

Figure 1.5 shows a comparison of gas demand by scenario between 2018 and 2030. The following paragraphs detail the consumer choices and technological developments that influence the composition of UK gas demand for each *Future Energy Scenario* by 2030.

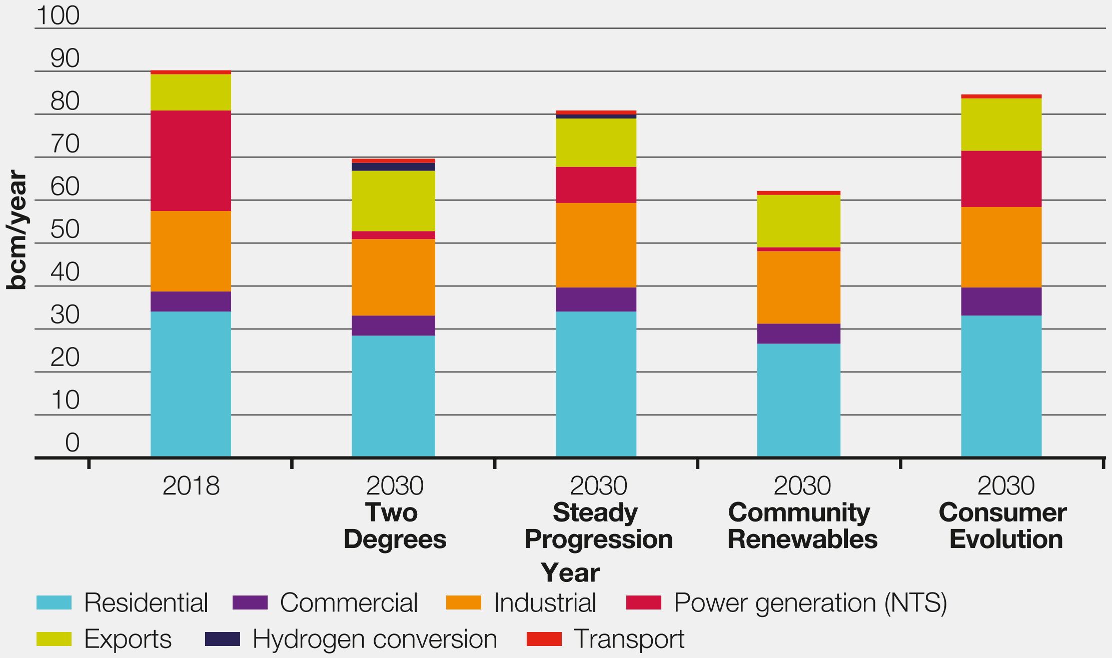
The **Two Degrees** scenario shows how the UK's decarbonisation target could be met using more centralised technologies. Residential gas demand declines as homes become more thermally efficient. Decarbonisation of heating is starting to be achieved by using hydrogen as an energy source. This is produced 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.

Steady Progression shows a muted reduction in demand from today's levels due to low energy efficiency improvements and the continued use of natural gas-fired electricity generation. However, this scenario does include a low (<5 per cent) hydrogen blend into the existing gas networks by 2028.

Community Renewables, explores how the UK's decarbonisation target could be achieved through a more decentralised energy landscape. Gas demand in this scenario is the lowest of the scenarios by 2030. Residential gas demand declines as homes become more thermally efficient and heat pumps (air source and hybrid) become the dominant heating technology. Gas is increasingly used in small power stations to provide flexibility in electricity supply.

Figure 1.5

Figure 1.5
Comparison of gas demand by *Future Energy Scenario* between 2018 and 2030



The highest gas demand in our scenarios by 2030 is found in **Consumer Evolution**. In this scenario, limited progress is made towards decarbonising heat and there are only small improvements in thermal efficiency as current heating technologies retain their market share.

Drivers of change
1.3 Customer needs

Peak daily demand

Gas peak day demand is illustrated in figure 1.6. Generally, it mirrors the movement of annual gas demands represented in the *Future Energy Scenarios*, as many of the factors that influence annual demand also influence peak demand. However, the declines are not as rapid in peak daily demand.

Gas is required in each of the *Future Energy Scenarios*. It is used for a diverse range of purposes including supporting electricity generation when intermittent power generation is producing less or for heating in gas boilers, hybrid heating systems or hydrogen production, depending on the scenario.

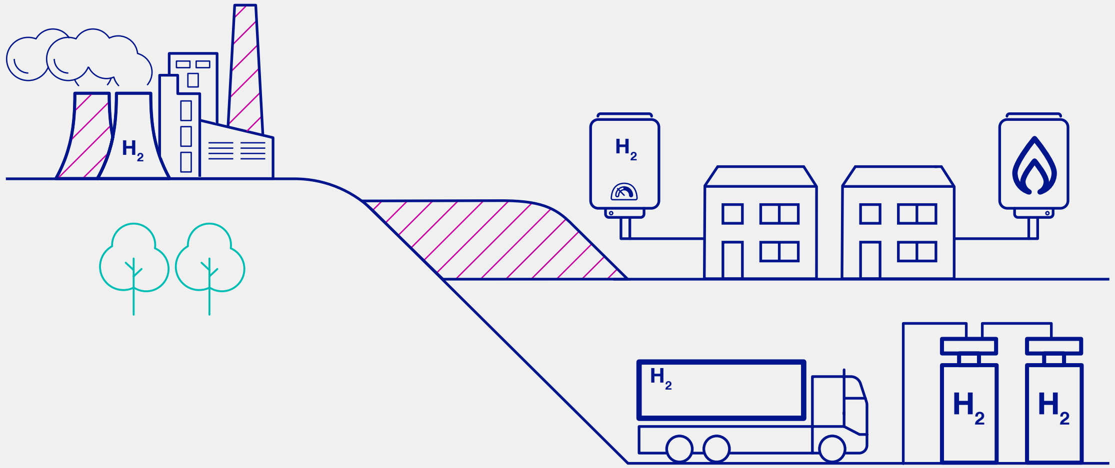
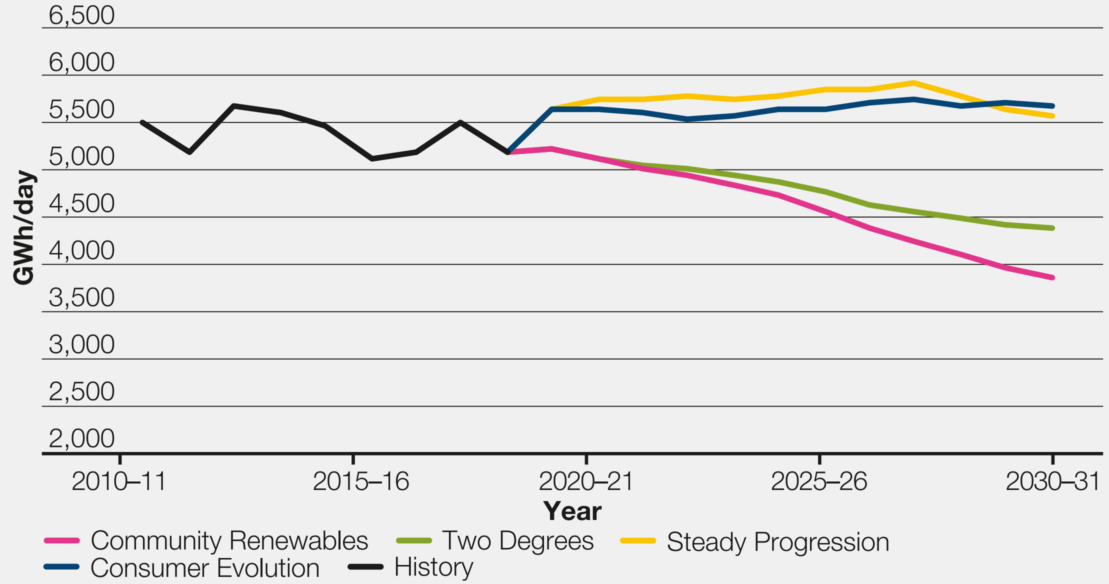


Figure 1.6

Figure 1.6
Peak demand 1-in-20



Drivers of change
1.3 Customer needs

1.3.6 Gas supply

On the NTS, we have eight primary gas supply terminals (figure 1.7). These deliver gas from the UK Continental Shelf (UKCS), the Norwegian Continental Shelf (NCS), Europe, and the world market delivered as liquefied natural gas (LNG).

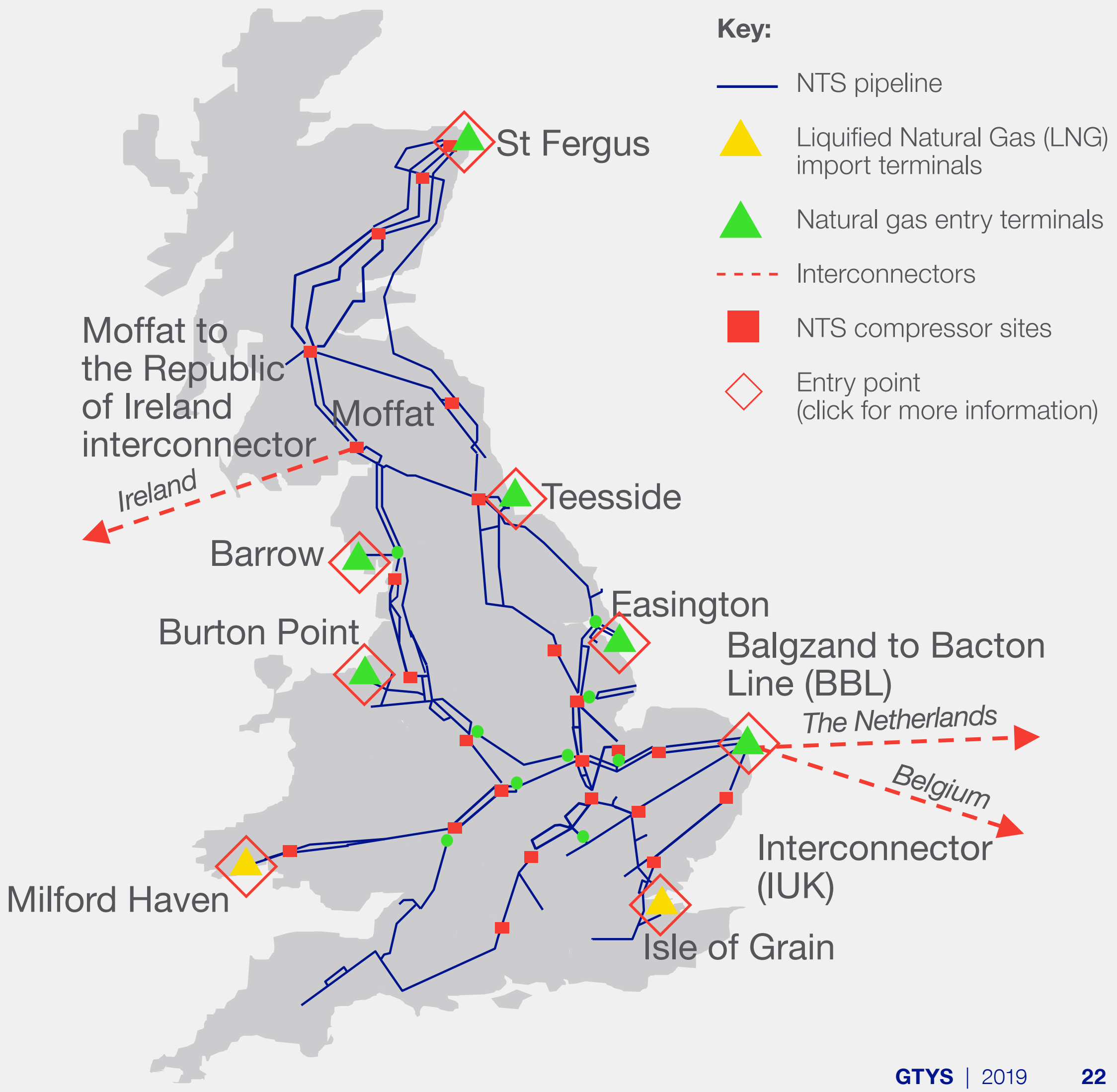
Over the past two decades, the UK has transitioned from being self-sufficient in gas (delivered from the UKCS) in 2000, to being dependent on imported gas for 56 per cent of our gas demand by 2018. Due to the decline of the UKCS, there is potential for the UK to reach 72 per cent dependency on imported gas by2030. The current and potential sources of indigenous gas in the UK include:

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

As the UKCS continues to decline, the UK is increasingly reliant on imported gas from continental Europe and from worldwide sources of LNG. Imported gas provides greater flexibility for us to manage the operational challenges of a rapidly-changing gas system.

On the following page, figure 1.8 shows a comparison of the UK's gas supply composition between 2018 and 2030 for each Future Energy Scenario.

Figure 1.7
NTS gas supply terminals



Drivers of change
1.3 Customer needs

In **Two Degrees**, gas is used to produce hydrogen as well as electricity, with the hydrogen production decarbonised via CCUS. Significantly more gas is imported from Europe than in **Community Renewables**.

Steady Progression includes shale gas (although at a lower scale than in **Consumer Evolution**) with increasing reliance on imported gas from Europe and Norway and worldwide supplies of LNG.

In **Community Renewables**, gas demand is the lowest of all the scenarios by 2030, with a significant proportion met by local sources of green gas connected to the distribution networks.

In **Consumer Evolution**, shale gas connects at scale to both distribution and transmission networks.

Figure 1.8
Comparison of gas supply by scenario between 2018 and 2030

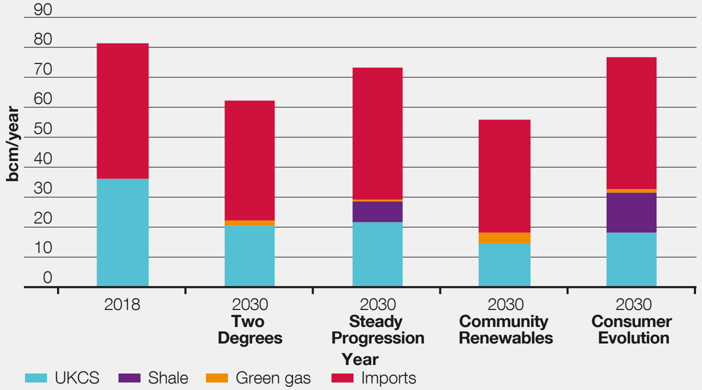


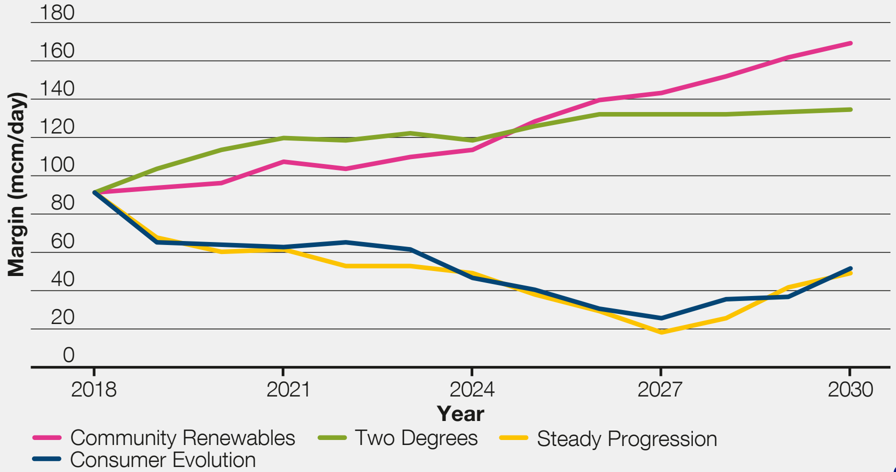
Figure 1.8 Figure 1.9

Peak supply

In all our scenarios, we assess whether there will be enough gas to supply peak demand. To make sure that demand can be met even if there is a failure in the network, we carry out an assessment assuming that the single largest piece of infrastructure is not available. For us, 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 1.9, we show the margin of supply over peak demand under N-1 conditions. The figure shows that supply exceeds peak demand in all scenarios out to 2030.

Figure 1.9
Peak supply margin under N-1 conditions



Drivers of change

1.3 Customer needs

1.3.7 *Gas Future Operability Planning*

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

We use the *GFOP* to help our customers and stakeholders engage with us and explore solutions to potential operability challenges on the NTS considering commercial options (rules), operational arrangements (tools) and physical investments (assets).

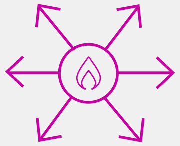
Engage with us

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

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

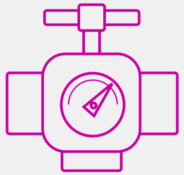
- challenge our assumptions about future operability challenges
- share views on the changes our customers and stakeholders envisage and what they require from the gas transmission network going into the future.

In October 2019, we published a summary of our stakeholder feedback from the past 18 months of *GFOP*, please click here[2] to view it online. In this document, we identified a number of areas we could undertake future operability studies on. These included:



Undertake study to further explore the flexibility requirements for distribution networks.

Explore impacts of gas-fired power station re-notification frequency and magnitude increasing further in the future.



Insight pieces into increasing low-carbon gas in the network, considering decarbonisation targets.

Further study to determine the impact of increasing linepack swing on our network.

Your views are really important to us. Please contact us to tell us what you think are the most important operability questions for us to focus on during 2020.

Drivers of change

1.4 Asset management

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

Asset health driven work accounts for over 50 per cent of our capital plan. Over the RIIO-1 period, we are planning to invest a total of £685m to maintain the health of our assets to continue to deliver a safe and reliable network for our customers.

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

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

Drivers of change

1.4 Asset management

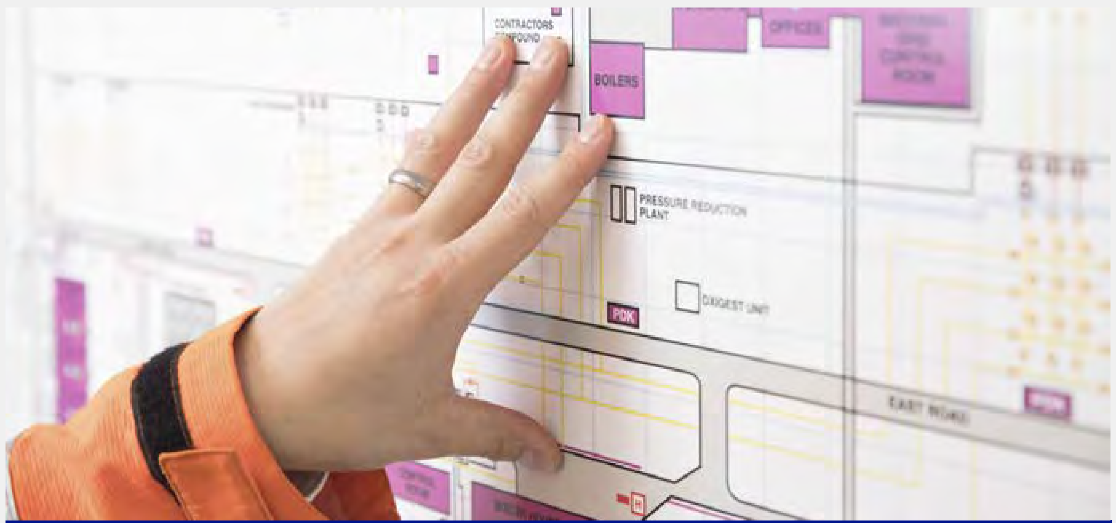
1.4.1 Developing our asset management approach

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 2018–19, we have been developing our asset management approach through investment in processes, data and technology systems, as detailed in figure 1.10.

Another key aspect of improving our asset management approach is the development of a monetised risk based approach. This new approach to the planning and targeting of investments and reporting of investment outcomes to Ofgem involves a new Methodology for Network Output Measures (NOMs). Through improved understanding of our asset base, how our assets can fail, their probability and consequence of failure, we can better understand risk across our network. With this improved understanding, we can target our investments to deliver further value to our customers and stakeholders.

Figure 1.10
Developing our asset management approach

Transformation programme | **Spotlight**



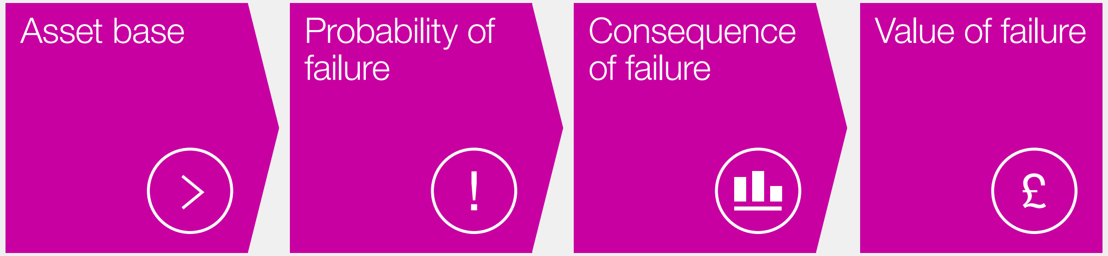
During 2018–19, we launched and delivered an internal change and transformation programme intended to provide improved asset management processes, systems, data, cost and management, policies and investment planning.

Drivers of change

1.4 Asset management

Ofgem have provisionally accepted our new NOMs methodology, and a proposed rebased RIIO-1 asset health target (using Monetised Risk, see figure 1.11) was submitted in January 2019. Full acceptance was delayed pending final validation of the methodology and submission of a Calibration, Testing and Validation (CTV) report. This work has now been completed and final versions of our rebased RIIO-1 target and CTV report were submitted to Ofgem in July 2019.

Figure 1.11
Network Output Measures methodology



Ofgem has undertaken tests to confirm that our new monetised risk target is as challenging as the target set at the beginning of RIIO-1. We understand these have been successful but are awaiting final confirmation. We are also awaiting final Ofgem confirmation of the process and timescales for undertaking the Licence change to embed the new target and provide "acceptance" of our NOMs methodology.

To provide further information, figure 1.12 describes the measures of risk that comprise our new monetised risk based asset management approach.

Figure 1.12
Measures of risk

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

Our new monetised risk based approach to investment planning is central to the development of our business plan for the next regulatory period, RIIO-2.

Our RIIO-2 business plan submission identifies an increase in asset investment expenditure from our RIIO-1 levels of spend, driven by an increased volume of work to maintain current levels of availability and reliability on our ageing asset base. You can find out more information in our RIIO-2 submission online.

Drivers of change

1.5 Legislative change

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

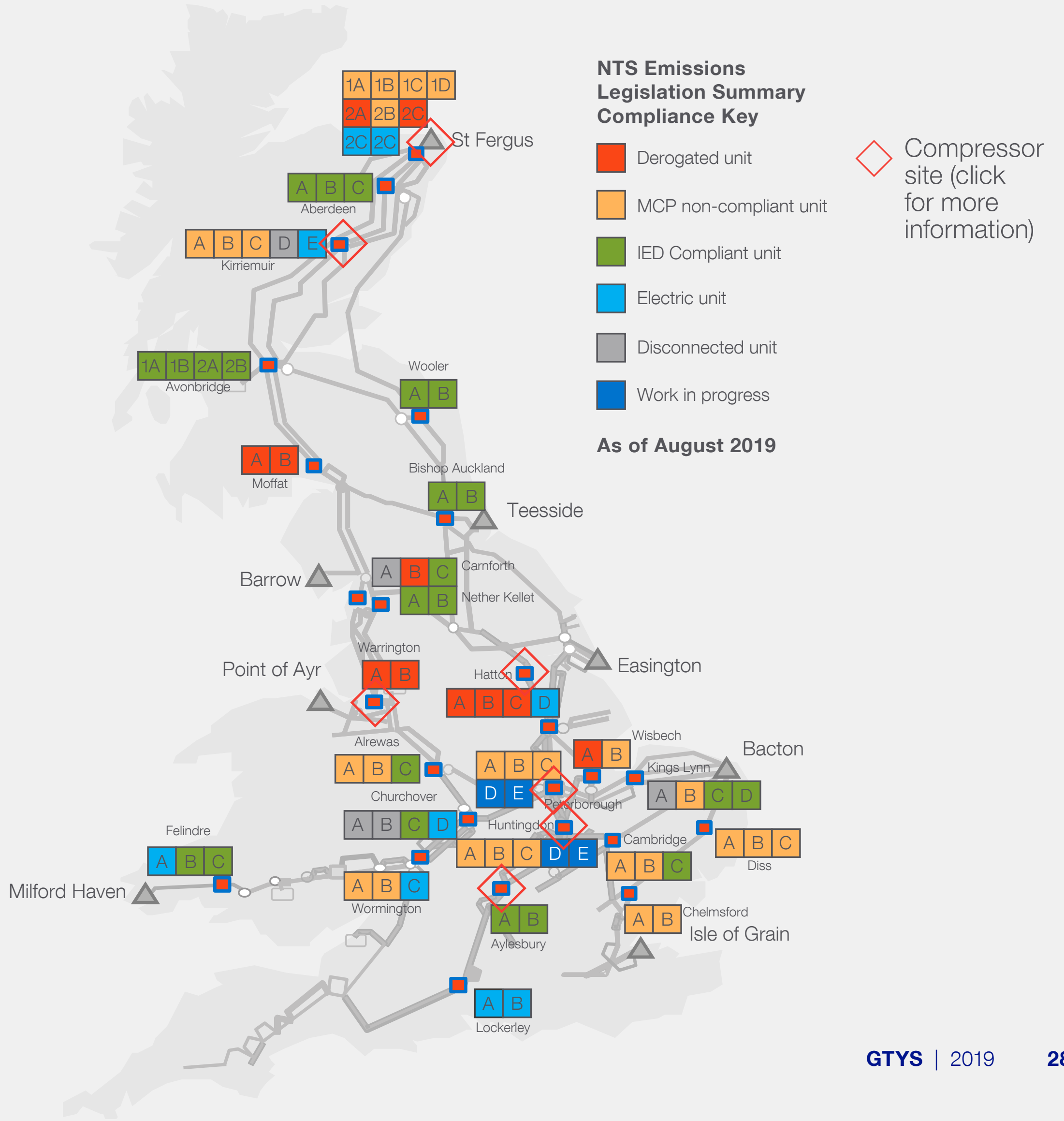
1.5.1 Industrial Emissions Directives

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

The IED forms the new mandatory minimum emission standards that all European countries must comply with by 2023 and came into force on 6 January 2013. The IED heavily impacts our current compressor fleet (figure 1.13) with implications for everyone who relies on the NTS.

We are committed to reducing emissions from our compressor stations as we work towards our ambition of operating the gas networks carbon free. Works to achieve IED compliance at our compressor sites have been submitted as part of our RIIO-2 business proposal. You can read our RIIO-2 business proposal online.

Figure 1.13
Impact of the IED on our current compressor fleet



Drivers of change

1.5 Legislative change

Industrial Emissions Directive – chapter II

Chapter II of the IED applies to 22 of our 24 NTS compressor sites. Chapter II of the IED details an integrated environmental approach to the regulation of certain industrial activities as well as requirements based on the use of Best Available Techniques (BAT).

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

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

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

A network-wide approach is described in the annual Network Review carried out by National Grid NTS to review all emissions from compressor sites. The findings are discussed and agreed with the Environmental Agency (EA), Natural Resources Wales (NRW) and the Scottish Environment Agency (SEPA). Further information and a copy of the Network Review may be obtained from the environmental agencies.

Drivers of change
1.5 Legislative change

Industrial Emissions Directive – chapter III

IED chapter III details the regulation of large industrial installations and incorporates requirements of the (now obsolete) Large Combustion Plant Directive (LCPD) that was implemented in 2001. Chapter III of the IED also affects a significant number of our compressor units on the NTS, impacting in total 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, and applies to industrial emissions for units with a thermal input of 50 MW and above.

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

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

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

Drivers of change
1.5 Legislative change

Medium Combustion Plant Directive (MCPD)

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

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

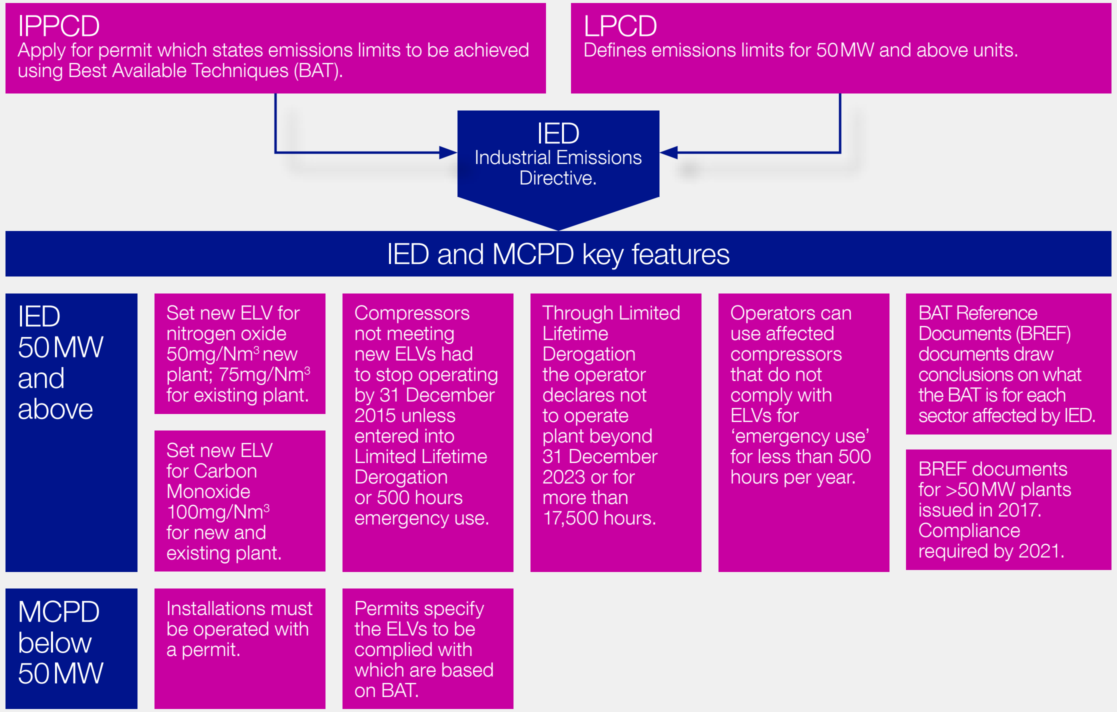
The MCPD applies to smaller gas compressors and will affect a further 39 of the NTS compressor units. Other combustion plants, such as pre-heat systems, are also captured as part of this directive. The impact assessment that we completed in 2016–17 is now being used to develop mitigation plans.

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

Figure 1.14

Please see figure 1.14 for an overall summary of the IED legislation.

Figure 1.14
Industrial Emissions Directive legislation key features



Drivers of change
1.5 Legislative change

1.5.2 Additional EU legislation

Following the UK's referendum result on EU membership in June 2016, we note that EU rules and regulations will continue to apply until the UK has formally left the EU.

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. As part of this process, we will engage with both the UK Government and Ofgem to understand the impact of the UK's exit from the EU on the implementation of future EU energy market requirements.

We will continue to engage in the European Network for Transmission System Operators for Gas (ENTSOG) and Gas Infrastructure Europe (GIE) to represent the needs of the domestic gas industry and consumers at a European level and will support, as appropriate, BEIS, Ofgem and stakeholders as discussions progress on a potential new European legislative package expected to be focused on gas and decarbonisation.

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.

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

These EU legislative requirements take priority over GB domestic legislation and associated regulations and codes, including the Uniform Network Code (UNC). Over recent years, as the Transmission System Operator (TSO), National Grid has raised a series of EU-related UNC Modifications to comply with the EU legislation.

The primary focus in the last year has been on the Revision of the Regulation on Gas Security of Supply ((EU) 2017/1938 of 25 October 2017). This replaces Regulation (EU) 2010/994 and introduces greater cooperation between Member States. It came into effect on 1 November 2017 with a phased implementation timetable. The solidarity principle is the last element to be implemented and work is ongoing with BEIS and Ofgem in conjunction with the Commission for BEIS to fulfil this obligation. Further details on UNC changes and implemented modifications can be found on the Joint Office website.

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

Drivers of change

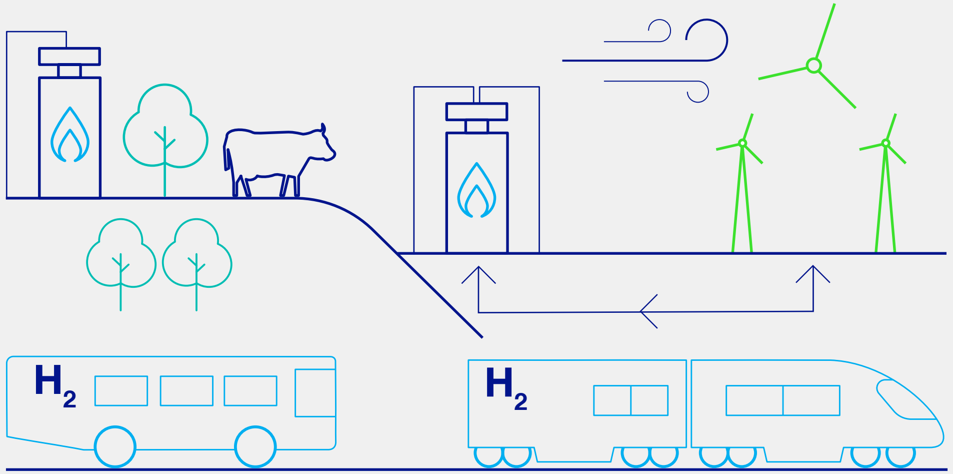
1.6 Net zero by 2050

Over the past year we have seen a number of policy commitments to the gas industry, including significant changes to the UK's decarbonisation targets.

Net zero by 2050

The UK Government legislated to achieve net zero greenhouse gas emissions by 2050 in June 2019, which was an important step to support domestic and international ambitions on climate change.

National Grid has used the *Future Energy Scenarios (FES)* to build this driver of change into our Network Development Process. The *FES 2019* includes a new, standalone sensitivity analysis on how net zero carbon emissions could potentially be achieved by 2050.



Spring Statement

The Chancellor's Spring Statement included several commitments to clean growth of relevance to the gas industry. The statement set out a commitment to the Future Homes Standard, to be introduced by 2025, to future-proof new build homes with low-carbon heating and improve energy efficiency. It also set out a commitment to 'green the gas grid' – to accelerate the decarbonisation of gas supplies by increasing the proportion of green gas in the grid.

BEIS roadmap for heat decarbonisation

In December 2018, the UK Government's Department for Business, Energy and Industrial Strategy (BEIS) published Clean Growth – Transforming Heating to review the evidence on options for achieving long term heat decarbonisation. The Government aims to develop and publish a new roadmap for policy on heat decarbonisation in 2020.

CCUS Action Plan

The Carbon Capture Usage and Storage (CCUS) Action Plan was launched at the end of November 2018. Government, industry and stakeholders have since been working together to progress the Action Plan, such as through the CCUS Advisory Group and recent government consultations in order to support the decarbonisation of heat, industry and transport (including through hydrogen production).

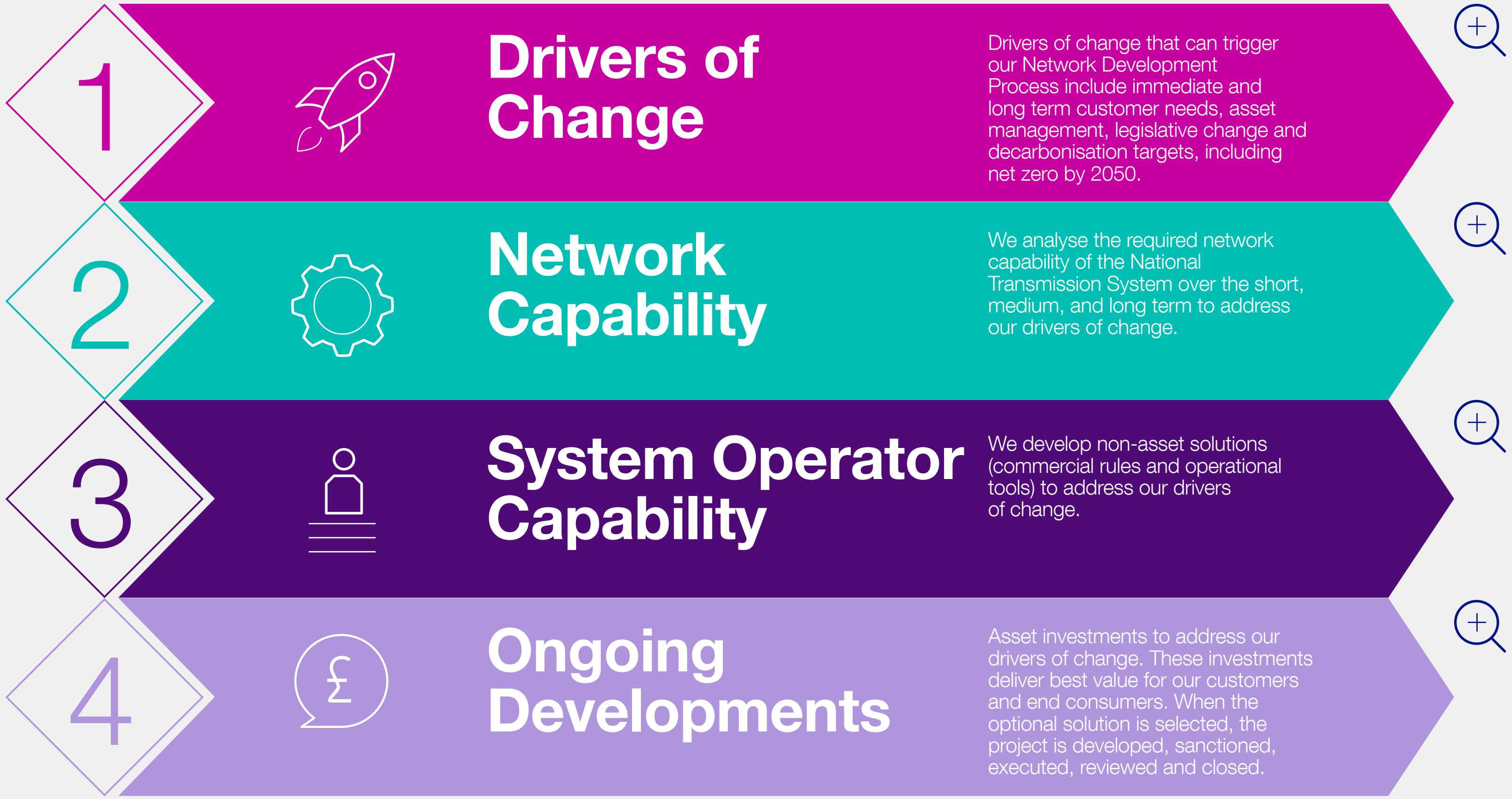
2>Network capability

Network capability

2.1 Introduction

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

Figure 2.1
Our Network Development Process



Key messages

When drivers of change trigger our NDP, understanding our network capability allows us to determine where rule, tool or asset solutions need to be found.

Network capability

2.2 Network Development Process: stage two

Our network capability and the development of the NTS is managed through the NDP. This chapter describes what happens when drivers of change have triggered stage one and we enter stage two of the NDP. Here, we analyse the required capability of the NTS to address drivers of change.

We initially look at the 'counterfactual' option. This is the minimum or 'business-as-usual' action we could take (ensuring compliance with legislation). This may mean no investment or minimum investment that still meets our safety and licence requirements. The change in risk is then calculated and used to support optioneering to explore commercial options (rules) and operational arrangements (tools) or physical investments (assets). Each option (rule, tool, asset) is then assessed, and either discounted if not feasible or fed into a cost-benefit analysis.

In chapter three, we discuss how we explore commercial and operational arrangements options. In chapter four, we discuss how we explore physical investments options to address drivers of change in order to deliver required network capability.

In this chapter, we summarise the past year of our analysis on the network capability of the NTS required to address drivers of change.

Network capability
2.3 Customer needs

Our annual planning process considers the network capability that may be required to respond to exit and entry capacity signals from the market.

Understanding our customers' immediate gas demand (exit capacity) and gas supply (entry capacity) needs across the NTS allows us to plan and operate our system efficiently and effectively, in order to deliver the network capability our customers need now and into the future.

When we receive an exit capacity or entry capacity request, we complete analysis to assess what impact an increase in demand has on the capability of our current network. This allows us to identify and plan for any geographical constraints (where flows exceed the network capability), which may arise from increasing customer exit capacity or entry capacity demand in an area of the NTS.

Where constraints to our current network capability are detected, we use our Network Development Process to identify options that meet our customers' needs in the most cost effective and efficient way.

You can find a detailed description of our entry and exit capacity application process in Appendix 6.

Spotlight on network capability required for Milford Haven

Spotlight

During 2018–19, we received an application for additional entry capacity at the Milford Haven Aggregated System Entry Point (ASEP).

After receiving this application, we entered phase one of the Planning and Advanced Reservation of Capacity (PARCA) process. Phase one has been completed, and the results indicate that physical reinforcement of the network is required.

The customer has indicated they would like to proceed to phase two of the PARCA process, and we have reserved additional capacity for the customer. Currently (November 2019), we are in the process of finalising a shortlist of strategic options.

Network capability
2.3 Customer needs

2.3.1 *Future Energy Scenarios*

Our long term customer needs are articulated within the *Future Energy Scenarios (FES)*. We use the latest *Future Energy Scenarios* as the starting point for our analysis of our network capability. If our analysis indicates we may not have the network capability to maintain customer needs going into the future, this can trigger our Network Development Process. A key example of our network capability analysis concerning our long term customer needs is included below.

Scotland 1-in-20

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

During 2018, the step change in the flows through the St Fergus terminal continued, but at a reduced level with supplies peaking at 92 mcm/d; 14 mcm/d less than the previous period. The average flow through St Fergus reduced to 68 mcm/d, from 89 mcm/d in 2017–18.

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

Network capability

2.4 Asset management

We are managing an ageing network with many assets at the end of their design life. The decisions we make today have lasting impacts on the level of network capability we can offer to stakeholders.

A significant proportion of our network capability analysis relates to asset health projects. We look at the impact of removing asset(s) or site(s) from the network, and assessing the potential impact on the network capability of the NTS. Optioneering is then completed, looking at the full range of rules, tools or asset solution options. Key examples of our network capability analysis concerning asset management are included below.

Bacton

The Bacton terminal is a key gas entry point to the UK.

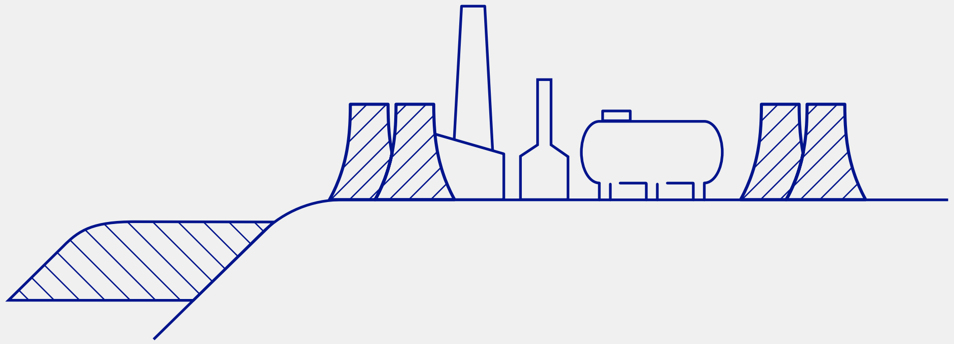
In 2019, the Bacton Balgzand Line interconnector was modified to enable the capability of bi-directional flows. Please view our spotlight on BBL to find out more information.

Changing UK gas supply and demand patterns mean that we need to continue to assess the future requirements of Bacton to efficiently invest in its asset health. The site requirements have been defined and will be monitored continuously. A detailed Cost Benefit Analysis is in progress to determine what functionality needs to be retained as the site is rationalised, and the finalised optimal solution is part of the RIIO-2 business case submission.

Redundant assets

We have identified redundant assets, sites and groups of assets that we are proposing to decommission within RIIO-2. Based on the environmental impact of our redundant assets, our opinion is that intervening now rather than later is the correct approach to take. We have developed our programme to prioritise investment on assets that pose the greatest environmental and safety risks and to comply with our contractual obligations.

You can find out more information on our asset management proposals within our RIIO-2 submission online[1].



Network capability

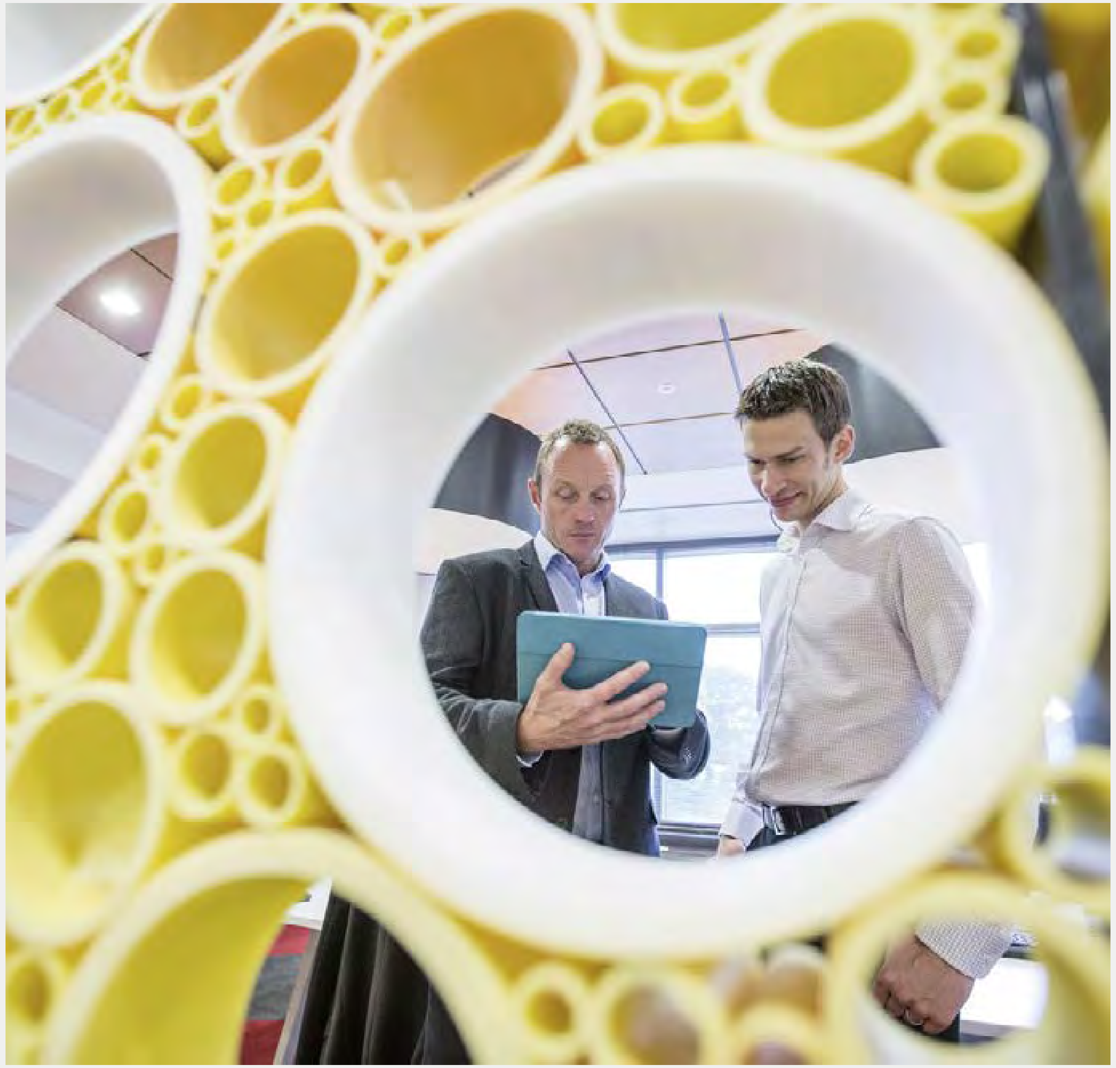
2.5 Legislative change and net zero by 2050

The Industrial Emissions Directive (IED), as discussed in chapter 1, forms the mandatory minimum emission standards that all European countries must comply with by 2023. We are committed to reducing emissions from our compressor stations as we work towards our ambition of operating the gas networks carbon free.

The IED heavily impacts our current compressor fleet, and a significant proportion of our network capability analysis relates to the impact of the IED. For example, our network capability analysis indicated that Huntingdon and Peterborough compressor sites needed investment during RIIO-1. Please view chapter 4 to learn more about the physical investments we are currently completing at Huntingdon and Peterborough compressor sites to deliver IED compliance on each site.

Our analysis considering the IED looks at the impact of removing asset(s) or site(s) from the network, and assessing the potential impact on the network capability of the NTS. Next, optioneering is completed looking at the full range of rules, tools or asset solutions.

Please view our RIIO-2 business proposal online for more information on our proposed further works to maintain compliance with the IED legislation.



Network capability

2.6 New network capability metrics

Understanding the capability of our network

Spotlight

As part of our business plan submission for RIIO-2, we have developed new Network Capability metrics to describe how the capability of the NTS meets our stakeholder needs.

Understanding the ability of our network to meet the needs of our stakeholders is essential to how we plan and operate the NTS, now and going into the future. Determining and delivering the network capability our stakeholders need will inform how much we spend on running and maintaining the network, the level of risk that we're prepared to take in operating the network, and give an indication of the financial and operational impacts on customers of the network.

We worked with our stakeholders on how we articulate and measure the capability of the NTS to demonstrate we understand our stakeholders' needs, show how our network meets those needs, and highlight how our RIIO-2 business plan will continue to meet those needs going forward.

You can find more detail on our new Network Capability metrics within our RIIO-2 business plan submission online.

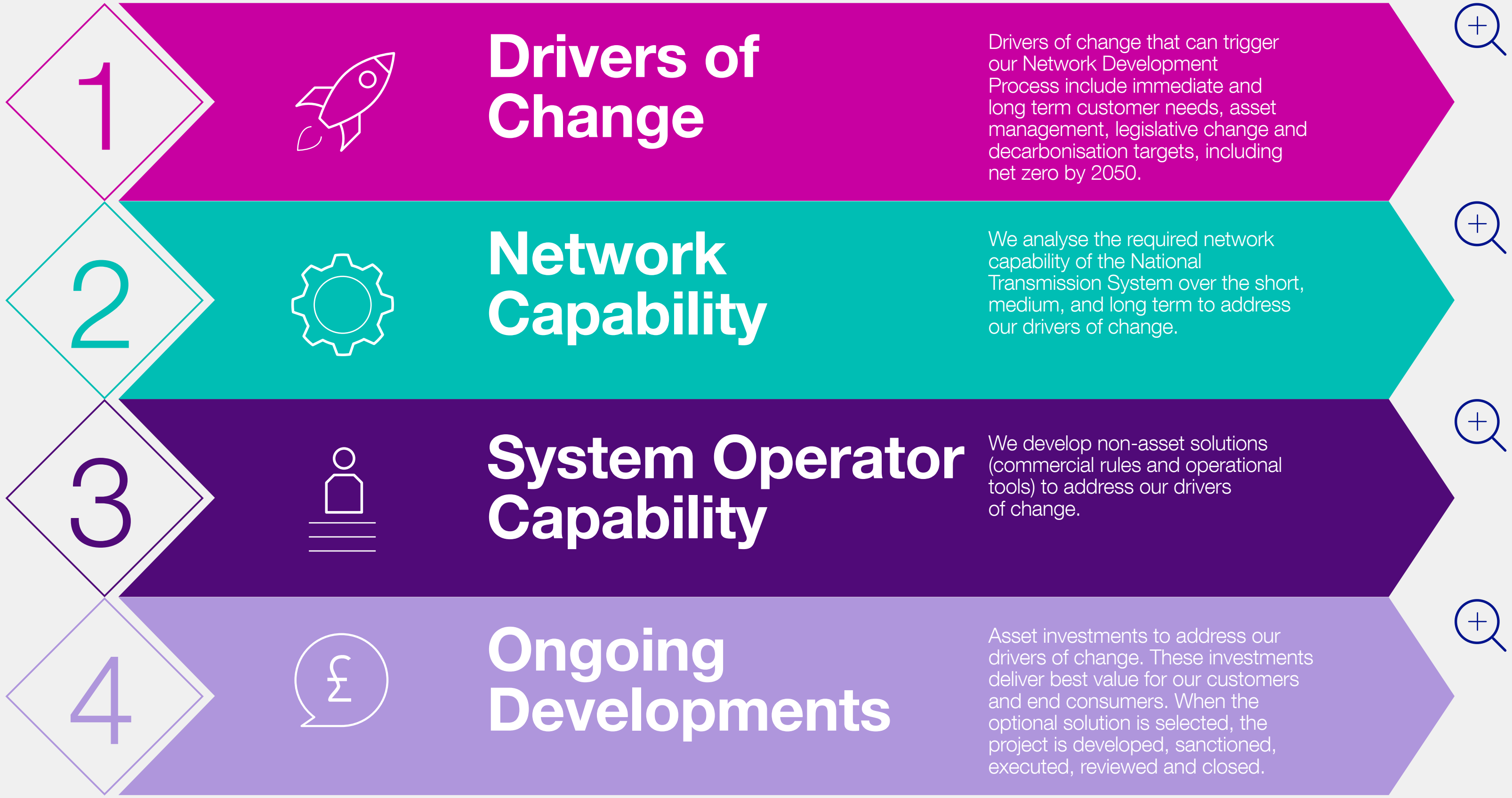
3>System Operator capability

System Operator capability

3.1 Introduction

This chapter explores the third phase of our Network Development Process (NDP) (figure 3.1). This chapter details how the gas System Operator (SO) develops non-asset options (commercial rules and operational tools) to deliver the required network capability to address our drivers of change.

Figure 3.1
Our Network Development Process



Key messages

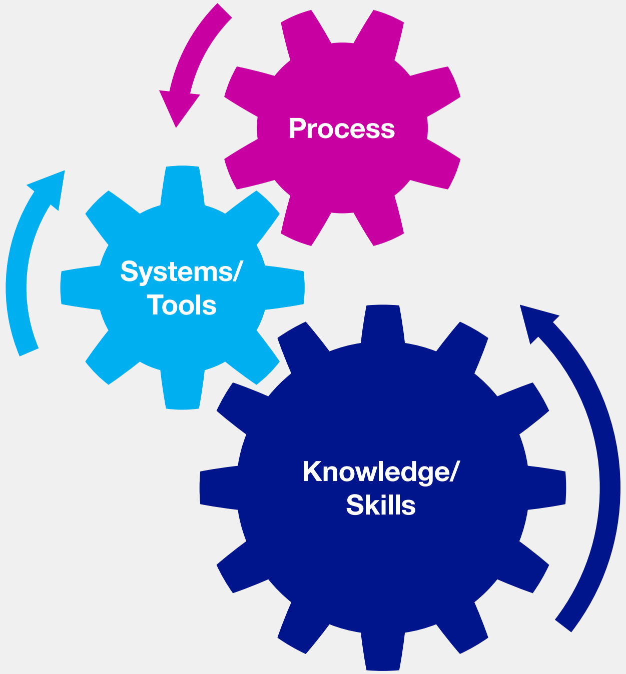
As the SO, we must operate a safe and reliable network. We know that you want to flow gas using within-day profiles that meet your operational, commercial and contractual needs, with minimum restrictions. This chapter describes how the SO makes efficient investment decisions that maximise our current network capability before we consider building new assets.

System Operator capability
3.2 Our SO capability

In this chapter we describe how we are developing our SO capability to make the most of our current network capability. Developing our SO capabilities means we can continue to plan to operate, and then operate, the NTS safely and efficiently.

Our SO capabilities include what we do to produce outputs that address our drivers of change. To make sure our outputs are fit for purpose, each SO capability requires a combination of efficient business processes, effective technology, and skilled and knowledgeable people (see figure 3.2).

Figure 3.2
Key inputs required for our SO capabilities



We are committed to developing our people to make sure we have the right knowledge, skills and experience to drive efficiency. This maximises our process and system performance to make sure we continue to deliver a reliable network and address drivers of change.

3.3.1 Deciding between commercial arrangements or operational tools and asset based solutions

As SO, 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.

This chapter explores how, as SO, we can better use rules (commercial arrangements) and tools (operational strategies) to make more efficient use of the network. Chapter 4 (Ongoing developments) will follow on from this by discussing how asset solutions are developed.

System Operator capability

3.3 Our SO capability continued

Here, we provide further information on how we decide between SO capability and physical asset investment to address drivers of change.

To make sure that identified solution options represent the most value for end consumers, we assess the options using Cost Benefit Analysis (CBA). This involves calculating the net present value (NPV) for each option to compare the costs and benefits of a project.

The CBA produces an NPV by considering a wide range of costs for each option, such as purchasing new assets, ongoing asset health works, changes to site configuration, compressor fuel usage, constraint management costs, site operation and commercial contracts.

To ensure a wider range of options are considered, we also perform a qualitative assessment. This will include operational issues, impacts on maintenance and future flexibility.

The solution options to address drivers of change are progressed based on both their NPV and the qualitative assessment.

We continue to actively work with our customers and stakeholders to make sure we understand our drivers of change, so that together we can make informed decisions that are right for end consumers. The following chapters discuss how we consider and improve the capability of the network using our SO capabilities.

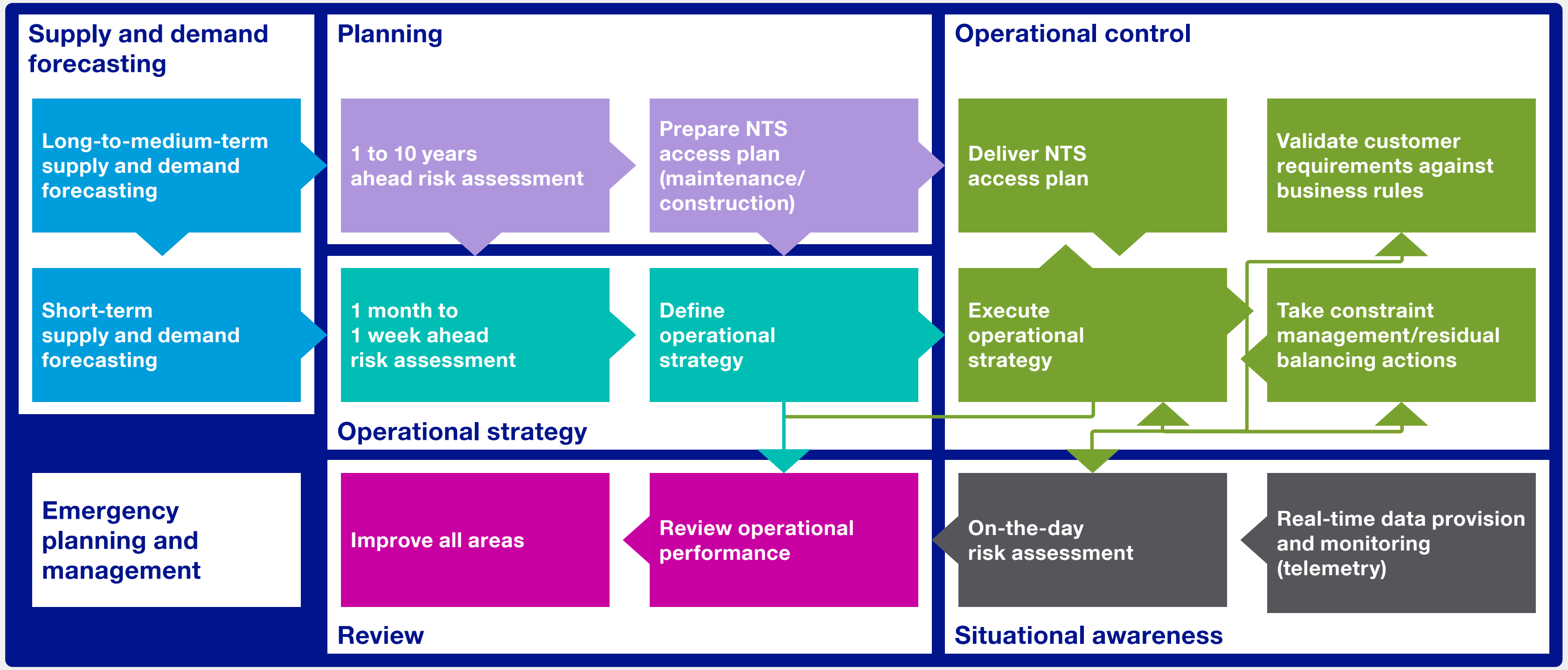
System Operator capability
3.4 Developing our SO capability

Our SO capabilities can be grouped into categories which have been summarised in figure 3.3. This gives an example of how information flows between our operational capabilities; it does not represent our organisational structure.

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 our customers and stakeholders.

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

Figure 3.3
Our SO operational processes



System Operator capability
3.4 Developing our SO capability

3.4.1 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 the *Future Energy Scenarios* as well as the latest market information. Forecasts are produced annually, monthly, weekly and daily, depending on the forecasting activity being undertaken.
- The forecasts feed into Planning Network Access (one to ten years ahead), Planning and Procuring activities (one week to one year 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, helping you manage your supply/demand balance position.

How are we improving?

We continuously improve our long-to-medium term supply and demand forecasts by ensuring we have an effective feedback loop between our operational and short-term forecasting teams and our longer-term forecasting teams. This helps us to capture and resolve any data gaps or inconsistencies quickly and effectively.

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

System Operator capability

3.4 Developing our SO capability

3.4.2 Planning

What is it?

- Planning considers a time horizon of approximately one to ten years ahead. We use analytical risk assessments (incorporating commercial and physical factors) to identify and quantify possible future system constraints, which may affect our network capability.
- We assess the capability of our network to operate safely while meeting our regulatory and contractual obligations and continuing to deliver your anticipated flow profile requirements. If the network has insufficient capability, we are able to use our SO constraint management tools (including 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 our customers and stakeholders.
- Our NTS Access Plan is where we agree mutually acceptable timescales with the Transmission Owner (TO) for maintenance and construction activities. This enables us to notify our customers and stakeholders when critical maintenance activities affecting their assets will be carried out.
- Our focus on asset management means that we are likely to continue to undertake a large number of maintenance activities in order to maintain our network. Our aim is always to minimise the impact on our customers and stakeholders, through effective planning and clear communication.
- We also complete network capability analysis for Operating Margins (OM) gas. 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.

System Operator capability

3.4 Developing our SO capability

3.4.2 Planning

How are we improving?

- We continue to improve our relationship and ways of working with our TO colleagues in National Grid Gas Transmission to ensure construction and maintenance activities can be delivered without risking our ability to provide a safe and reliable network for our customers and stakeholders.
- We are developing our ability to undertake multi-scenario network analysis over planning and operational timescales. This will help us to better assess future network capability requirements and evaluate network access requests. When combined with our improvements in long-to-medium term supply and demand forecasting capabilities, this further helps us to develop more comprehensive, robust and long-term commercial, investment and operational strategies, thereby minimising costs.
- The above improvements allow us to develop a more informed NTS Access Plan with reduced risk of maintenance activities on assets being cancelled or deferred.
- Looking to the future, within our RIIO-2 business submission, we have included a proposal to further develop our planning capabilities, including our network analysis capability. Please view our spotlight on RIIO-2 SO capability to learn more.
- Considering future planning, during our RIIO-2 stakeholder engagement, our stakeholders told us it is important that we continue our work to enable and support the drive towards a sustainable and decarbonised future. Please see our spotlight on the Gas Markets Plan (GMaP) for more information on how we are introducing a collective gas industry plan to ensure market frameworks support the changing way we will supply and use gas going into the future.

Gas Markets Plan (GMaP)

Spotlight

Background to the Gas Markets Plan

In November 2016, National Grid launched its *Future of Gas (FOG)* stakeholder engagement programme to gather evidence, discuss and test the role of gas in the UK's transition to a low-carbon economy.
A commitment from the *FOG* programme was to work with stakeholders to develop a long-term GMaP. The Gas Markets Plan will proactively prepare for and co-ordinate market change over the 2 to 10 year time horizon, driving consumer value and enabling the energy transition.

The Gas Markets Plan

The GMaP aims to introduce a collective gas industry plan for evolving market frameworks in an agile way to ensure the market supports the changing way we supply and use gas. This plan will seek to build proactive market development, considering future energy system developments. For more information on the GMaP or the *FOG* programme, please contact the Gas Market Development Team.

The Gas Markets Plan work packages

Given the uncertainty in the role of gas in the future energy system, the GMaP will consider a variety of topics that could influence market evolution needs, and determine which factors to prioritise and take forward in the forthcoming year. As new policies in addition to new technical and market developments emerge, it will be necessary to reassess the big questions that the market will need to address. Therefore, GMaP will be periodically reviewed to determine the next set of work. Once the priorities are determined, detailed work packages will be developed and undertaken that (depending on the nature of the project and urgency for market change) could include reports, recommendations for further work, Unified Network Code (UNC) proposals or licence change proposals.

Industry engagement

Industry engagement is a vital component in ensuring the success of the GMaP and the GMaP work packages. The collective knowledge of the need for market change and potential solutions will help to ensure outcomes that are in the best interests of end consumers. To further enhance industry engagements, we have created two new engagement routes: The Forum and the Steering Group.

The Forum

A platform for engagement on the GMaP, the work packages, and related industry activity. The aim is to allow discussion and debate on the direction and outputs from the GMaP to help shape and guide future work. It will also help raise awareness of ongoing activity to support the industry in debating and developing solutions for the future.

The Steering Group

A newly created body of industry leaders to provide direct leadership, strategic direction and cross industry support by bringing together a broad range of perspectives. The Steering Group will help to develop and define priorities for the GMaP. A call for members was launched during the first Forum in May 2019, and the first meeting of the Steering Group was held in September 2019.

System Operator capability

3.4 Developing our SO capability

3.4.3 Operational Strategy

What is it?

- Within our operational strategy activities, we develop short-term plans to make sure that we configure our network and associated assets in an optimum way 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 network. 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.

How are we improving?

- 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 our customers and stakeholders.
- 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 needs.

System Operator capability

3.4 Developing our SO capability

3.4.4 Situational Awareness

What is it?

- In Situational Awareness, we receive, process, and interpret real-time data to determine current and future operational risks.
- 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 needs. Real-time information allows us to make informed decisions to ensure that we efficiently operate the system so that out customers 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.

How are we improving?

- 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 customer 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 and stakeholders.

System Operator capability

3.4 Developing our SO capability

3.4.5 Operational Control

What is it?

- In Operational Control, we resolve any system issues to maintain safe and efficient operation.
- Our activities within Operational 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.

How are we improving?

- With GCS, we have greater ability to use data visualisation and analytics software to bring together relevant information from our operational capabilities and external data sources. This helps our control room to make operational decisions and take control actions based upon the most up-to-date data and analysis. This improves our ability to mitigate issues and minimise the risk of your operation being affected.
- Looking to the future, within our RIIO-2 business submission, we have included a proposal to continue to enhance our data visualisation and analytics software. Please view our spotlight on RIIO-2 SO capability to learn more.

System Operator capability

3.4 Developing our SO capability

3.4.6 Review

What is it?

- We are continuously improving how we operate our network to make sure we are providing the best service for you.
- Given the changing, increasingly uncertain supply and demand environment, we need to find new ways of informing how we operate our network. This places greater emphasis on effective feedback from our review process into our Planning and Operational Control activities.
- We increasingly monitor our customers' compliance with contractual obligations and technical standards. We provide feedback to parties that may be operating outside their obligations, particularly if their operation impacts our ability to deliver a reliable service.

How are we improving?

- 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 the ability of our customers and stakeholders to operate, we always review and, where possible, share any lessons learned to reduce the risk of repeat occurrences.
- Our data visualisation and analytics software embedded within GCS will help us to draw conclusions faster than we were previously capable of, ensuring effective learning is developed and fed back into our other operational processes and systems so that we continuously improve our service to you.
- Looking forward to RIIO-2, our proposal includes IT investment focused on sustaining the technology health of our core SO IT systems that we use to operate the network. The challenges of an ageing gas asset infrastructure and our targets of enabling a decarbonised network, in line with the Government's net zero carbon targets, means we need to continue to innovate and digitise our technology capabilities to facilitate the energy system of the future. For more information on our proposed IT investments on our core SO IT systems, please view our spotlight on our proposal to improve SO capability during RIIO-2, in addition to our draft RIIO-2 submission online.
- We are sharing more information on our operational performance with you in the Operational and System Operator forums. For more information, please see our spotlight on the operational data enhancement programme.

Operational data enhancement programme

Spotlight

Introduction

To improve the quality of data and information provided by National Grid to industry, and to improve the transparency of our commercial and operational decisions, we set up the data enhancements project. All decisions throughout this project have been driven by stakeholder feedback, signalling where we can drive efficiencies in the market and ultimately deliver value to the end consumer through these efficiencies.

Engagement

An integral part of our data enhancement project included gathering feedback from across the industry on what data you use, what you don't use, how you access it, and what else could be provided.

Project delivery so far:

As a result of your feedback, we created an interactive community platform where users can post in discussion boards, vote on data requirements, and comment on trial data and our latest news. This platform will be used on an ongoing basis to continue transparency of our operations and improve our communication with the energy industry.

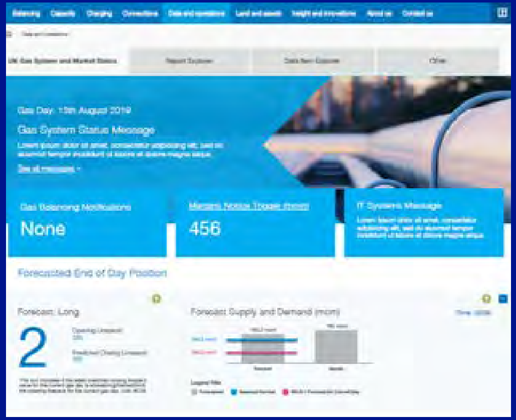
You can view the community platform here.

Acting upon your feedback, we have fast-tracked the delivery of two new data sources:

- Instantaneous Demand Data (now available alongside supply data)
- Hourly breakdown of National Grid Balancing Trades and Price.

We have also been re-designing the prevailing view screen to provide you with a better single screen snapshot of a Gas Day, and link into our other data sources. This is part of our ongoing online data system re-design programme.

We engaged with you through a variety of methods, including working groups, operational forums, bilateral meetings, and our website.



RIIO-2 SO people capabilities

Spotlight

As the gas energy landscape continues to evolve at an unprecedented pace and scale, we need to continuously adapt our SO capabilities to address our drivers of change.

Our greatest asset is our people and we need to make sure we have the right skills, knowledge and experience to continue to deliver our SO commitments. This spotlight describes five people-focused capabilities for the SO that we have included in our RIIO-2 business plan proposal. Please view our proposal online to find out more.

Engineering remains at the heart of everything we do and one of our core capabilities. It is essential both in terms of network capability forecasting and analysis, and network planning, including outages and real-time operations.

Engineers will be managing unprecedented amounts of data which will need to be processed.

Looking forwards, we will need to develop greater automation to process data and our data literacy, including a step change in our analytics capabilities.

Enhancing our engineering capability as well as our systems capabilities will be key to addressing our drivers of change.

Data and analytics capabilities are required to support almost all of our key SO processes.

We use data and analytics to provide information and insights to help market participants make informed decisions. This supports the efficient functioning of the gas market.

Looking forwards, we will need to develop our capability to analyse mass quantities of data in real-time via integrated IT systems and our analysis techniques so that they can be consistently used to steer decisions in a predictive way.

By enhancing our capability in data and analytics, we will be able provide enhanced data, information and insights to the market.

Leading the debate requires us to use our SO expertise to collaborate with energy leaders across the public and private sectors. Together, we can shape an energy landscape for Great Britain that is fit for the future.

Looking forwards, we need to demonstrate strategic thinking across the energy landscape, articulate how the landscape is evolving and raise awareness and influence key stakeholders on key changes to the energy landscape.

Developing our capability to lead the debate allows us to champion consumers' best interests, ensuring value for money and security of supply.

Change management is essential to make sure we meet our business plan commitments.

In order to embrace change, we need to be more agile in our approach to implementing and absorbing change across our business and the wider industry.

Looking forwards, we need to enable our leadership to lead us through change, to empower our people to deliver through periods of uncertainty. We also need to develop our resilience to manage the "unknowns" to come, for example the introduction of new gases.

Improving our change management capability will help make sure we continue to deliver the best outcome for stakeholders and consumers.

Innovation needs to become part of everything we do.

Innovation will help us to keep pace with the evolving energy landscape, harness the potential of new technologies, encourage new energy participants, and embrace changes to regulation.

Looking forwards, we will develop our capabilities to explore and harness different types of innovation.

Increasing our knowledge and skills in delivering innovation will support Great Britain's energy agenda to decarbonise the gas industry. This is essential to help achieve net zero by 2050.

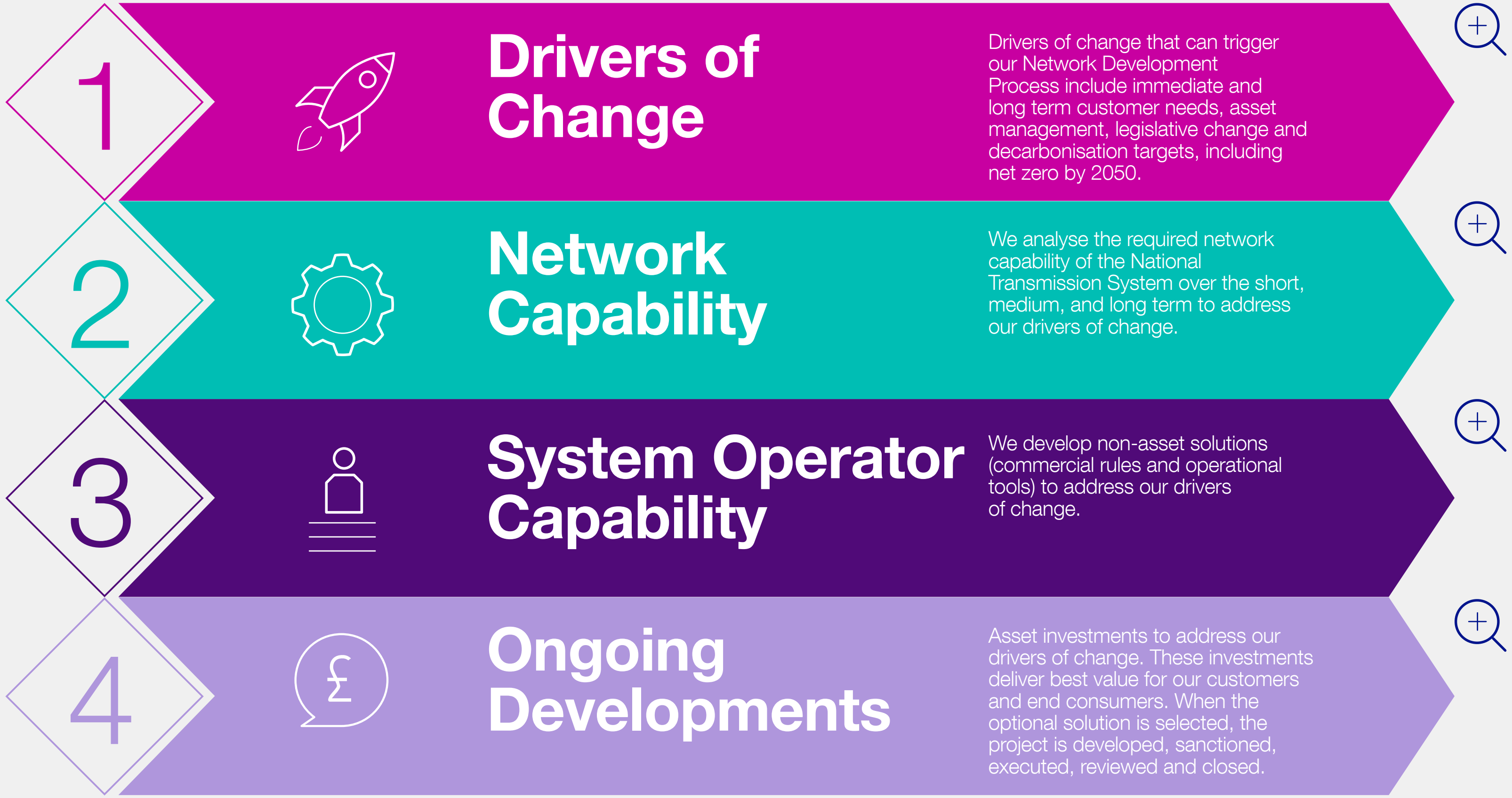
4>Ongoing developments

Ongoing developments

4.1 Introduction

This chapter describes the fourth phase of our Network Development Process (NDP), when physical changes to our network are required to address our drivers of change (figure 4.1).

Figure 4.1
The Network Development Process



Key messages

This chapter includes our sanctioned NTS maintenance projects, reinforcement projects, projects under construction in 2018–19, and potential future investment options.

Ongoing developments

4.2 Network Development Process: stage four

Stage four of our NDP is only reached if the optimal solution to a driver of change cannot be found within our existing network capability or met by our System Operator capabilities.

The aim of this stage of the NDP is to investigate a range of asset investment options, including a 'Do minimum' option. This allows for the comparison of a broad range of options in terms of effectiveness at delivering network capability and overall cost.

During this stage we also facilitate stakeholder workshops to provide us the opportunity to receive feedback on our options. With this feedback, our asset investment options are narrowed down to identify a preferred option that addresses our drivers of change and delivers a legally compliant solution. Our aim is to provide the best value for end consumers, as we continue to operate the NTS safely and efficiently.

This chapter details where asset investment has been identified as the preferred option to address our drivers of change.

Ongoing developments
4.3 Our asset investment programme

Where an asset investment is required to address our drivers of change, similar works are bundled together into campaigns to ensure their cost effective delivery. We simplify scopes of work for our contractors, use Standard Designs, and streamline project documentation to drive down costs. This approach makes better use of network outages to ensure that our asset delivery isn't constrained or customers unnecessarily impacted.

During 2018–19, we continued to deliver our asset investment programme, investing £130m in the health of our assets to keep our network running safely and reliably.

Our current asset health investment campaigns are included in table 4.1.

Table 4.1
Current asset health investment campaigns

Category	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 asset health challenges to re-life for continued operation.
Above-ground installation renovation	Renovation of valves, above ground pipework and supporting structures at sites across the NTS.
Compressor train	Overhaul of compressor train assets across the fleet.
Pipelines	In-line inspection and remediation of buried pipelines and refurbishment of ancillaries such as corrosion prevention assets.
Peterborough	Critical asset health works to support the replacement of compressor units under the Industrial Emissions Directive.
Huntingdon	Critical asset health works to support the replacement of compressor units under the Industrial Emissions Directive.
Electrical	Refurbishment of electrical distribution boards, uninterruptable power supplies and back-up generators.
Pressure systems	Inspection and remediation of pressurised vessels to comply with Pressure Systems Safety Regulations.
Cab infrastructure	Refurbishment of compressor cabs and associated assets such as exhaust stacks and safety systems.
Control Systems and Cyber Security	Replacement of the industrial control systems on compressor units and increasing the resilience of control systems from cyber threats.
Gas quality, metering and telemetry	Replacement of gas analysers and metering equipment required to comply with Gas Safety Management Regulations.
Pre-heating	Replacement of unreliable gas preheating systems typically required at power station offtakes.

Ongoing developments

4.3 Our asset investment programme

4.3.1 Key asset investment works 2018–19

Feeder 9 project – Humber Crossing

Our river Humber Gas Pipeline Replacement Project to replace an underwater section of the Feeder 9 pipeline with a tunnelled solution is progressing well. This pipeline section is one of the most critical to UK gas supplies on the NTS and removing the risk associated with both tidal estuary erosion and third party interference is essential in continuing to provide a reliable and secure gas supply to our customers. In 2018–19, the tunnel boring machine made significant progress completing 3,402m of the 4,862m total tunnel length. Tunnelling was completed on 10 September 2019, and the next phase includes installing the pipeline. In addition, the final weld on the eight 650m long pipeline sections was completed in September 2018. The project is due for completion in 2022–23. You can track progress of the project on our website.

Industrial Emissions Directive (IED) works

We are currently completing works at Huntingdon and Peterborough compressor sites to deliver two new IED compliant gas turbines on each site.

The new units, each 15.3 MW in size, are manufactured by Solar Turbines. They are gas turbine driven compressors that use dry low emissions (DLE) technology, recognised as the next generation of low-carbon compressors, and feature computer-controlled combustion systems and low emission burners. They will replace existing infrastructure, the Peterborough units were commissioned in the 1970s and those at Huntingdon in the late 1980s.

Once operational, the compressors will reduce NOx emissions by around 95 per cent over 20 years, with a 16 per cent reduction in CO_2 over the same timeframe.

RIIO-2

Our asset health investment plan for the RIIO-2 period will set out how we manage and invest in our existing asset infrastructure to maintain the levels of safety, reliability and flexibility that our customers and consumers have told us they expect.

Given we are managing an ageing network with many assets at the end of their design life, we are observing an increased volume of condition-related issues. Our RIIO-2 plan addresses these known condition issues and ensures we continue to meet customer and consumer needs, providing a valued and consistent level of service now and into the future. You can view our RIIO-2 business proposal online.

Ongoing developments

4.4 Protecting our assets from external threats

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

The Physical Security Upgrade Programme (PSUP) was launched by the government to enhance physical site security to mitigate risks to cyber security. The NIS (Network and Information Systems) directive also came into force in the UK on the 10 May 2018, to co-ordinate and raise overall levels of cyber security across the European Union (EU).

Since the level, nature and response to cyber threats is evolving and inherently uncertain, two PSUP reopeners, one in May 2015 and one in May 2018, have been submitted during RIIO-1. An Enhanced Security costs reopener, relating to cyber security enhancements, was also submitted in May 2018.

Further investments have been included in our RIIO-2 submission for the continuation of our activities in both these areas with a significant increase in cyber security on our assets to combat the increasing risk of cyber-attacks.

Ongoing developments

4.5 Innovation

At National Grid, innovation is integral to our business. We aim to deliver better outcomes for our customers and communities, whilst being more agile, flexible, responsive and maximising value.

Throughout 2018–19, we have embedded the Gas Network Innovation Strategy published in March 2018, realigning our innovation portfolio and assessing our performance against five key themes:

- Future of Gas.
- Safety and Emergency.
- Reliability and Maintenance.
- Environment and Low carbon.
- Security.

In 2018–19, we spent £4.67m of the £4.82m from our annual Network Innovation Allowance (NIA).

Our total Network Innovation Competition (NIC) expenditure incurred in 2018–19 for Project GRAID (Gas Robotic Agile Inspection Device) and Project CLoCC (Customer Low Cost Connections) totalled £2.9m.

Both of these NIC projects are now concluded, and both received 100 per cent of the Successful Delivery Reward Criteria (SDRC) from Ofgem.

During 2018–19 we undertook 36 NIA projects across our five key innovation themes. Particular successes this year have included projects such as our:

Overpipe geogrid protection against third party damage

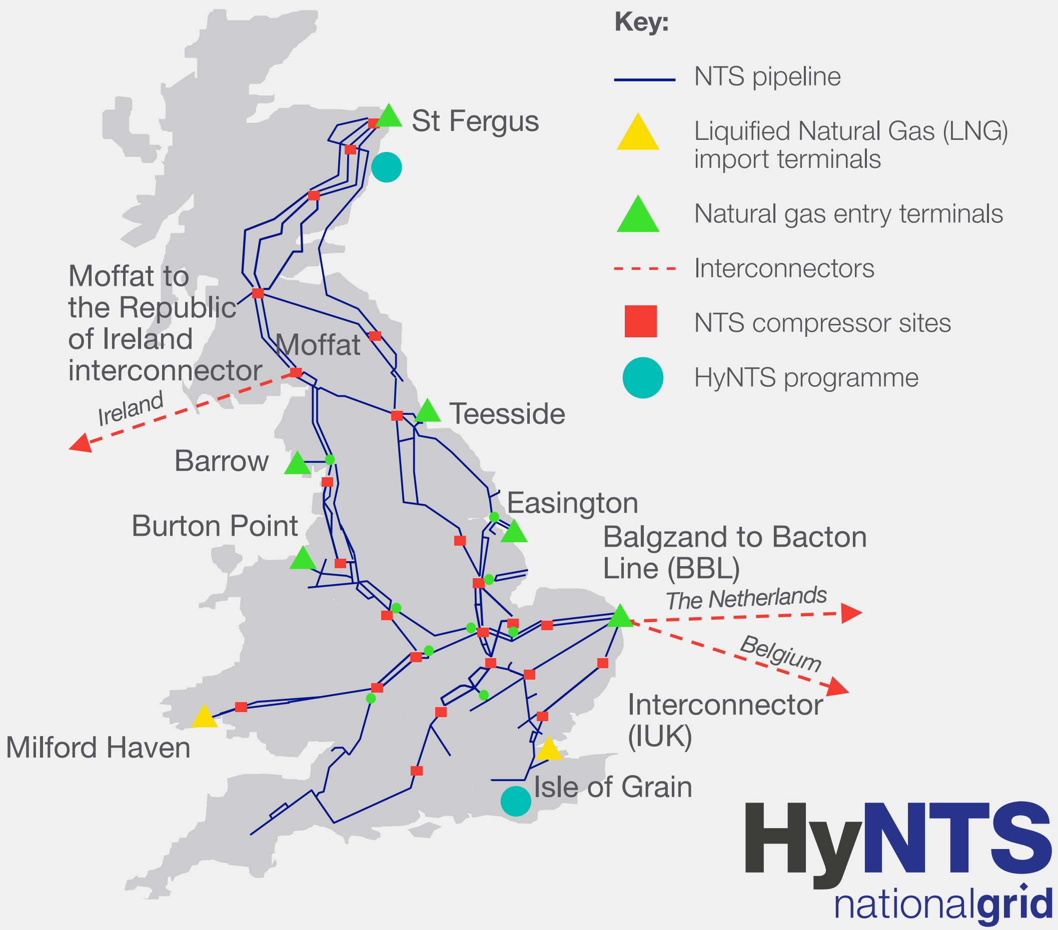
Intrusion detection system

For more information on NIA projects, please see the 2018–19 Network Innovation Allowance Summary. During 2018–19, we also launched our Hydrogen in the NTS (HyNTS) programme. Please view our spotlight on HyNTS to find out more.

Hydrogen in the NTS (HyNTS)

Spotlight

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



Currently we have three projects live in our HyNTS programme:

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

Hydrogen flow loop
Offline test loop to evaluate metallurgy changes on existing NTS steel pipe and new MASIP pipe when exposed to 30 per cent hydrogen, identifying next steps to assess the NTS' suitability to transport hydrogen.

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

Two projects are under development:

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

H21 Network operations NIC 2019 bid
Supporting NGN's 2019 NIC bid alongside the other GDNs to address the impact of 100 per cent hydrogen distribution from LTS offtake to the consumers' meters, encompassing the potential impact on current operational and maintenance activities, regulations and procedures.

Two projects are now completed:

Feasibility of hydrogen in the NTS
A feasibility study with the aim of determining the capability of the NTS to transport hydrogen. Includes a review of relevant assets, pipeline case study and draft scope for offline trials.

Aberdeen vision
A feasibility study for the generation of hydrogen at St Fergus using the NTS (up to 2 per cent) to supply the city of Aberdeen. Includes hydrogen generation, injection, separation and transport.

5>Looking forward

Looking forward

5.1 Introduction

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

5.2 Continuous development of the *GTYS*

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

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

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

Looking forward

5.3 Your feedback

We welcome your feedback and comments on this interactive edition of the *GTYS*. It helps us to better tailor the document to include information you value, and to format the document to make it easier for you to navigate. Over 2019–20, we are keen to hear your views on the following areas of our gas transmission business:

- new Network Capability metrics
- future system operability challenges
- asset management
- GB gas quality specifications development
- Network Development Process
- the transition to net zero.

5.4 Future engagement

In addition, we welcome your feedback on whether the *GTYS*:

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

We also welcome your feedback on:

- which areas of the *GTYS* are of most value to you
- which areas of the *GTYS* we can improve
- whether there is there any additional information you would like to see included in the *GTYS*.

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

Appendix

Welcome >
Executive summary >
Introduction >
Chapter 1 Drivers of change >
Chapter 2 Network capability >
Chapter 3 System Operator Capability >
Chapter 4 Ongoing developments >
Chapter 5 Looking forward >
Appendix >

Appendix 1
National Transmission System maps

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

Figure A1.1
Scotland (SC) – NTS

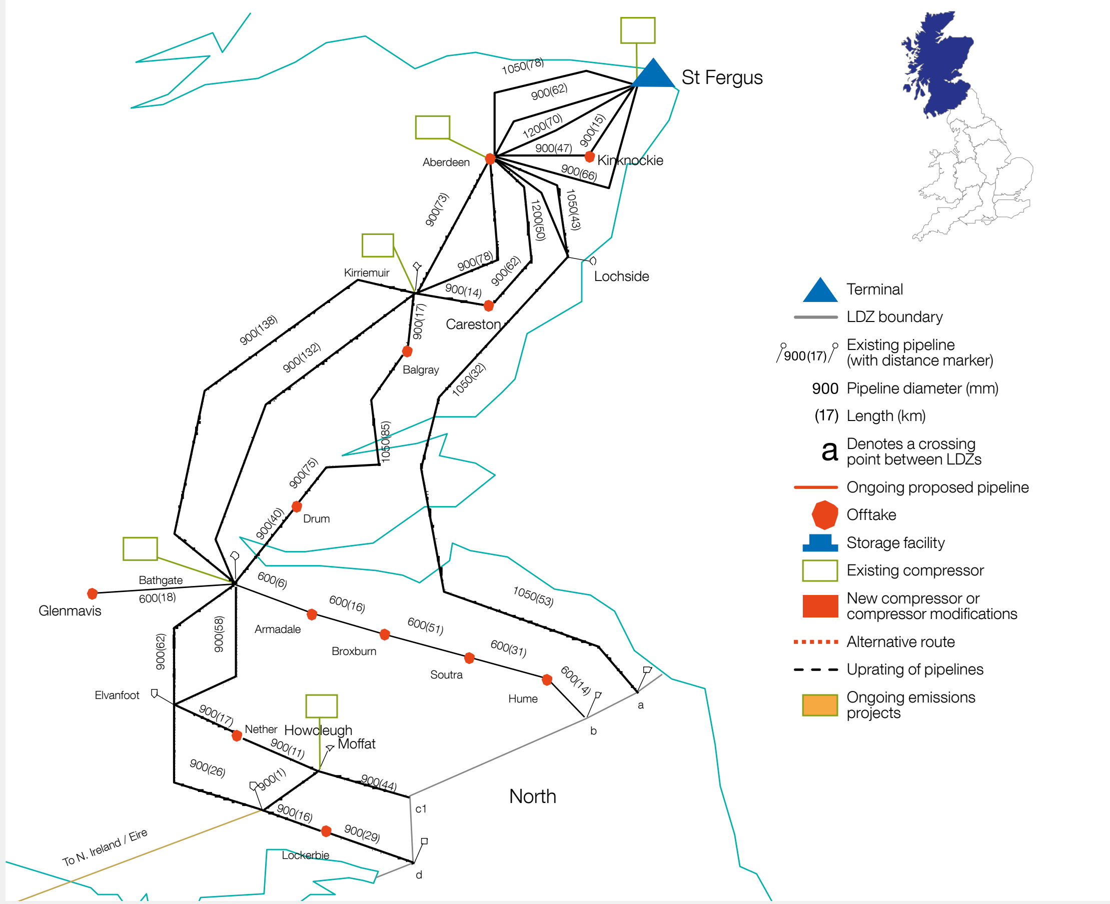
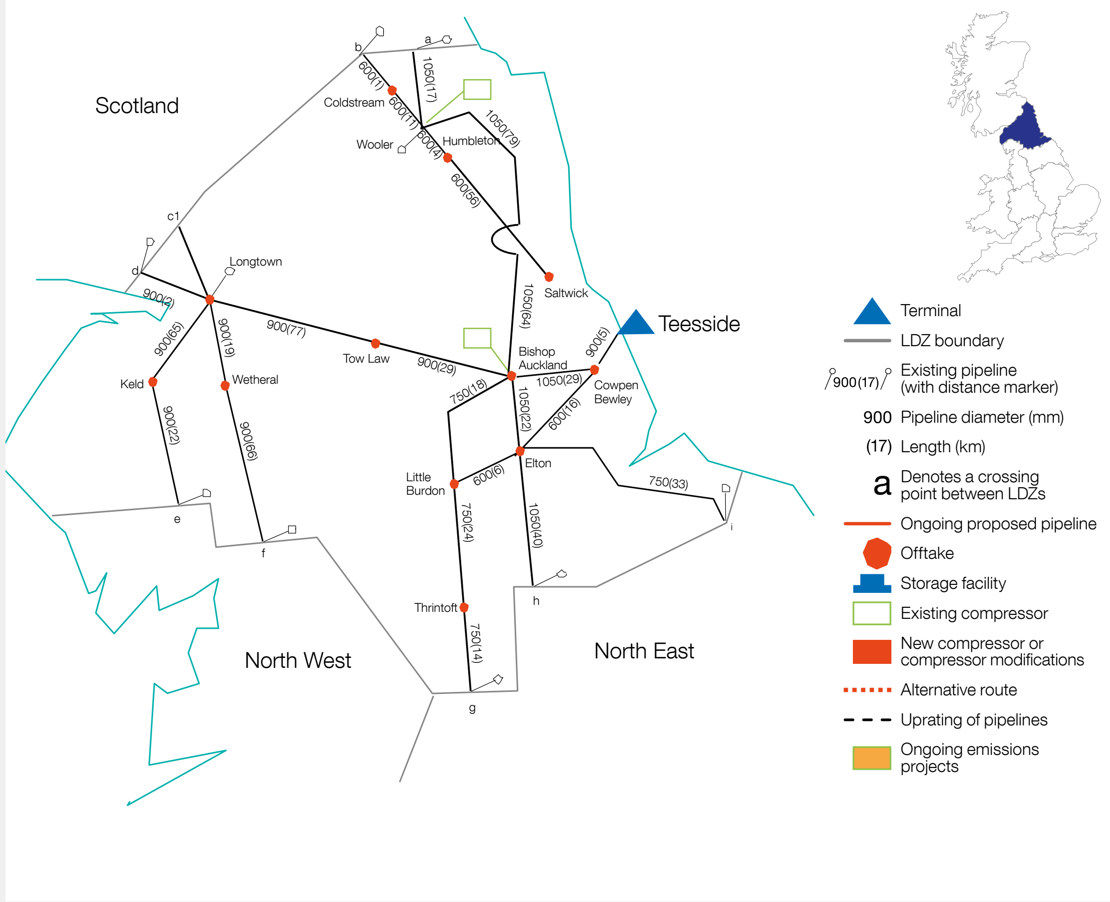


Figure A1.2
North (NO) – NTS



Appendix 1
National Transmission System maps

Figure A1.3
North West (NW) – NTS

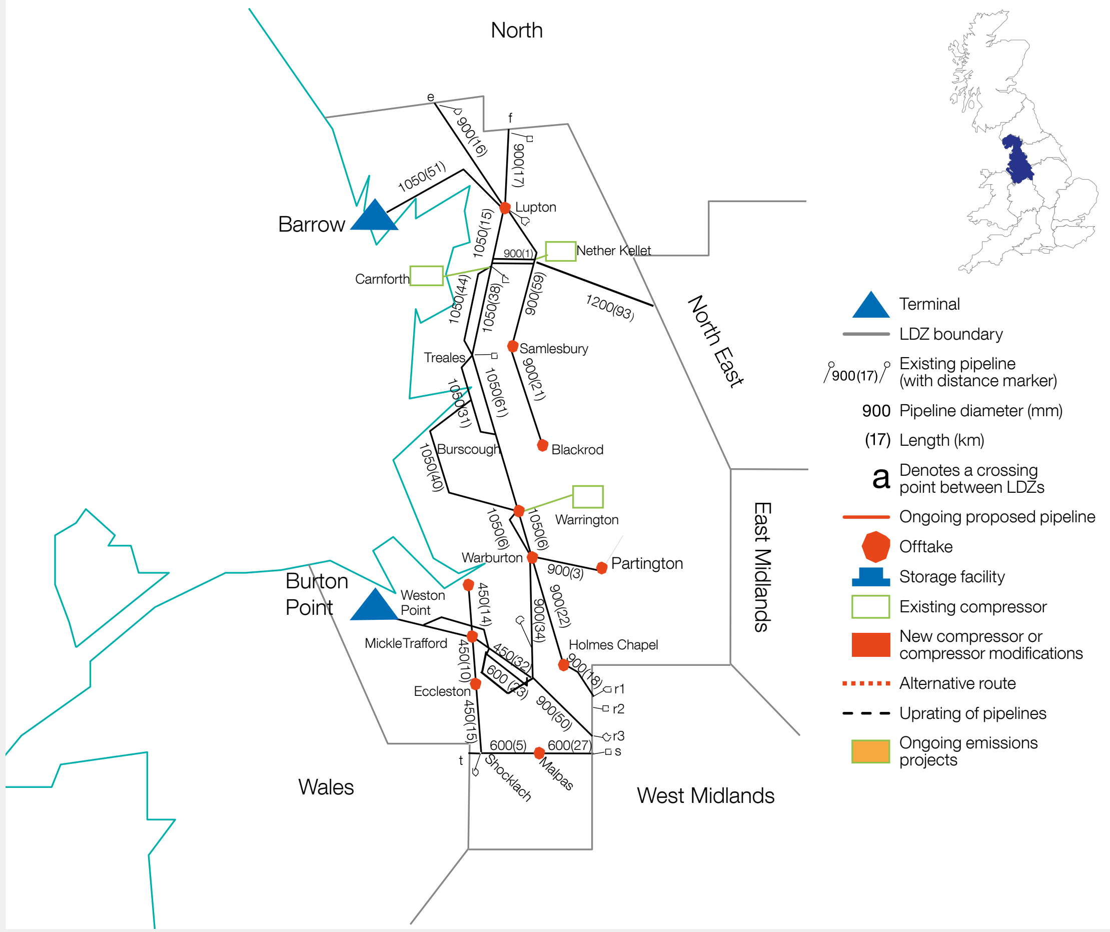
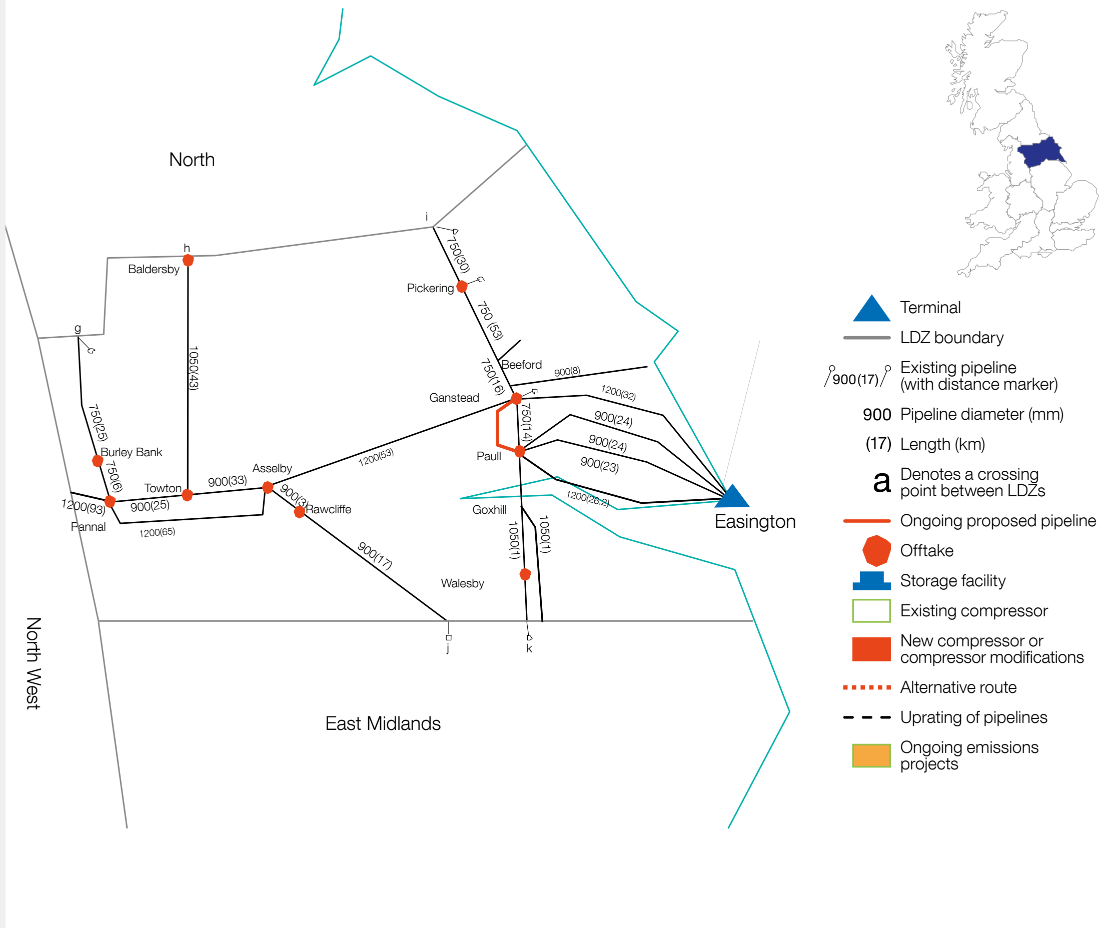


Figure A1.4
North East (NE) – NTS



Appendix 1
National Transmission System maps

Figure A1.5
East Midlands (EM) – NTS

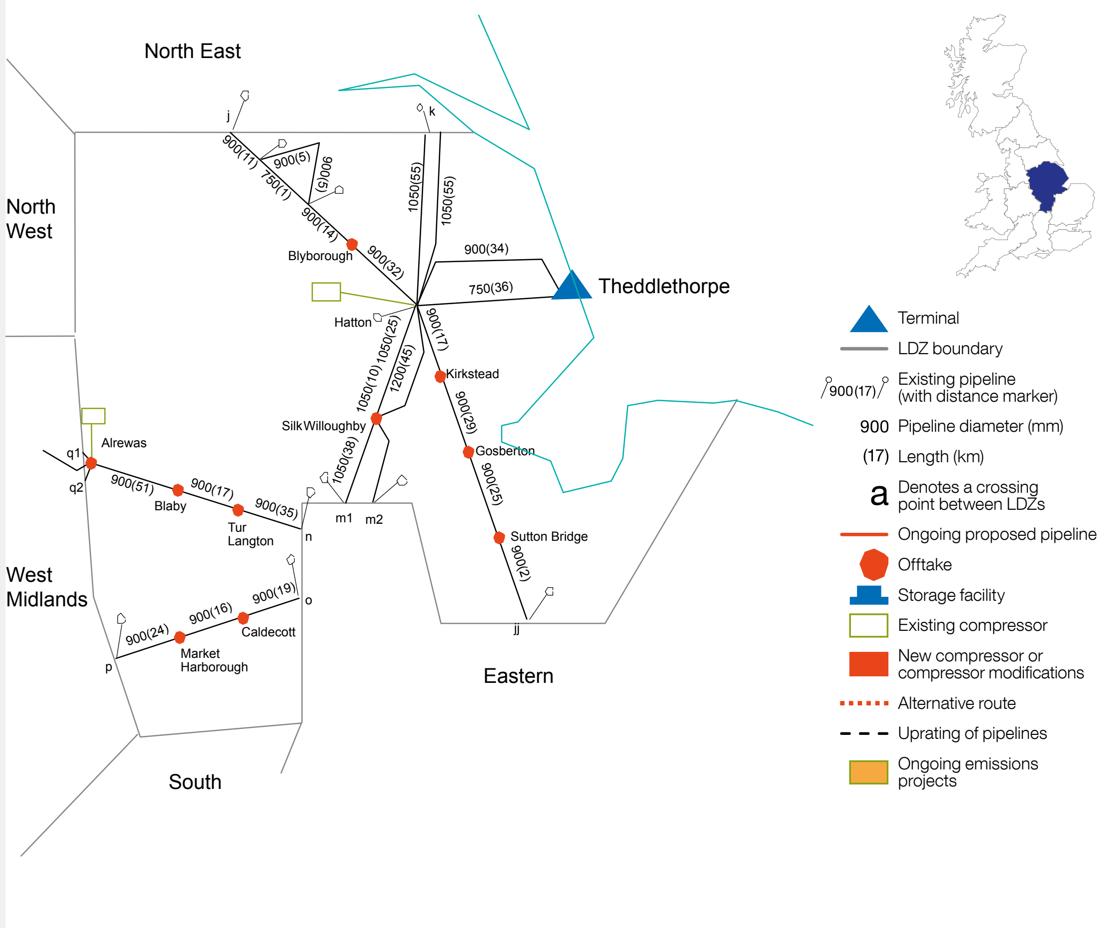


Figure A1.6
West Midlands (WM) – NTS

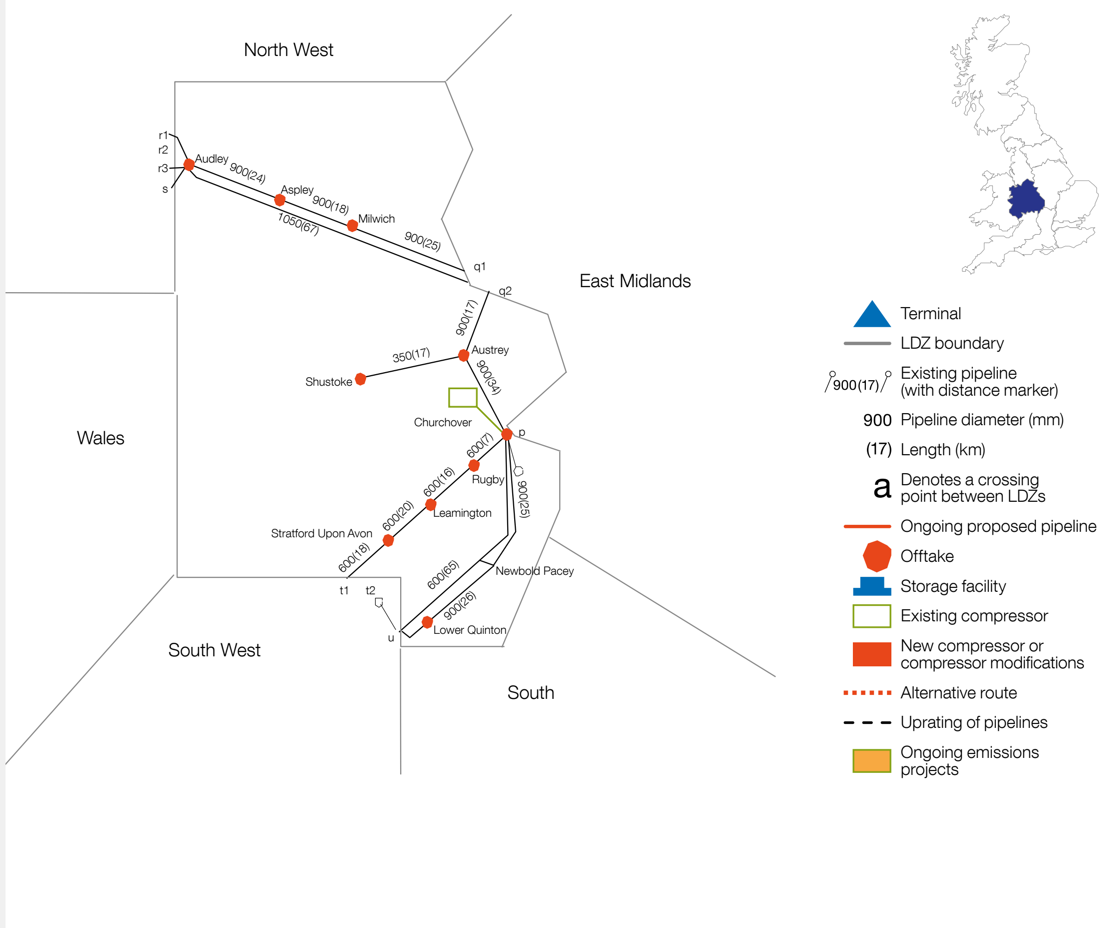


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Figure A1.7
Wales (WN & WS) – NTS

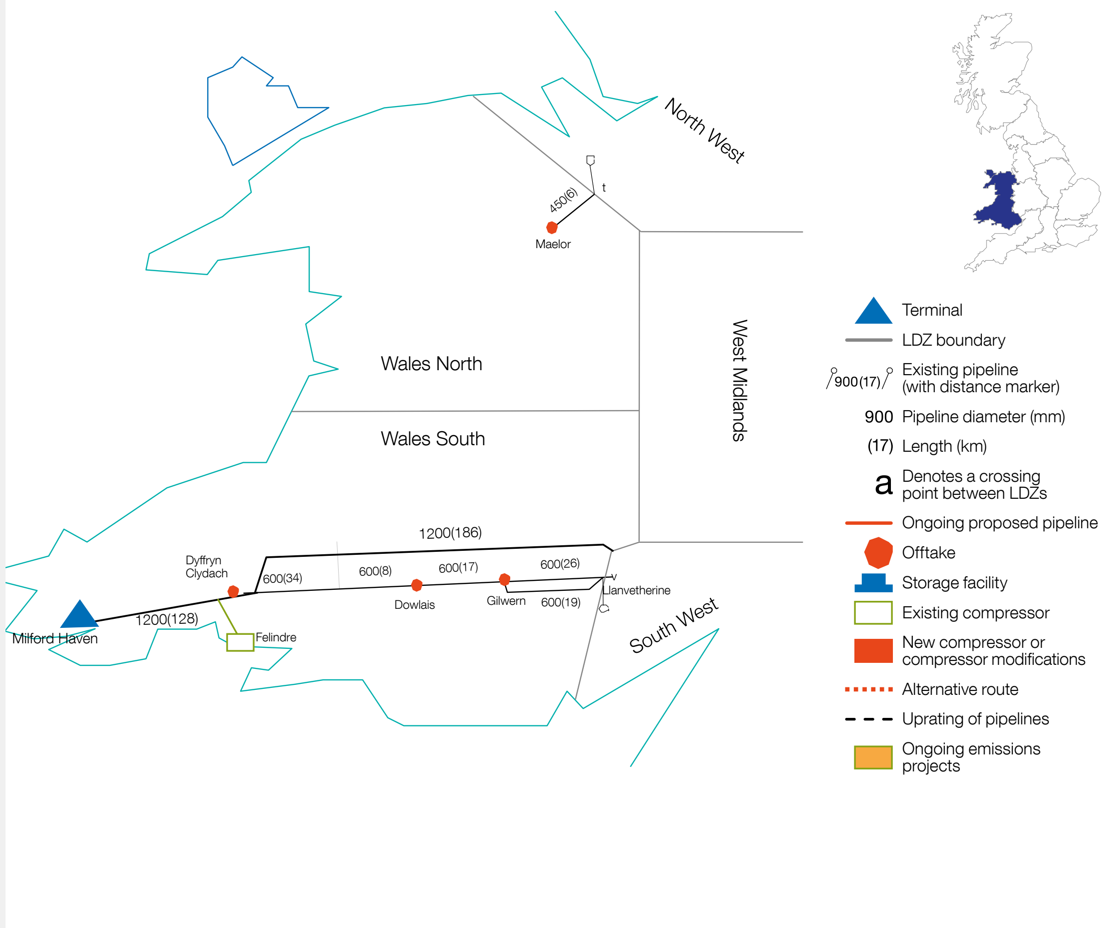

Figure A1.8
Eastern (EA) – NTS

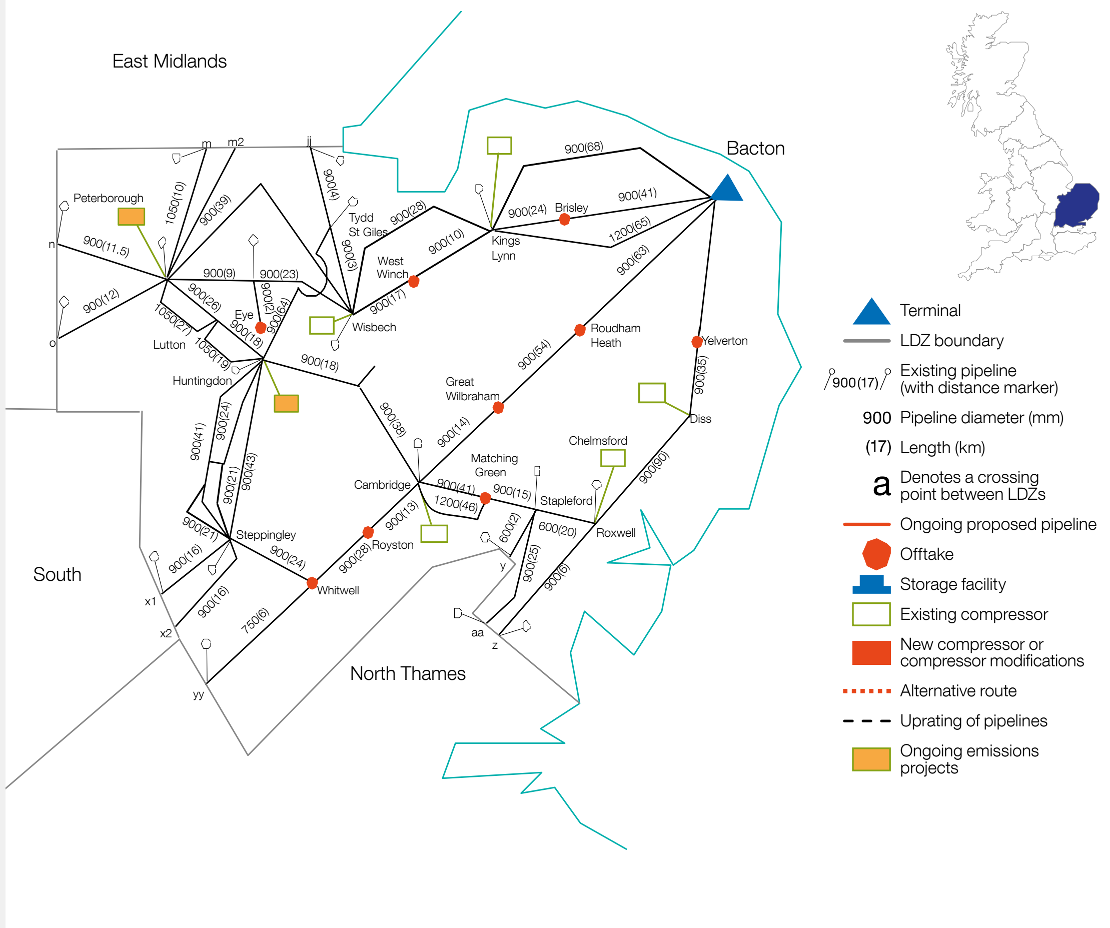

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Figure A1.9
North Thames (NT) – NTS

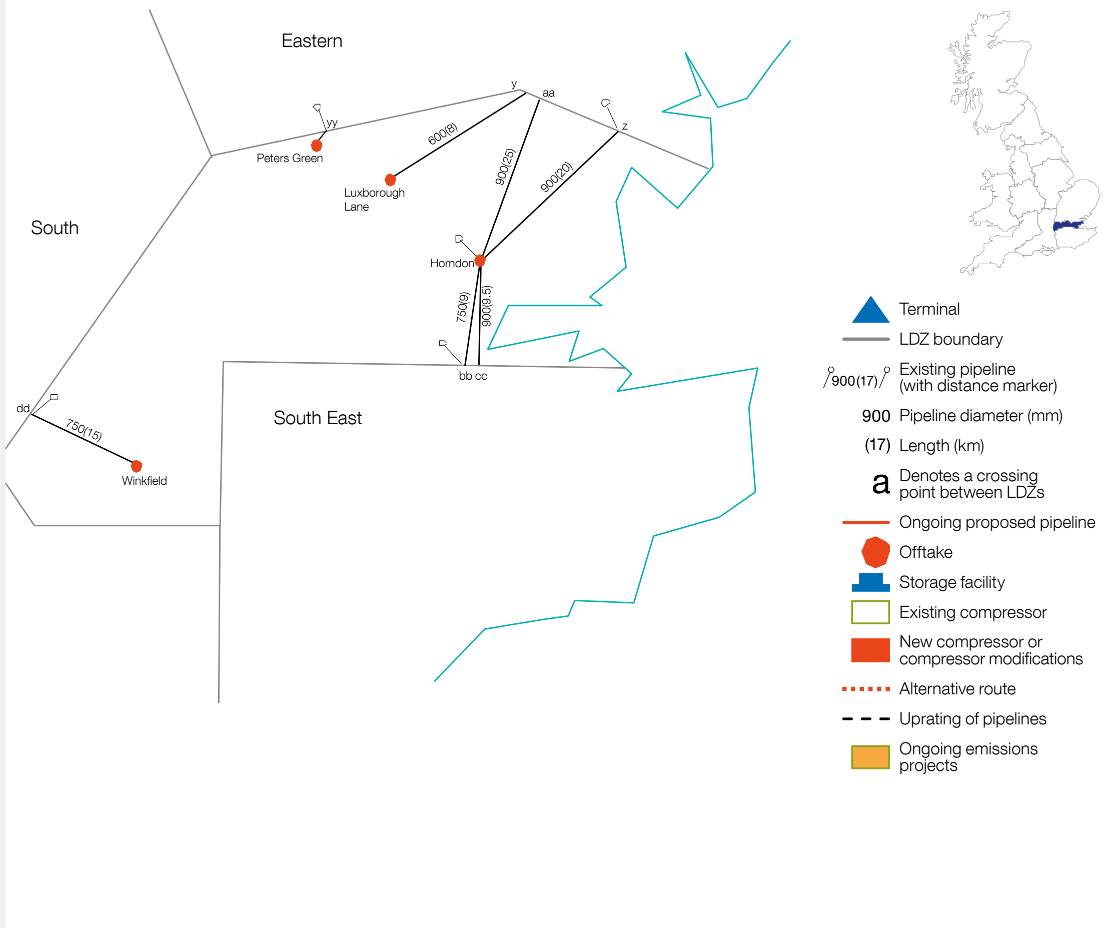

Figure A1.10
South East (SE) – NTS

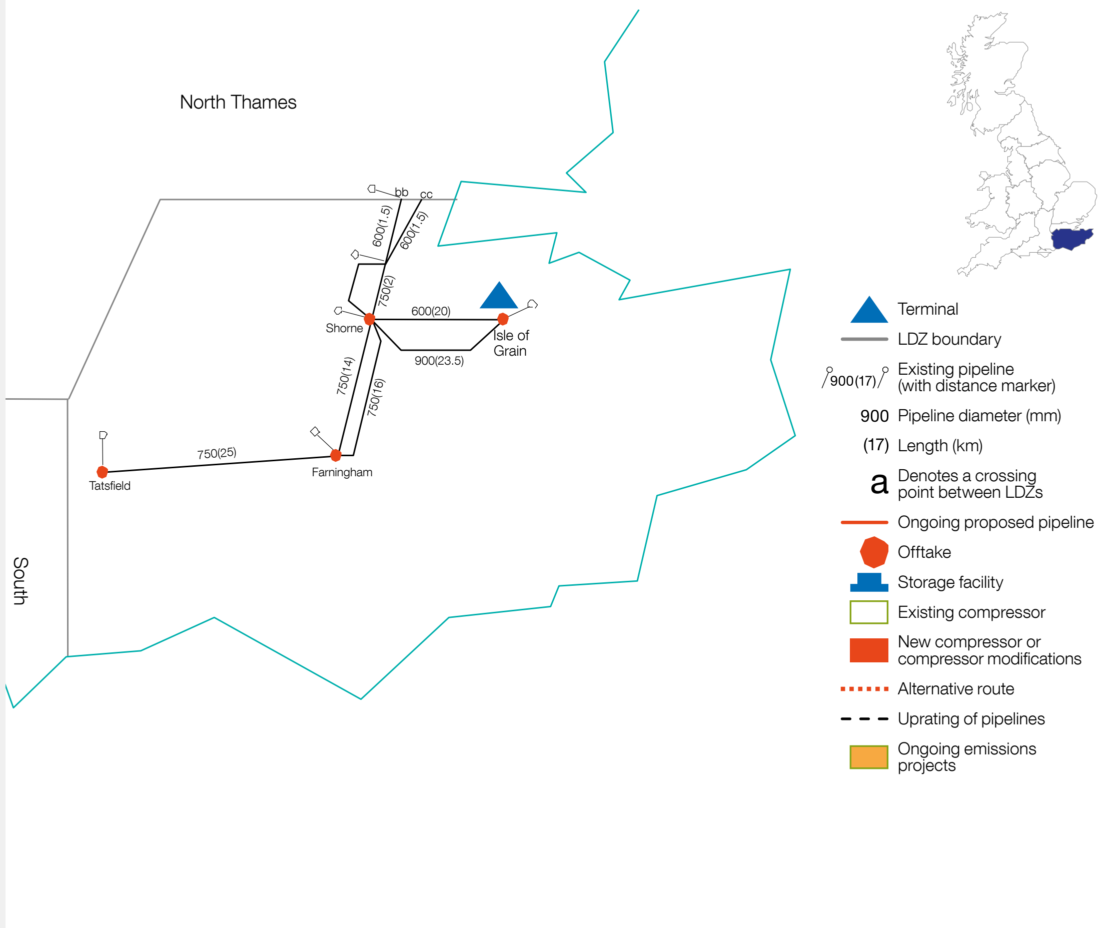

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Figure A1.11
South (SO) – NTS

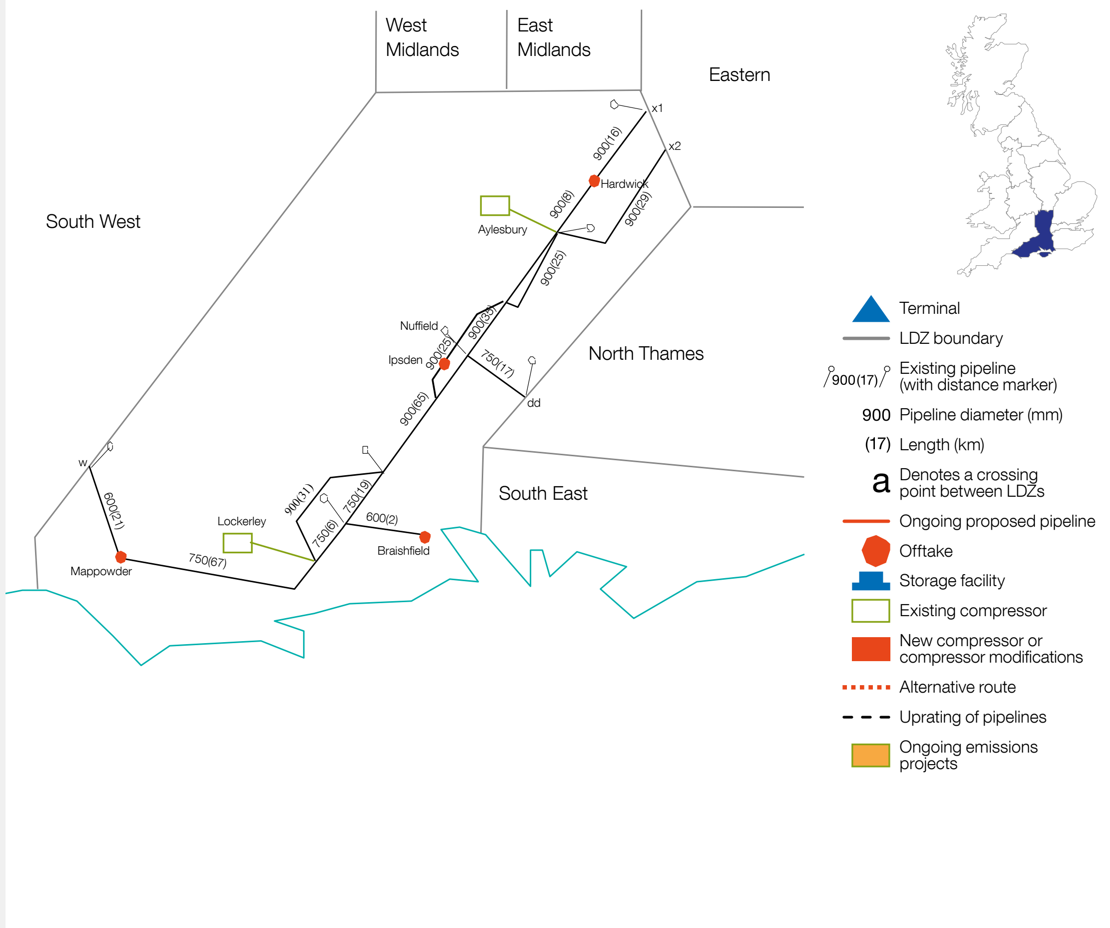
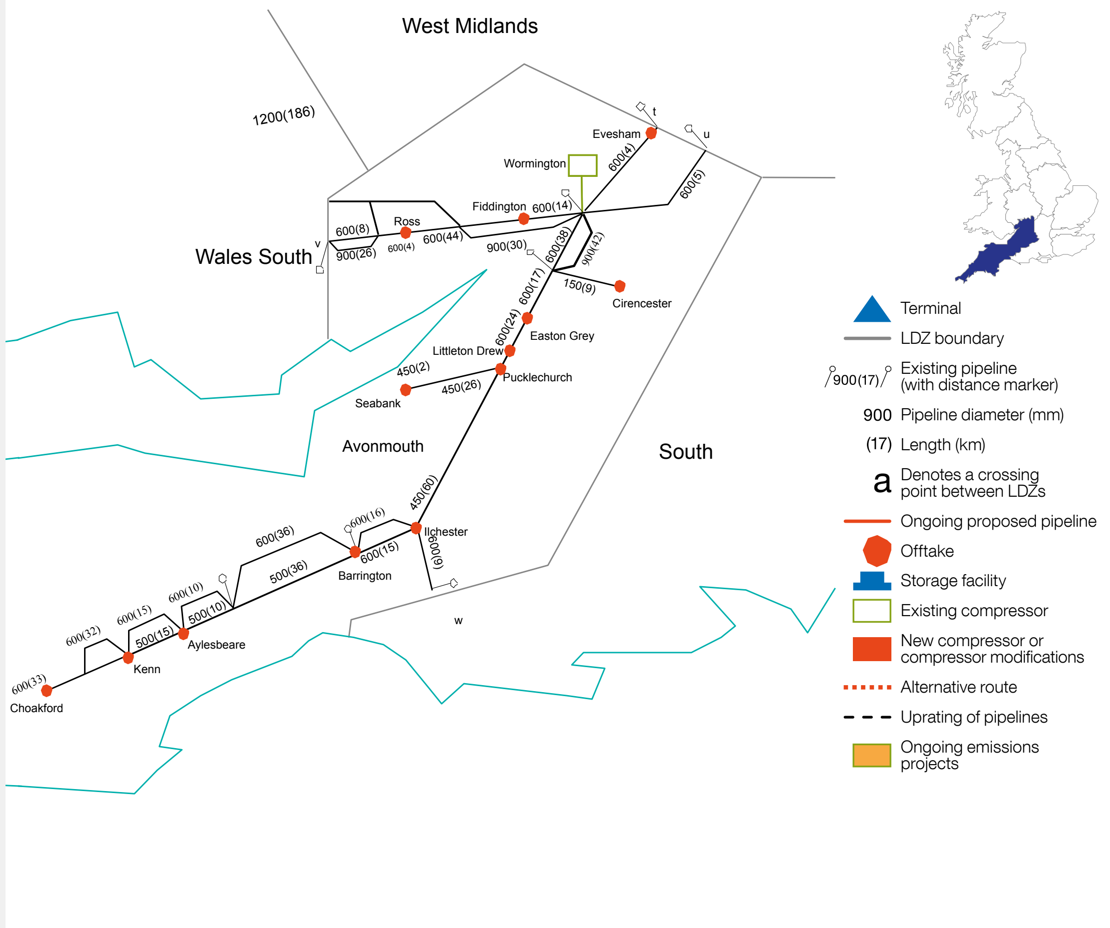


Figure A1.12
South West (SW) – NTS



Appendix 2 – Gas quality

2.1 Network entry quality specification

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

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

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

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

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

Table A2.1
Gas quality specifications

Parameter	Quality requirement
Hydrogen sulphide	Not more than 5 mg/m^3
Total sulphur	Not more than 50 mg/m^3
Hydrogen	Not more than 0.1% (molar)
*Oxygen	Not more than 0.001% (molar)
Hydrocarbon dewpoint	Not more than -2°C at any pressure up to 85 barg
Water dewpoint	Not more than -10°C at 85 barg
Wobbe number (real gross dry)	The Wobbe number shall be in the range 47.20 to 51.41 MJ/m^3
Incomplete combustion factor (ICF)	Not more than 0.48
Soot index (SI)	Not more than 0.60
*Carbon dioxide	Not more than 2.5% (molar)
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. The odourisation requirements in GS(M)R do not apply where the gas is at a pressure above 7 barg.
Pressure	The delivery pressure shall be the pressure required to deliver natural gas at the delivery point into our entry facility at any time, taking into account the back pressure of our system at the delivery point, which will vary from time to time. The entry pressure shall not exceed the maximum operating pressure at the delivery point.
Delivery temperature	Between 1°C and 38°C

*Requests for higher limits will be considered.

Appendix 2 – Gas quality

2.1 Network entry quality specification

Please 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/m^3 to 42.3MJ/m^3 but the Wobbe number provides the overriding limit.

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

Appendix 2 – Gas quality
2.2 Gas quality developments

EU gas quality harmonisation

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

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

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

This challenge has led to a proposal to de-couple the entry and exit specifications with a wide range at entry and offtakes categorised according to the Wobbe Index of the gas they are expected to receive, with TSOs having a role in determining and monitoring this. A public consultation on the proposals is expected later in 2019, with the standard EN 16726 being updated in 2020.

GB developments

The Institute of Gas Engineers and Managers (IGEM) has established an industry working group seeking to make changes to the GB gas quality specification currently in Schedule 3 of the Gas Safety (Management) Regulations 1996 (GS(M)R) and incorporate the revised specification into an IGEM standard. At the same time, a review of the other sections of GS(M)R is taking place.

The objective is to have a specification that can be developed more easily in the future as GB's gas supply diversifies, and to allow a wider quality of gas to be conveyed in GB networks, subject to appropriate demonstration of safety and consideration of impacts on industry stakeholders.

A draft standard has been developed which proposes to increase the upper limit of Wobbe Index from 51.41 MJ/m^3 to 52.85 MJ/m^3, replace the soot index and incomplete combustion factor parameters with relative density, and increase the legal limit for oxygen content from 0.2 mol per cent to 1.0 mol per cent. The group is also considering the impacts of reducing the lower limit for Wobbe Index.

It is currently expected that a proposed standard will be finalised by the end of 2019, following which it will be subject to a consultation and impact assessment process led by the HSE in 2020.

Appendix 2 – Gas quality
2.2 Gas quality developments

Following consultation with industry on a number of issues related to gas quality in 2017–18, we are exploring the potential for National Grid to offer a gas quality blending service at St Fergus and Bacton, being the NTS entry locations where multiple sources of gas are delivered into and comingled within the National Grid terminal prior to being discharged onto NTS pipelines.

Our first step is to assess the technical feasibility of such a service by modelling the blending capability of these terminals, which we intend to complete via a study funded by our Network Innovation Allowance. In parallel, we plan to consider the safety assurance and commercial and regulatory issues that would need to be addressed prior to such a service being available and intend to consult more widely with industry in due course.

Appendix 3 – Connection and capacity application process

3.1 Connection and capacity application process

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

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

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

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

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

Appendix 3 – Connection and capacity application process

3.1 Connection and capacity application process

Table A3.1
Our connection and capacity application process

	Our connection and capacity processes				
	Our customers and their key service requirements:	Find more information in *GTYS*:	Gas shipper	Distribution network (DN) (Signatory to the UNC) B4:B9 Rights to offtake gas from the system.	Customers
Connections	Application to Offer (A2O)	Appendix 3, chapter 3.2	✗	✓	✓
	Disconnection/ decommissioning	Appendix 3, chapter 3.2	✗	✓	✓
Entry and exit capacity	Quarterly system entry capacity auctions	Appendix 3, chapter 3.3	✓	✗	✗
	Exit application windows	Appendix 3, chapter 3.4	✓	✓	✗
	Exit application window. Enduring annual NTS exit capacity	Appendix 3, chapter 3.4	✓	✓	✗
	Flexible capacity for flow changes	Appendix 3, chapter 3.4	✗	✓	✗
	Entry/Exit planning and advanced reservation of capacity agreement	Appendix 3, chapter 3.6	✓	✓	✓
CAM incremental	Incremental entry/exit capacity trigger process for Interconnection Points (IP). This follows the principles of PARCA.	Appendix 3, chapter 3.5 and 3.7	✓	✗	✓

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

Connection and disconnection

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

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

Table A3.2
NTS gas connection and disconnection

	NTS gas connection and disconnection
Entry connections	Connections to delivery facilities processing gas from gas producing fields or Liquefied Natural Gas (LNG) vaporisation (importer) facilities, biomethane facilities or any other gas delivery facility, for the purpose of delivering gas into the NTS.
Exit connections	These connections allow gas to be supplied from the NTS to the premises (a supply point), to a distribution network (DN) or to connected systems at connected system exit points (CSEPs).
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 states. They can supply gas from and/or deliver gas to the NTS.
Disconnection and decommissioning	Disconnection is the positive isolation from the NTS and the customer's facilities through a physical air gap between the two assets. Decommissioning is where the site is returned to its original state. All assets are disconnected and removed including the removal of pipeline.

Appendix 3 – Connection and capacity application process

3.2 Connecting and disconnecting to/from our network

Customer connections – Application to Offer (A2O)

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

The UNC provides:

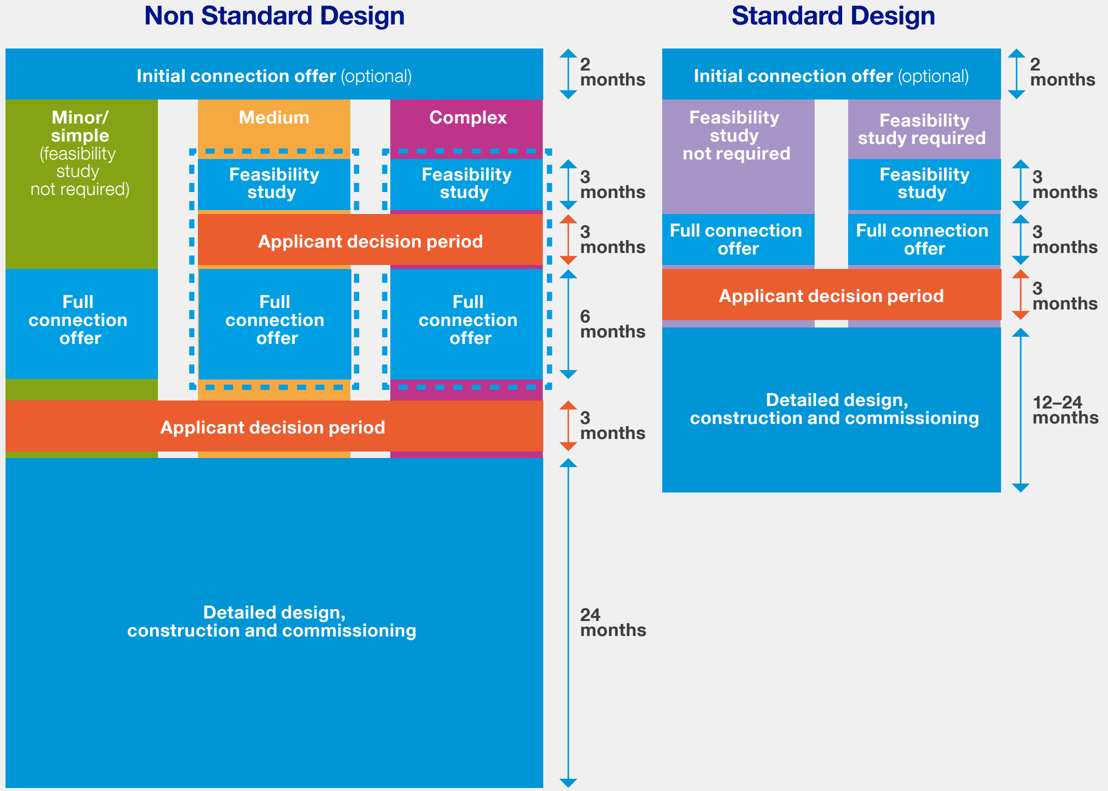
- a formal connection application process (TPD V.13)
- definition of the content of an initial connection offer
- definition of the content of a full connection offer
- how to request a modification to a full connection offer
- timescales for National Grid to produce a connection offer
- timescales for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

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

Figure A3.3

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

Figure A3.3
Application to Offer (A2O) process



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

Connection application charges

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

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

Connection pressures

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

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

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

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

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

General connection pressure information

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

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

Ramp rates and notice periods

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

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

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

Appendix 3 – Connection and capacity application process

3.2 Connecting and disconnecting to/from our network

Reinforcements to our network

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

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

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

Appendix 3 – Connection and capacity application process

3.3 NTS entry capacity

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

NTS entry capacity types

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

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

- Baseline NTS Entry Capacity (obligated)
- Funded Incremental NTS Entry Capacity (obligated)
- Non-Obligated NTS Entry Capacity.

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

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

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

NTS entry capacity auctions — Spotlight

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

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

Information on Interconnection Points entry capacity auctions can be found in Appendix 3 chapter 3.5.

Incremental obligated capacity

In order to increase the obligated level of entry capacity at an ASEP, shippers or developers should submit a PARCA application[1]. If this capacity can be made available via capacity substitution, then the baseline capacity at the location will be increased. If this request for additional capacity leads to a requirement to reinforce the network, it can only be triggered when the customer enters into a PARCA.

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

Appendix 3 – Connection and capacity application process

3.3 NTS entry capacity

Figure A3.4
2019 QSEC auction

1. **The QSEC auctions opened on Monday 18 March and closed on Wednesday 20 March 2019.**
2. **Bids were received for non-obligated entry capacity at Murrow, which was allocated.**
3. **No bids were received at any other ASEPs.**

Appendix 3 – Connection and capacity application process

3.4 NTS exit capacity

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

NTS exit capacity types

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

- Baseline NTS Exit Capacity (obligated)
- Incremental NTS Exit Capacity (obligated)
- Non-Obligated NTS Exit Capacity.

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

- Use it or Lose it (UIOLI)
- Unutilised Maximum NTS Exit Point Offtake Rate (MNEPOR)
- Discretionary.

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

NTS exit capacity application windows and auctions

Spotlight

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

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

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

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

Appendix 3 – Connection and capacity application process

3.5 Capacity at Interconnection Points

The UK currently has three direct gas pipelines (gas interconnectors) connecting the NTS to other states. These include Moffat to the Republic of Ireland, Balgzand to Bacton Line (BBL) to the Netherlands and IUK to Belgium. Please see the spotlight on BBL to learn more about the recent modification to this interconnector to facilitate capability of two-way flow.

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

Entry:

Interconnection Point Annual Yearly auctions (IPAYSEC)
Interconnection Point Annual Quarterly auctions (IPAQSEC)
Interconnection Point Rolling Monthly auctions (IPRMSEC)

Exit:

Interconnection Point Annual Yearly auctions (IPAYNEX)
Interconnection Point Annual Quarterly auctions (IPAQNEX)
Interconnection Point Annual Rolling Monthly auctions (IPRMNEX)

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

The Annual Quarterly auctions will be held four times a year as follows:

- The first is held on the 1st Monday of August, capacity will be auctioned for all four quarters (October–December, January–March, April–June and July–September).
- The second is held on the 1st Monday of November, capacity will be auctioned for the quarters January–March, April–June and July–September.
- The third is held on the 1st Monday of February, capacity will be auctioned for the quarters April–June and July–September).
- The fourth is held on the 1st Monday of May, capacity will be auctioned for the last quarter (July–September).

The Rolling Monthly auction will be held once a month. It will open on the third Monday of each month for the following monthly standard capacity product.

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

Please view this page[2] for an explanation of how the trading of gas with European states will operate in the event of a no-deal Brexit and the actions you will need to take to prepare.

Appendix 3 – Connection and capacity application process

3.6 PARCA framework

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

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

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

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

3.6.1 PARCA framework structure

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

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

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

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

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

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Appendix 3 – Connection and capacity application process

3.6 PARCA framework

Figure A3.5
PARCA framework process

Phase 0	Customer approaches National Grid for initial project discussions	Informal assessment completed	Customer submits PARCA application and PARCA application fee		
Phase 1 Up to 6 months	National Grid confirms receipt of the application within two business days	National Grid provides formal acceptance of a competent application to the customer within six business days	National Grid initiates Phase 1 Works	Within ten business days National Grid may trigger a PARCA window and an ad hoc QSEC capacity auction	National Grid will issue the customer with the Phase 1 Output Report and the PARCA contract
Phase 2 Up to 60 months	National Grid will reserve the capacity on behalf of the customer (reservation date)	National Grid initiates the Phase 2 works	Customer provides demonstration information and annual financial security	Where customer is a non-code party, nominates a User(s) at least one month prior to capacity allocation date	National Grid formally allocate the capacity to the customer (allocation date)
Phase 3 Up to 24 months	National Grid will conduct network reinforcement if this is required	Capacity is delivered (registration date)			

Appendix 3 – Connection and capacity application process

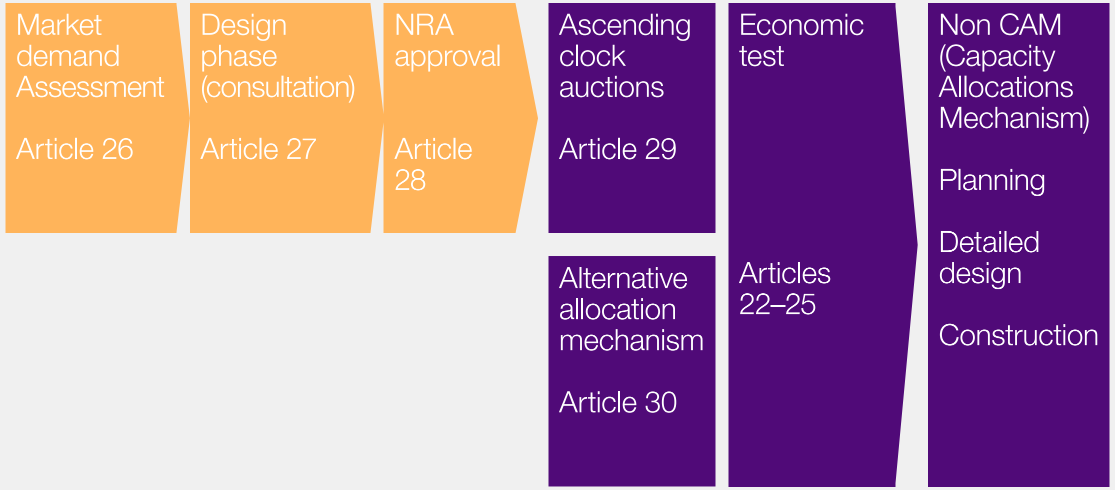
3.7 Incremental capacity at Interconnection Points

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

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

The 2019 Market Demand Assessment window opened on 1 July for 8 weeks to 26 August 2019. The report with the results of this process is published on our website.

Figure A3.6
Phases of releasing incremental capacity



Please view this page[3] for an explanation of how the trading of gas with European states will operate in the event of a no-deal Brexit and the actions you will need to take to prepare.

Appendix 4 – Meet the teams

4.1 Customer Projects Contact Management team

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

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

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

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

4.2 Operational Liaison and Business Planning team

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

- Gas Operational Forum
- Annual Liaison Meetings.

We also co-ordinate Last Mile Commissioning (the system set-up for connections and biomethane sites), and are the business custodian for Operational Data.

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

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

Joshua Bates
Martin Cahill
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Avita Rai

Appendix 5
EU activity

In chapter 1.5.2, we discussed the European Union (EU) Third Energy Package of legislation which was introduced in 2009. Since then, we have worked with multiple stakeholders to enable the development of several EU gas Network Codes including:

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

We play an important role in representing domestic consumer and stakeholder interests at a European level, including in the development and implementation of legislation. We have influenced the EU code developments and supported the GB industry and our customers through a process of extensive dialogue. This involved 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.

We have carried out extensive work with GB shippers to review GB charging arrangements under UNC modifications 0621 and 0678 (and their various alternatives) in accordance with the harmonised tariff arrangements required under the TAR code. Whilst the compliance date for this TAR code obligation is 31 May 2019 for the following tariff year, the final modification report for 0678 was discussed at a UNC Modification Panel in May 2019 and is currently with Ofgem for decision. We expect a Regulatory Impact Assessment to be carried out prior to any implementation decision being made. We are working to implement as soon as reasonably practicable following October 2019.

We have worked closely with the 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 Uniform Network Code (UNC) modifications.

Appendix 5
EU activity

With the current European Commissioners' term of office ending in December 2019, the Commission's forward thinking is now focussed 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. This package was expected to focus on 'mirroring' common topics from the Clean Energy Package into gas arrangements; strengthening market functioning and the future role of gas. This may change under the new European Commission. As members of both European Network of Transmission System Operators for Gas (ENTSOG) and Gas Infrastructure Europe (GIE), we have been supporting the increasingly important input these organisations have in shaping these potential future market developments.

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

Finally, the Uniform Network Code (UNC) modifications to implement the EU Codes and Guidelines that have been completed to date and have been closed are available online and are listed in the previous versions of *GTYS* online.

The UNC modifications to implement the EU Codes and Guidelines that have been completed since the previous *2018 GTYS* or are ongoing include:

- 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.
- 0678/A/B/C/D/E/G/H/I/J (Amendments to Gas Transmission Charging Regime). Sent by the UNC Panel to Ofgem for decision on 23 May 2019.

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Appendix 6 – Exit and entry capacity application process

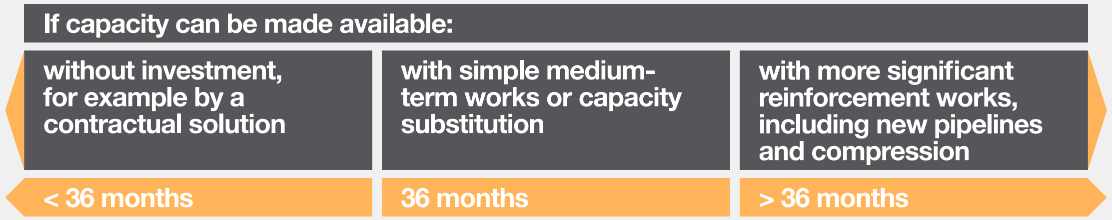
6.1 Exit capacity on the NTS

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

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

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

Figure A6.1
Capacity lead times



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

6.1.1 Available (unsold) NTS exit (flat) capacity

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

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

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

Appendix 6 – Exit and entry capacity application process

6.1 Exit capacity on the NTS

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

This table has been updated to shows how unsold capacity has changed since the publication of the *2018 Gas Ten Year Statement*.

As a result of stakeholder feedback received during RIIO-2 business plan engagement on our capacity baselines and general access arrangements, National Grid Gas has raised UNC request 0705R – NTS Capacity Access Review, which has the following purpose:

To review the principles and establish long-term strategy for the NTS capacity access regime. Ensuring the regime is appropriate for commercial behaviours experienced today, simplified and adaptable whilst being consistent with relevant obligations. To make recommendations for change and addressing short-term problems in accordance with the long-term ambition.

More detail on this request can be found online.

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

Region number	Region	Obligated	Unsold		
		(GWh/d)	(GWh/d)	% of unsold capacity	% change from *2018 GTYS*
1	Scotland and the North	719	156	22	+1
2	North West and West Midlands (North)	1,110	423	38	+1
2.1	North Wales and Cheshire	315	204	65	+1
3	North East, Yorkshire and Lincolnshire	1,566	252	16	-12
4	South Wales and West Midlands (South)	569	50	9	0
5	Central and East Midlands	281	113	40	-7
6	Peterborough to Aylesbury	126	29	23	0
7	Norfolk	367	119	32	0
8	Southern	526	294	56	-3
9	London, Suffolk and the South East	1,504	372	25	-7
10	South West	461	64	14	-7

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

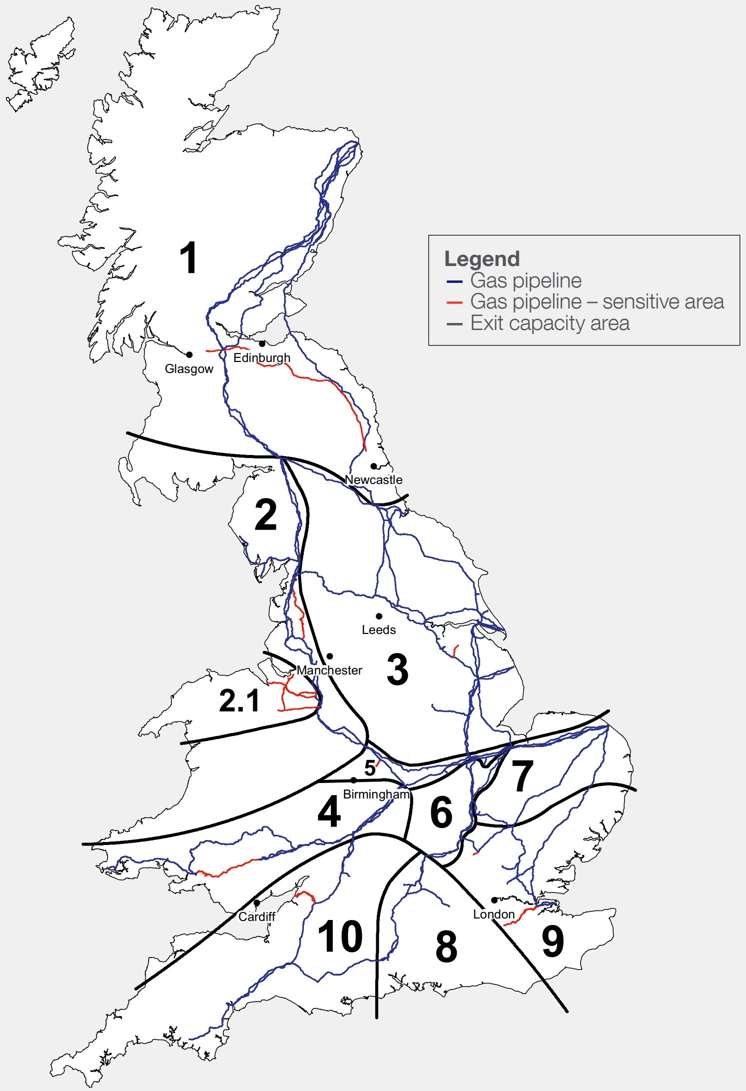
6.1.2 NTS exit capacity map

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

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

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

Figure A6.2
NTS exit capacity map



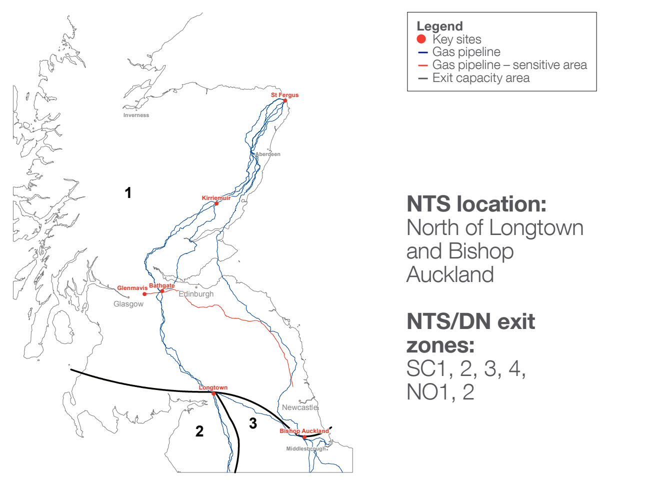
Appendix 6 – Exit and entry capacity application process

6.1 Exit capacity on the NTS

Figure A6.3

Region 1 – Scotland and the North

Figure A6.3
Region 1 – Scotland and the North



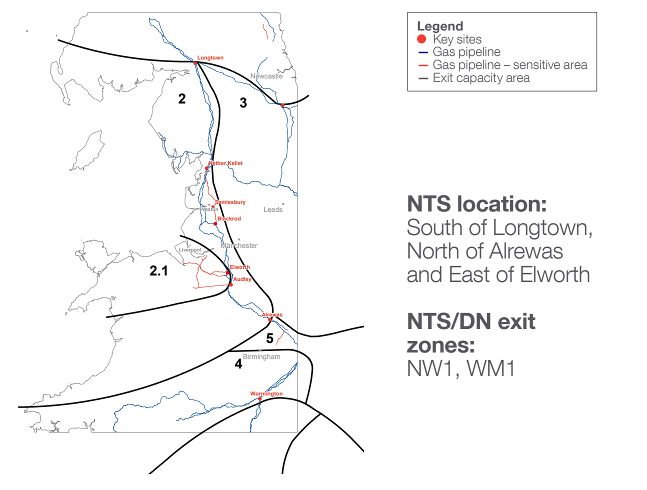
This region is sensitive to St Fergus flows. High St Fergus flows mean that exit capacity will be available, as flows from the St Fergus terminal are predominately in a North to South direction. As St Fergus flows reduce, exit capacity will be constrained.

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

Figure A6.4

Region 2 – North West and West Midlands (North)

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



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

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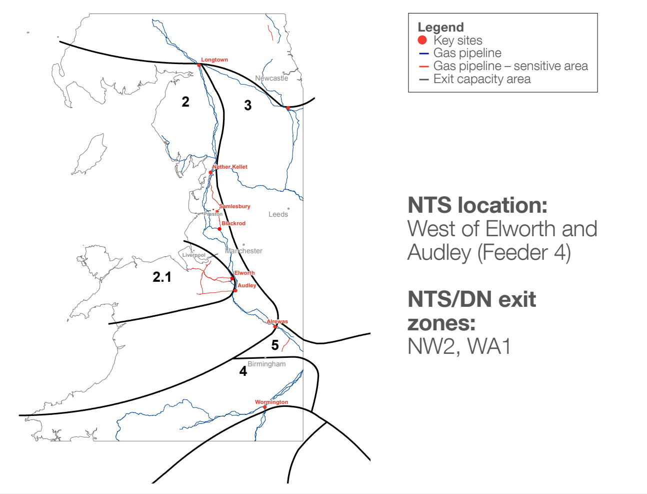
Appendix 6 – Exit and entry capacity application process

6.1 Exit capacity on the NTS

Figure A6.5

Region 2.1 – North Wales and Cheshire

Figure A6.5
Region 2.1 – North Wales and Cheshire



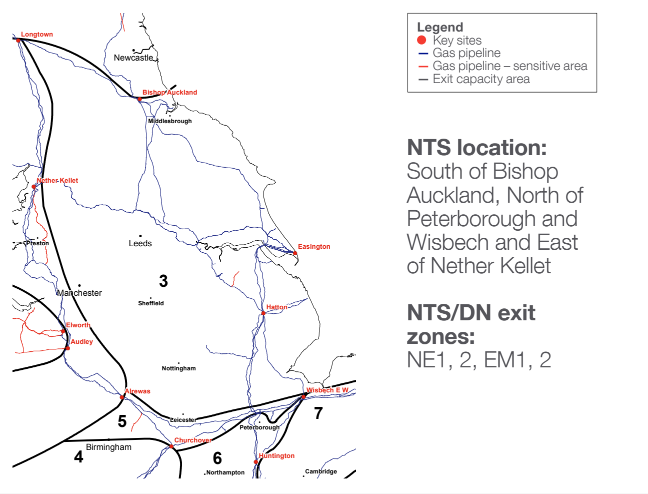
This is an extremity of the system with limited local supplies (Burton Point) and a significant number of storage facilities.

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

Figure A6.6

Region 3 – North East, Yorkshire and Lincolnshire

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



There are numerous power stations in this region and this may impact on future ramp rate agreements. The amount of unsold capacity in the region indicates that capacity could be made available through exit capacity substitution.

Further capacity should be available without needing reinforcement, assuming stable North-East supplies; however, this may be limited on smaller diameter spurs, including between Brigg and Blyborough on Feeder 7. Non-Planning Act reinforcements, including compressor modifications, could be carried out to make additional capacity available.

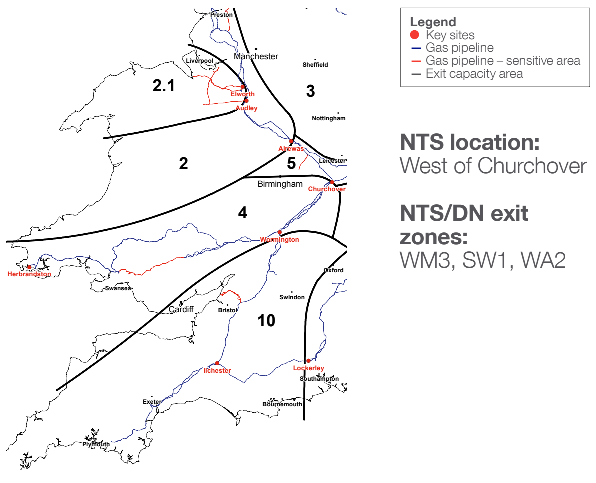
Appendix 6 – Exit and entry capacity application process

6.1 Exit capacity on the NTS

Figure A6.7

Region 4 – South Wales and West Midlands South

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



NTS location:
West of Churchover

NTS/DN exit zones:
WM3, SW1, WA2

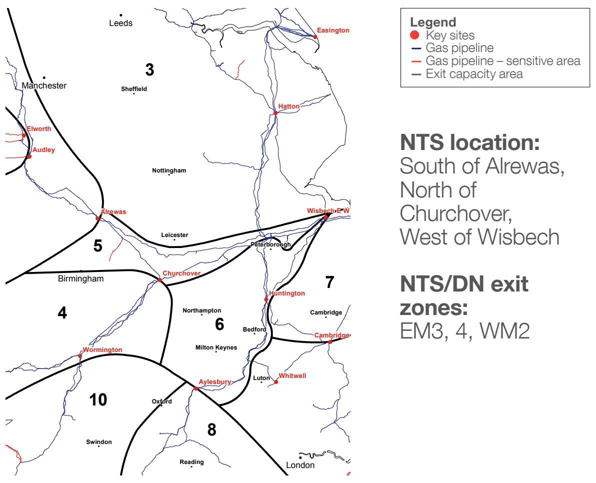
Exit capacity availability is highly sensitive to Milford Haven flows. Low Milford Haven flows result in reduced South Wales pressures, which limit capacity. High Milford Haven flows result in reduced pressures in the West Midlands which may limit capacity.

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, particularly in the sensitive area on Feeder 2, South of Cilfrew between Dyffryn Clydach and Gilwern, due to the different pressure ratings.

Figure A6.8

Region 5 – Central and East Midlands

Figure A6.8
Region 5 – Central and East Midlands



NTS location:
South of Alrewas,
North of Churchover,
West of Wisbech

NTS/DN exit zones:
EM3, 4, WM2

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

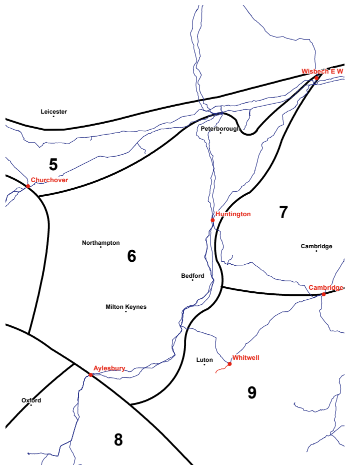
Appendix 6 – Exit and entry capacity application process

6.1 Exit capacity on the NTS

Figure A6.9

Region 6 – Peterborough to Aylesbury

Figure A6.9
Region 6 – Peterborough to Aylesbury



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

NTS location:
North of Aylesbury, South of Peterborough and Wisbech, West of Huntingdon

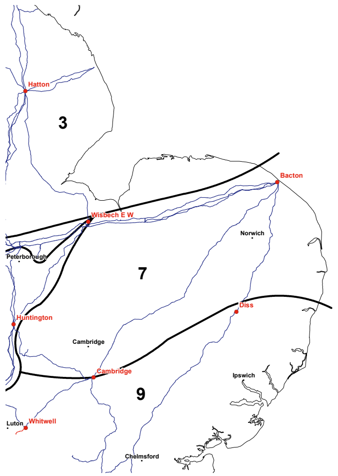
NTS/DN exit zones:
EA6, 7

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

Figure A6.10

Region 7 – Norfolk

Figure A6.10
Region 7 – Norfolk



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

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

NTS/DN exit zones:
EA1, 2, 3

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

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

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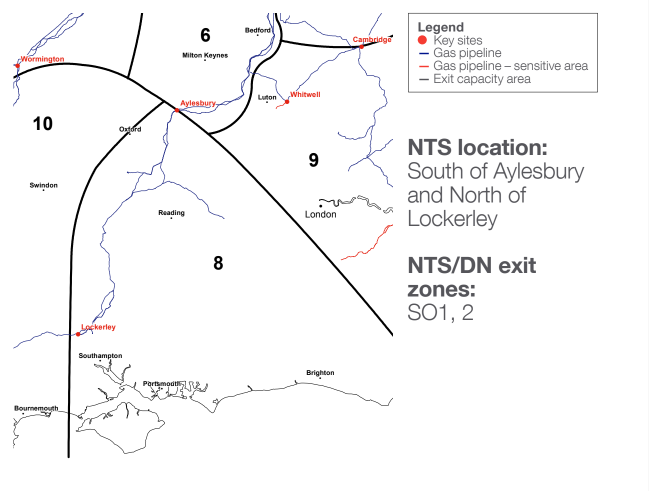
Appendix 6 – Exit and entry capacity application process

6.1 Exit capacity on the NTS

Figure A6.11

Region 8 – Southern

Figure A6.11
Region 8 – Southern

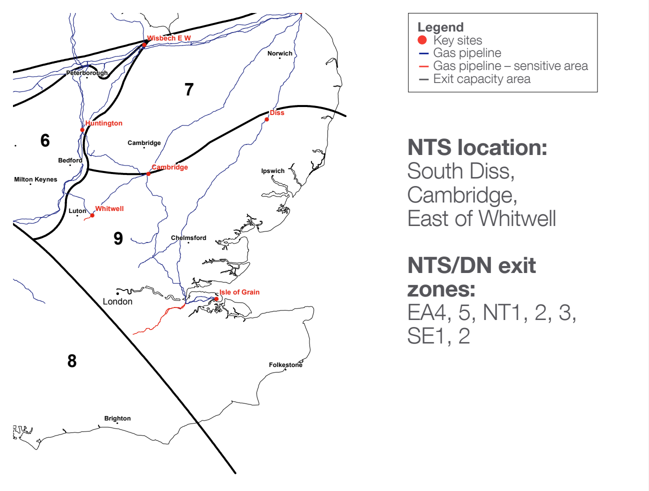


The region is sensitive to demand in the South West; if demand increases, capacity may become more constrained. The amount of unsold capacity indicates a good chance that capacity could be made available via exit capacity substitution. Potential non-Planning Act reinforcements (compressor station modifications)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

Figure A6.12

Region 9 – London, Suffolk and the South East

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



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

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

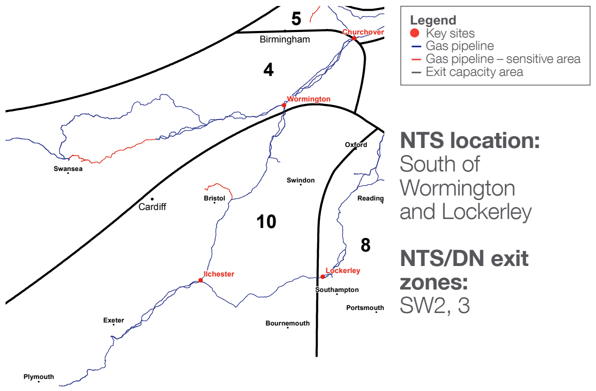
Appendix 6 – Exit and entry capacity application process

6.1 Exit capacity on the NTS

Figure A6.13

Region 10 – South West

Figure A6.13
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 from Pucklechurch to Seabank on the Feeder 14 spur due to small diameter pipelines.

There is also sensitivity to low Milford Haven flows. During peak demand with low Milford Haven flows, it becomes more difficult to maintain assured pressures in the South West.

Appendix 6 – Exit and entry capacity application process

6.1 Exit capacity on the NTS

6.1.3 Directly connected exit points

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

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

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

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

6.1.4 NTS/DN exit zones

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

Table A6.3
NTS/DN exit zones

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

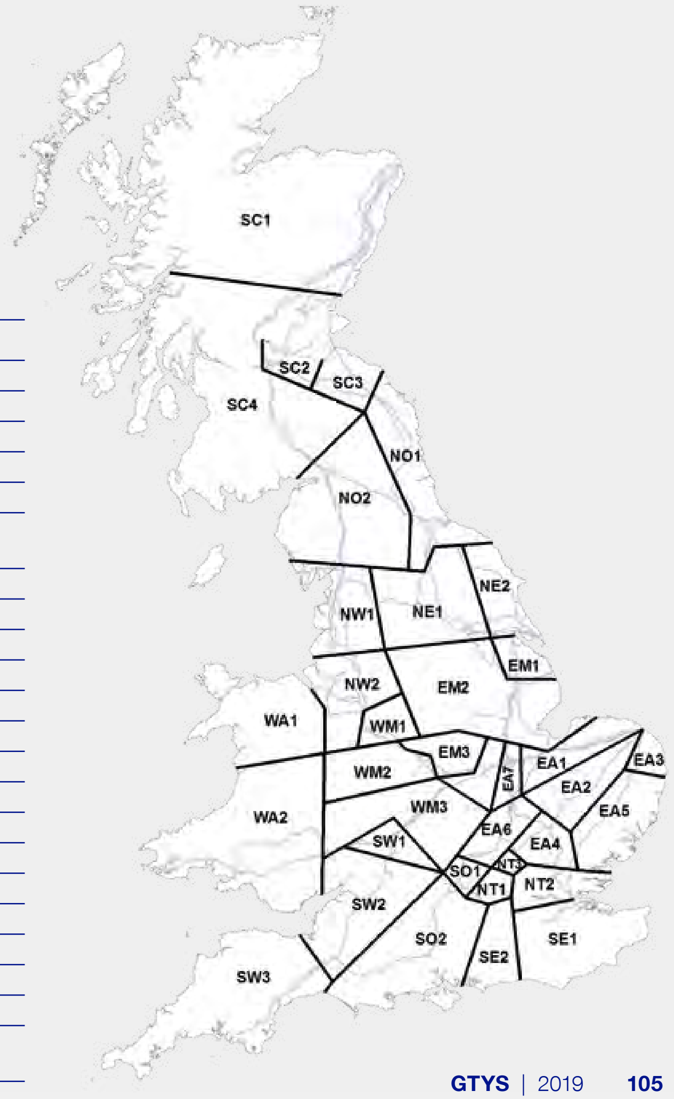
Exit zone	Offtake
EM3	Tur Langton
EM4	Market Harborough
	Caldecott
NE1	Towton
	Rawcliffe
	Baldersby
	Pannal
	Asselby
	Burley Bank
NE2	Ganstead
	Pickering
	Paull
NO1	Guyzance
	Cowpen Bewley
	Coldstream
	Bishop Auckland
	Corbridge
	Thrintoft
	Saltwick
	Humbleton
	Little Burdon
	Elton
NO2	Wetheral
	Keld

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

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

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

Figure A6.14
NTS/DN exit zones



Appendix 6 – Exit and entry capacity application process

6.2 Entry capacity on the NTS

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

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

This chapter contains information about capacity availability and the lead time for providing NTS entry capacity as a guide for shippers and developers. Unsold NTS entry capacity available at an existing Aggregate System Entry Point (ASEP) can be accessed via the daily, monthly and annual entry capacity auction processes. If unsold capacity is not available, including at new entry points, the lead times may be longer. The GTYS aims to help you understand the likely lead time associated with new entry points. New entry points can result in significant changes to network flow patterns, and we encourage you to approach our Customer Contracts team to discuss specific requirements. The following information is just an indication; actual capacity availability will depend on the amount of capacity requested from all customers at an ASEP and interacting ASEPs.

6.2.1 Gas supply diversity

Chapter 1 discussed the diversity of our future gas supply mix arises from both existing supplies and potential new developments.

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

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

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

Appendix 6 – Exit and entry capacity application process

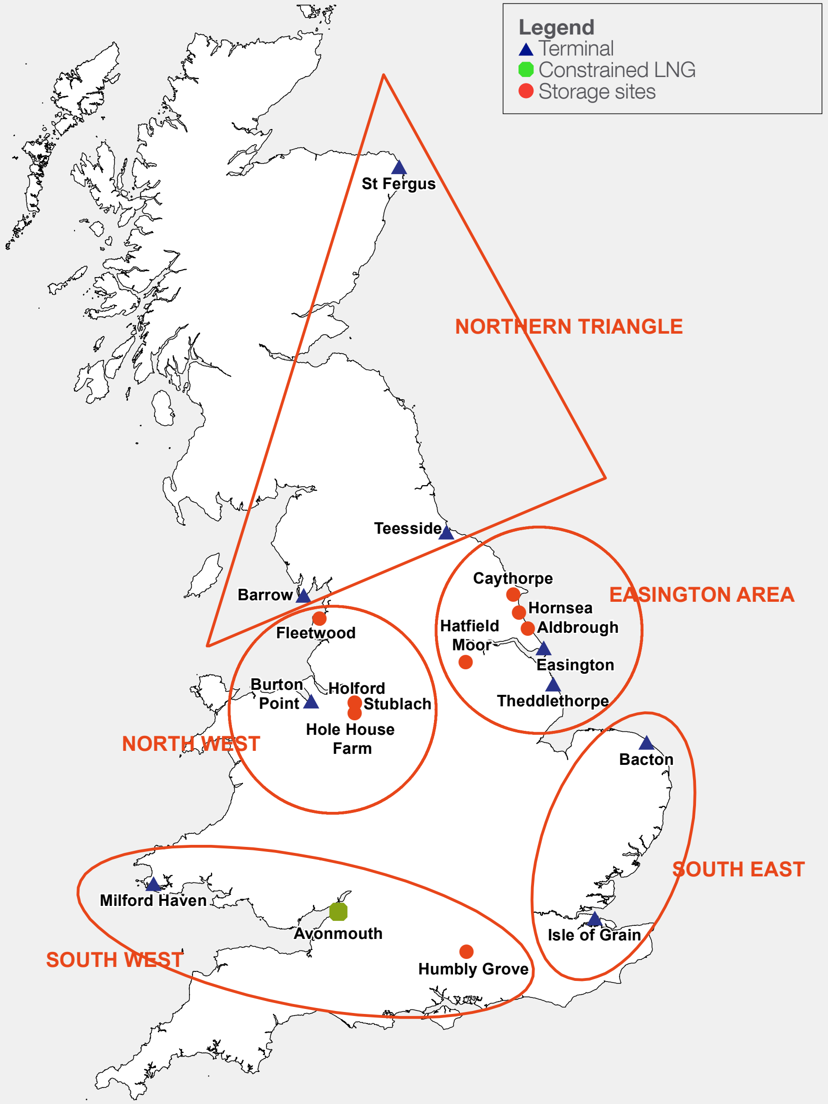
6.2 Entry capacity on the NTS

6.2.2 Entry capacity zones

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

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

Figure A6.15
Zonal grouping of interacting supplies



Appendix 6 – Exit and entry capacity application process

6.2 Entry capacity on the NTS

6.2.3 Customer entry capacity applications

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

- high west–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–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–north.

In addition to the traditional geographical scenarios, we may also investigate several commercially driven sensitivities, for example:

- a sensitivity scenario with a reduction in imported gas, balanced by high medium-range storage entry flows to meet winter demand.

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

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

6.2.4 Available (unsold) NTS entry capacity

Table A6.4 contains the ASEP names as defined in the NTS Licence, and indicates the quantities of obligated and unsold NTS entry capacity at each ASEP within each entry zone. This table has been updated to shows how unsold capacity has changed since the publication of the *2018 Gas Ten Year Statement*.

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

As a result of stakeholder feedback received during RIIO-2 business plan engagement on our capacity baselines and general access arrangements, National Grid Gas has raised UNC request 0705R – NTS Capacity Access Review, which has the following purpose: To review the principles and establish long-term strategy for the NTS capacity access regime. Ensuring the regime is appropriate for commercial behaviours experienced today, simplified and adaptable whilst being consistent with relevant obligations. To make recommendations for change and addressing short-term problems in accordance with the long-term ambition. More detail on this request can be found online.

Appendix 6 – Exit and entry capacity application process

6.2 Entry capacity on the NTS

Our charts and tables workbook provides further information about the level of booked and obligated entry capacity at each ASEP, excluding those that are purely storage. We also provide data points representing historic maximum utilisation and the range of future peak flow scenarios for these ASEPs.

Table A6.4
Quantities of entry capacity by zone

Entry zone	ASEP	Obligated capacity	Unsold capacity		
		GWh/day	2019–2020 GWh/day	2023–2024 GWh/day	2024–2025 GWh/day
Northern Triangle	Barrow	340.01	253.65	280.51	338.53
	Canonbie	0	0	0	0
	Glenmavis	99	99	99	99
	St Fergus	1,670.70	1,547.33	1,641.30	1,663.74
	Teesside	445.09	354.30	377.92	390.76
North West	Burton Point	73.5	60.36	73.5	73.5
	Cheshire (includes Holford and Stublach storage facilities)	556.27	28.59	28.59	28.59
	Fleetwood	350	350	170.95	35
	Hole House Farm (includes Hill Top Farm storage facility)	296.6	13.16	13.16	13.16
	Partington	201.43	201.43	201.43	201.43

Entry zone	ASEP	Obligated capacity	Unsold capacity		
		GWh/day	2019–2020 GWh/day	2023–2024 GWh/day	2024–2025 GWh/day
Easington Area	Caythorpe	90	0	0	0
	Easington	1,407.15	106.20	393.98	531.91
	Garton (includes Aldborough storage facility)	420	0	280	420
	Hatfield Moor (onshore)	0.3	0.3	0.3	0.3
	Hornsea	233.1	27.31	233.1	233.1
	Hatfield Moor (storage)	25	3	3	3
	Theddlethorpe	610.7	601.5	610.7	610.7
South West	Avonmouth	179.3	179.3	179.3	179.3
	Barton Stacey (includes Humbley Grove storage facility)	172.6	82.6	172.6	172.6
	Dynevor Arms	49	49	49	49
	Milford Haven	950	0	95	95
	Wytch Farm	3.3	3.3	3.3	3.3
South East	Bacton IP	1,297.80	1,020.59	1,181.82	1,181.82
	Bacton UKCS	485.60	0.00	0.00	0
	Isle of Grain	699.68	35.38	35.38	177.08

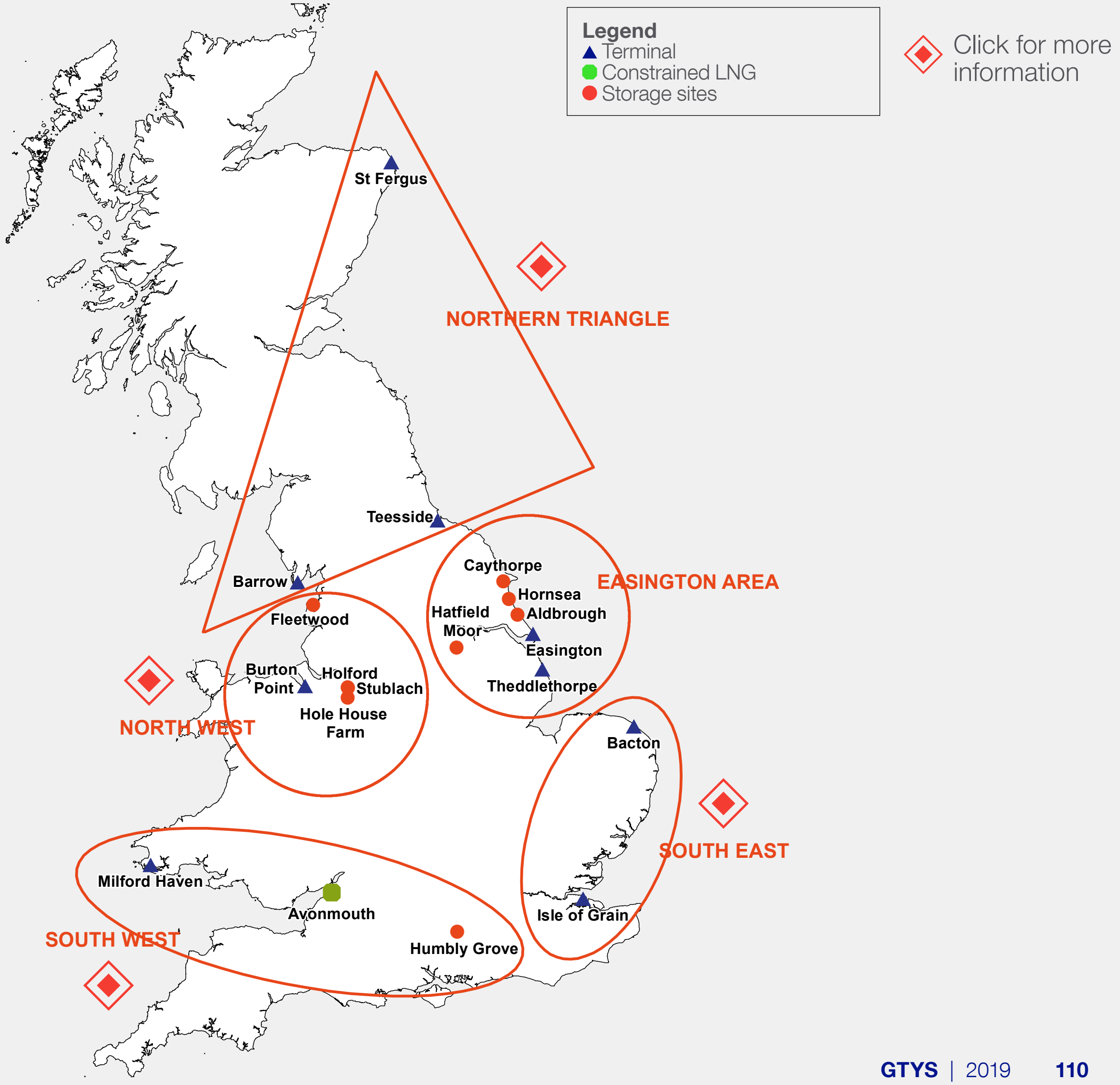
Appendix 6 – Exit and entry capacity application process

6.2 Entry capacity on the NTS

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

While all 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.

Figure A6.16
NTS entry capacity by zone



Appendix 7
Conversion matrix

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

Table A7.1
Conversation matrix

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

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

Appendix 8 – Import and storage infrastructure

8.1 Import infrastructure

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

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

Table A8.1
Existing import infrastructure

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

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

Table A8.2
Proposed import infrastructure*

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

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

Appendix 8 – Import and storage infrastructure

8.2 Storage infrastructure

In the last 12 months, no proposals have attained Final Investment Decision (FID) for subsequent construction. The following tables A8.3 and A8.4 detail UK storage in terms of existing storage sites, those under construction and proposed sites.

Table A8.3
Existing storage sites

Site	Operator/ Developer	Location	Space (bcm)	Approximate max delivery (mcm/d)
Aldborough	SSE/Statoil	East Yorkshire	0.2	31
Hatfield Moor	Scottish Power	South Yorkshire	0.07	2
Holehouse Farm	EDF Trading	Cheshire	0.02	0
Holford	E.ON	Cheshire	0.2	22
Hornsea	SSE	East Yorkshire	0.24	12
Humbly Grove	Humbly Grove Energy	Hampshire	0.3	7
Hill Top Farm	EDF Energy	Cheshire	0.06	14
Stublach*	Storenergy	Cheshire	0.22	18
		Total	**1.31**	**106**

*Current works at the site are expected to be completed in January 2020, which will increase space to 0.4bcm and max delivery to 30mcm/d

It is important to note that due to operational considerations, the space and deliverability may not be consistent with that used for operational planning as reported in the 2019–20 *Winter Outlook* report.

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

Appendix 8 – Import and storage infrastructure

8.2 Storage infrastructure

Table A8.4
Proposed storage projects*

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

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

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

Further information

Spotlight on Facilitating flexible connections for gas customers (page 16)

First NTS biomethane connection

To help us prove the new concepts from project CLoCC, 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 anærobic digestion plants, and is supported by CNG Services.

Since then we have been working with Biocow and CNG Services to develop the new connection for biomethane to enter the NTS, the first of its kind. This included allowing a more flexible oxygen specification using a new risk assessment. We are working towards the completion and commissioning of the project for 2019.

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 National Transmission System. 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. We will be working collaboratively with Biocow and CNG Services to learn from the implementation of the project and further review our policies and procedures in light of this new connection.

Fourdoun – First Compressed Natural Gas (CNG) connection

We have been working on a new connection in Scotland with Air Liquide and CNG Services which will be the first of its kind for the NTS (and for any other 75 bar transmission grid in the EU). This is a Compressed Natural Gas (CNG) Mother Station which will use gas from the NTS to fill trailers to deliver CNG to a whisky distillery. This is Europe's largest "virtual" pipeline, transporting gas to off-grid distilleries to support the transition from oil [used for raising steam in the boilers] to cleaner natural gas with a 30 per cent reduction in carbon emissions.

This is an exciting development as it is using the new concept of Self Build. Under this approach, the customer has been responsible for the design and build of the whole project including the NTS connection assets. In addition, following risk assessment, we were able to agree that there was no requirement for a remotely operable valve to be installed which helped to reduce the capital costs. This project has been able to accommodate a number of firsts in our approach to the connection, including reducing costs to the customer wherever possible.

This project is a trial and currently under commissioning (September 2019). Once the project has been approved for commercial go-live, we will conduct a lessons learned exercise with the project participants. Following this, we will review the potential benefits to customers from this approach and consider the technical and commercial aspects from a National Grid perspective in order to consider how this concept can be taken forward.

Spotlight on Bacton Balgzand Line (BBL) (page 18)

1. There were significant challenges for us to overcome.

There were operational, commercial and communication points to consider, as well as a potential challenge in managing the possible additional flow out from Bacton whist maintaining all our obligations to current connected parties in addition to meeting our own obligations.

Further information

2. We completed studies and network analysis to explore our ability to facilitate BBL's request.

We conducted a full Hazard and Operability study (HAZOP) of the assets, with BBL's cooperation, for physical reverse flow at the key operational Bacton site. We then carried out network analysis to determine the capacity we could offer.

3. We engaged with a wide range of customers and stakeholders to understand their views and priorities.

We worked collaboratively across all stakeholders including Ofgem, shippers, HSE and other connected parties through communicating via various channels including industry workshops.

Drivers of change
1.3 Customer needs (page 19)

Decarbonisation
Ready for decarbonisation includes a focus strongly on how the National Transmission System (NTS) will transport a blended mix of 'green' gasses and focus on future technology to better manage the assets we own.

Speed of decarbonisation
The speed of decarbonisation axis represents the take-up of low-carbon solutions driven by policy, economic and technological factors, and consumer sentiment. All scenarios show progress towards decarbonisation, with Community Renewables and Two Degrees meeting the 2050 target of an 80 per cent reduction in greenhouse gas emissions compared to 1990 levels.

Level of decentralisation
The level of decentralisation axis indicates how close energy supply is to the end consumer, moving up the axis from large-scale central to smaller-scale local solutions. All scenarios show an increase in decentralised production of energy compared with today.

Drivers of change
1.3 Customer needs (page 23)

Community Renewables
This scenario achieves the 2050 decarbonisation target in a decentralised energy landscape.

Consumer Evolution
This scenario makes progress towards decarbonisation through decentralisation, but does not achieve the 2050 target.

Two Degrees
This scenario achieves the 2050 decarbonisation target with large-scale centralised solutions.

Steady Progression
This scenario makes progress towards decarbonisation through a centralised pathway, but does not achieve the 2050 target.

Steady State
Steady State is one of the *Future Energy Scenarios*. Please see chapter 2.3.1 for more information.

Drivers of change
1.3 Customer needs (page 24)

Linepack swing
The range between minimum and maximum linepack in the NTS within a Gas Day. Linepack is the amount of gas within the National Transmission System at any time.

Further information

Drivers of change 1.5.1 IED (page 28)

St Fergus:
In 2015 two new electric VSDs were installed to deliver our obligation under IPPCD. We are currently in discussions with Ofgem to agree how to deliver our obligations under LCPD and IPPCD at St Fergus.

Kirriemuir:
In 2015, one new electric VSD was installed to deliver our obligation under the IPPCD.

Hatton:
In 2016, one new electric VSD was installed to deliver our obligation under IPPCD. We are currently in discussions with Ofgem to agree how to deliver our obligations under the LCPD at Hatton.

Aylesbury:
In 2017, CO oxidation catalysts were installed on exhaust stacks at Aylesbury to reduce CO emissions to deliver our obligation under the LCPD.

Warrington:
Based on the current *FES*, the Warrington compressor site is no longer required to support the NTS. Our business proposal online includes decommissioning this site.

Huntington:
For 2022, we are on schedule to deliver two new gas turbines at Huntingdon to deliver our obligations under the IPPCD.

Peterborough:
For 2022, we are on schedule to deliver two new gas turbines at Peterborough to deliver our obligations under the IPPCD.

Chapter 2 – Spotlight on Understanding the capability of our network (page 41)

Zones
Please note: it has been a conscious decision to keep utilising the existing zones within the capacity maps, instead of utilising the new network capability zones as described in chapter 2.6, in order to keep in line with existing processes.

System Operator capability 3.4 Developing our SO capability (page 52)

GCS
In July 2016 we replaced our core control room and support systems with the new Gas Control Suite (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.

Spotlight on RIIO-2 SO people capabilities (page 56)

Fit for the future
Fit for the future includes safeguarding and preparing our assets for the challenges in operating for the next 50 years and towards a decarbonised future.

Ongoing developments 4.5 Innovation (page 63)

Intrusion detection system
The threat of cyber-attacks on IT networks and operational technology is a growing challenge for all network operators. One measure that's used to good effect is intruder detection systems (IDS). Like a burglar alarm, they provide an early warning of cyber-attacks. However, because these solutions are aimed at large, centralised IT networks, they're incredibly expensive and can cost

Further information

more than £100,000. This puts them out of reach for smaller operational systems, such as our above-ground installations (AGI). These sites, which are found along the route of our cross-country pipeline, are managed remotely from our central control centre in Warwick using telemetry systems. With this project, we're exploring whether we can build a low-cost IDS solution that can be fitted to existing telemetry systems and give us an early warning if security at our AGIs is compromised. We've successfully built a platform that uses the Open Source Supervisory Control And Data Acquisition (SCADA) system we developed for our SCADA project to host the IDS. The next step is to engineer the platform so the IDS can work in tandem with our telemetry units. If we can do that, we'll be able to identify how serious an attack is likely to be and rank it accordingly. If it's a low-risk attack, we can balance that with the needs of the network and keep the gas flowing. If it's more serious, we can take appropriate action. This will help us focus on the most significant events and ensure our essential services continue to operate when the risk is low. The project will provide a strong case for using open source technologies and low-cost hardware to meet our cyber security needs. Where current solutions would cost £125,000 a site, our new system would cost a fraction of that – between £10,000 and £25,000. If successful, we'll roll out the solution to all our AGIs and promote its use across the distribution networks.

Overpipe geogrid protection against third party damage

Third party damage, caused by people digging or doing agricultural work near our network, continues to pose a significant threat to our gas pipelines. A single incident can put the safety of the public, contractors and our engineers at risk and cause significant disruption. Costs can easily run into the millions, especially if the pipeline has to be shut down while the damage is repaired. We're also finding more examples of reduced soil cover and shallower ditch crossings above our pipes, which only adds to the challenge. We've carried out a number of innovation projects to reduce the threat of third party damage. These include the development of low-cost plastic (PE) protection slabs and new in-line inspections that accurately measure soil depth. During research for these projects, we identified another potential solution – overpipe protective netting – which is used in parts of Europe. For this project, we put two versions of this protection mesh through their paces – a yellow warning mesh, designed to alert anyone working near our pipes, and a high-strength protection mesh, designed to restrict the digging capabilities of excavators.

To test the warning mesh, we installed it under half a metre of soil. Excavators weighing 15 and 22 tonnes then attacked it with their digger buckets from various positions. The high-visibility mesh not only provided an early warning to the driver, it survived attempts to lift and tear it. We installed the mechanical mesh 0.3m above a 12m length of 900mm diameter pipe and 0.8m below ground level. It successfully resisted attack from the excavators and the pipe remained undamaged. An additional benefit of the mechanical mesh is it's significantly cheaper than installing concrete slabs.

Our next step is to define types of high-risk areas where these new protection measures can be best put to use. Once we've done that, we'll update our standards so these innovative solutions can be rolled out on future projects.

Further information

Spotlight on Ongoing developments (page 64)

Decarbonised energy system
A decarbonised energy system includes working predominantly on hydrogen: how hydrogen will interact with the NTS, how trading could be managed and whether direct offtakes for hydrogen can support the transport and commercial market.

Appendix 3 – Connection and capacity application process (page 80)

Application to Offer (A2O)
Includes physical pipeline connections to the NTS (if required) for new connections, modifications and diversions.

Disconnection/ decommissioning
Follows the Application to Offer (A2O) process. Disconnection from the NTS covers the creation of a physical air gap and the removal of all assets.

Entry/Exit planning and advanced reservation of capacity agreement
PARCA – reserve unsold/ additional capacity and allocation.

Exit application windows
Unsold within baseline capacity – gas years y+1 to y+3.

Enduring annual NTS exit capacity
Ad-hoc – m+6 – Evergreen rights.

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). QSEC – Gas years y+2 to y+17.

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.

Gas shipper
(Signatory to the Uniform Network Code (UNC)), Capacity Rights to flow gas onto the system (short, medium long term).

Appendix 3 – Connection and capacity application process 3.2 Connecting and disconnecting to/from our network (page 81)

CSEPs
There are several types of connected systems 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.

Appendix 3 – Connection and capacity application process 3.3 NTS entry capacity (page 85)

Non-obligated basis
A non-obligated basis would mean the obligated capacity level would not increase for future auctions.

PARCA
More information on the PARCA Framework can be found in Appendix 3 chapter 3.6.

Appendix 3 – Connection and capacity application process 3.4 NTS exit capacity (page 87)

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

Further information

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 per cent of the baseline NTS exit (flat) capacity for the year in which the application is received or the application must exceed 1 GWh/day.

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. Successful applications submitted in the EAFLEC window (both increases and decreases) will be allocated on or before 30 September.

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.

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. Successful applications submitted in the AFLEC window will be allocated within ten business days of the application window closing.

Appendix 3 – Connection and capacity application process 3.6 PARCA framework (page 90)

Phase 0
Phase 0 is a bilateral discussion 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.

Phase 1
When National Grid receives 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.

We will explore a number of ways of delivering the requested 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 also release long-term NTS capacity through established UNC capacity auction and application processes. 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 the long-term NTS capacity processes. 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:

Further information

- 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. 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
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
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.

Appendix 5
6.2 EU activity (page 93)

Multiple stakeholders
These stakeholders have included: Ofgem, other Transmission System Operators (TSOs), European Network of TSOs for Gas (ENTSOG), the European Commission, the Agency for the Cooperation of Energy Regulators (ACER), Ofgem, the UK Government, and the wider energy industry.

Appendix 6 – Exit and entry capacity application process
6.1 Exit capacity on the NTS (page 96)

NTS exit 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 (GTYS)*.

Appendix 6
6.2 Entry capacity on the NTS (pages 107 and 110)

Northern Triangle:
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.

Further information

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.

South East:
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.

South West:
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.

North West:
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.

Glossary

1-in-20
The 1-in-20 peak day demand is a level of daily demand that, in a long series of winters, with connected load held at the levels appropriate to the winter in question, would be exceeded in 1 out of 20 winters, with each winter counted only once. The 1-in-20 peak day is calculated from a statistical distribution of simulated historical peak days. It is not the highest demand in the last 20 years, nor is it the demand that would be expected in the coldest weather experienced in the last 20 years.

Annual liaison meetings
These help us maintain a positive relationship with connected sites by formally meeting face to face for individually tailored operational discussions, including topics such as gas quality and maintenance.

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.

Annual planning cycle
National Grid commences its annual planning cycle after initial data has been gathered through the *Future Energy Scenarios* process. The data is used to compile long term supply and demand scenarios. The annual planning process will consider the capability that may be required to respond to entry and exit capacity signals from the market. National Grid will use detailed network models of the NTS under different supply and demand scenarios in order to understand how the system may behave under different conditions over a ten year planning horizon.

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 network 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.

ASEP
Aggregated System Entry Point.

Assured Offtake Pressures (AOPs)
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.

Assured Operating Pressures
Minimum pressures at an offtake from the NTS to a DN that is required to support the downstream network. AOPs are agreed and revised through the annual Offtake Capacity Statement process.

Bacton
Bacton manages a large volume of the nation's gas, and is a critical component of the gas transmission network now and going into the future. Bacton is a key dynamic swing node for a large subset of our customer base at an interdependent part of the network.

Glossary

In addition, Bacton bridges GB with EU via two interconnectors (BBL and IUK), and controls flows into the South East to ensure security of supply for London and the west–east transit route for LNG into Europe.

Baseline NTS entry capacity (obligated)
Defined by our Gas Transporters Licence.

Baseline NTS exit capacity (obligated)
Defined by our Gas Transporters Licence.

Best Available Techniques (BAT)
BAT assessments provide a balance between the costs to the operator against the benefits to the environment.

Biomethane
Whilst production of biomethane is growing rapidly worldwide, significant investment and innovation is still needed for it to become a major source of gas supply in the UK. The Chancellor's 2019 Spring Statement included new proposals to advance the decarbonisation of gas supplies by increasing the proportion of green gas in the grid, helping to reduce dependence on burning natural gas in homes and businesses. The consultation is expected to consider continued support for biomethane after funding for the Renewable Heat Incentive comes to an end in 2021.

Capacity substitution
Capacity substitution involves moving unused capacity from one or more system points to a point where there is excess demand.

This is intended to avoid the unnecessary construction of new assets. Exit Capacity Substitution is the transfer of unsold Non-Incremental Obligated Exit Capacity from one NTS Exit Point (the donor NTS Exit Point) to another (the recipient NTS Exit Point) where there is demand for Incremental Obligated Exit Capacity.

Constraints
A restriction affecting part of the system which results in the gas flows in that part of the system being limited.

Entry – where a pressure Terminal Flow Advice is in place at an ASEP and firm entitled flow rate is greater than the capability/TFA.

Exit – Failure (or forecast) to meet a required offtake pressure obligation. Either the User elects not to offtake gas at a pressure lower than obligated or NTS pressure so low that gas will physically not flow through offtake and down stream users affected or low pressure safety limit reached.

December 2017
The requirements for the MCPD are detailed in Pollution Prevention and Control (Scotland) (Amendment) Regulations 2017 that came into force 19 December 2017 and for England and Wales in the Environmental Permitting (England and Wales) (Amendment) Regulations 2018 that came into force 29 January 2018.

Discretionary – entry
National Grid can make additional interruptible entry capacity available to the market at its discretion.

Discretionary – exit
National Grid can make additional exit off-peak capacity available to the market.

ELVs
The ELVs are legally enforceable limits of emissions to air for IED chapter II and III units.

Glossary

Electricity Market Reform (EMR)
The Government's Electricity Market Reform (EMR) programme has the goal of ensuring adequate capacity within an electricity system, that in the future will rely increasingly on intermittent wind, and inflexible nuclear generation.

End of Gas Day
'End of day' refers to the end of the Gas Day at 5pm.

Exchange rates
The ratio between donated capacity to received capacity.

FES
As of 2019, the *FES* is now published as an Electricity System Operator (ESO) document. The ESO became a legally separate entity within the National Grid Group on 1 April 2019. Separating the ESO business from National Grid's Electricity Transmission Owner business provides transparency in our decision-making and gives confidence that everything we do will promote competition and is ultimately for the benefit of consumers. While the *FES* is an ESO publication, the analysis continues to consider the whole energy system – ensuring the implications for, and interactions across, electricity, gas, heat and transport are fully considered.

Funded incremental NTS entry capacity (obligated)
Firm capacity made available over and above baseline, in response to market demand and backed by User commitment.

Gas Control Suite (GCS)
In July 2016, we replaced our core control room and support systems with the new Gas Control Suite (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.

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.

Green gas
In the *FES* scenarios, 'green gas' is utilised to include both biomethane and bioSNG.

Hybrid heating system
An integrated system using a heat pump alongside a traditional installation such as a gas boiler to provide year-round efficient and flexible heating. A heat pump is a device that transfers heat energy from a lower temperature source to a higher temperature destination. A heat pump can be ground source or air source.

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.

Integrated
This integrated environmental approach means that emissions to air, water (including discharges to sewer) and land, plus a range of other environmental effects, must be considered together.

Integrated Pollution Prevention and Control Directive (IPPCD)
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.

Glossary

ISO55000 accreditation
ISO55000 is the international asset management standard against which we are audited. We endeavour to improve how we do asset management and use the standard as a framework. National Grid have been accredited for a number of years now.

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.

Non-obligated NTS entry capacity
At our discretion, we can release additional firm NTS entry capacity at an ASEP, over and above obligated levels.

Non-obligated NTS exit capacity
At our discretion, we can release additional firm capacity at an offtake point over and above obligated levels.

Notice periods
Notice periods are required to ensure that pressures can be maintained at times of system stress including high demand. Notice periods are typically defined as the number of hours' notice for increases of up to 25 per cent, up to 50 per cent, and greater than 50 per cent of maximum offtake rate.

Office of Gas and Electricity Markets (Ofgem)
A government body formed to promote competition and protect consumer interests.

Project CLoCC
Project CLoCC (Customer Low Cost Connections) has spent a total of £4.5m to simplify the process of connecting to the National Transmission System (NTS) for a new generation of gas customers, opening up the NTS to a wider range of gas sources from smaller and larger connections. The project has successfully delivered against its three objectives:

I. Creating an online connections platform to facilitate the customer experience. The goal of this workstream was to consider what elements of the current Application to Offer (A2O) process (a National Grid procedure specified within the Uniform Network Code) could be supported by development of an online gas customer connections portal and what functionality would be most beneficial to potential future customers.

II. Innovative physical connection solutions tailored to the needs of non-traditional NTS gas connections at high pressure. This workstream was tasked with completing a global technology watch, developing conceptual designs and conducting field trials of the proposed engineering connection solution(s).

III. Optimising commercial processes to meet the requirements of non-traditional NTS gas customers. Considering areas such as payment terms, fees and contract optimisation.

As a result of the project, we have demonstrated time and cost savings by considering the new Standard Design connection journey a customer follows and a number of customers have indicated they will be applying to National Grid for a Standard Design connection as the project is implemented.

Glossary

Project GRAID
Project GRAID (Gas Robotic Agile Inspection Device) has spent a total of £6.5m over the project lifecycle to design and develop a remotely operable robot that can be inserted into live, high pressure 100 bar(g), mild steel pipework systems to undertake both visual and physical inspection of the otherwise inaccessible buried sections of the system. The project has successfully delivered against its four main objectives:

I. To accurately and reliably determine the condition of high-pressure below ground pipework at above-ground installations (AGIs) using an internal inspection robot.

II. To generate a proactive, rather than reactive, risk based approach to the management and maintenance of ageing assets, based on the knowledge of the actual condition of pipework.

III. Minimise the occurrence of unnecessary excavations and eradicate premature replacement of assets, reducing significant carbon emissions and generating cost savings of circa £58m over 20 years.

IV. Minimise the likelihood of asset failure through proactive asset management, thereby significantly reducing the risk of a high-pressure gas release into the atmosphere and the consequential financial, environmental and reputational impact.

Following completion of the NIC project, we have begun an NIA project to assess the suitability of using Acoustic Resonance Technology (ART) sensors on the GRAID robotic platform, which would significantly improve the quality, quantity and speed of an inspection. This in turn will save money on site during the inspection and provide additional data which will strengthen the confidence in the assessment of the condition of the unpiggable pipeline.

Ramp rates
The rate at which the offtake of gas can be increased at the offtake.

Reinforcement
Reinforcement is the enhancement of network capability by building new or modifying existing assets.

Rolling monthly trade and transfer (RMTnTSEC)
The RMTnTSEC is held on a monthly basis at the month ahead stage. Any unsold quantities from Annual Monthly System Entry Capacity (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.

Shale
Future availability of UK indigenous shale gas remains highly uncertain. In July 2018, BEIS launched a consultation on including major shale gas projects in the Nationally Significant Infrastructure Project regime. The consultation recognised that the development of onshore gas resources could reduce UK reliance on imported gas and deliver substantial economic benefits to the UK economy, but relies heavily upon support from local communities. The proportion of people opposed to fracking reached its highest point since first surveyed, increasing from 35 per cent in December 2018 to 40 per cent in March 2019, and only 12 per cent of people support fracking, according to the BEIS public attitudes tracker.

Glossary

Shipper
A shipper is a company that transports gas through our network to gas customers.

Solidarity principles
The solidarity principles are the last element to be implemented and work is currently proceeding with BEIS and Ofgem (in conjunction with the Commission) for BEIS to fulfil this obligation.

Standard offtake pressures
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.

Substitution
Substitution involves moving unused capacity from one or more offtakes to a point where there is excess demand.

Third Energy Package
This was transposed into law in Great Britain (GB) by GB Regulations that came into force in 2011.

UKCS
Production from the UK Continental Shelf (UKCS) is in decline. In recent years, the discovery of new gas fields has resulted in a short-term increase in UKCS production. However, the challenges of decarbonisation are expected to reduce investment in exploration for new fields. Production from UKCS will therefore decline as existing fields are depleted, but not replaced.

UNC
The Uniform Network Code (UNC) forms the basis of the commercial rights and responsibilities of all providers and users of the NTS. It also gives all parties equal access to available transportation services.

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 per cent 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.

Use it or lose it (UIOLI) – exit
Any firm exit capacity that hasn't been used over recent days can be resold to the market as interruptible capacity.

Use it or lose it (UIOLI) – entry
Any firm entry capacity that hasn't been used over recent days can be resold to the market as interruptible capacity.

Index of links

Welcome

[1] https://www.nationalgridgas.com/insight-and-innovation/gas-ten-year-statement-gtys

Introduction

[1] https://www.nationalgridgas.com/about-us/business-planning-riio/how-were-performing

Chapter 1

[1] https://gas-connections.nationalgrid.com/CustomerPortal/#/landing

[2] https://www.nationalgridgas.com/document/128446/download

Chapter 2

[1] https://www.nationalgridgas.com/about-us/business-planning-riio/have-your-say-our-future-business-plans

Appendix

[1] https://www.nationalgridgas.com/connections/reserving-capacity-parca-and-cam

[2] https://www.gov.uk/government/publications/trading-gas-with-the-eu-if-theres-no-brexit-deal/trading-gas-with-the-eu-if-theres-no-brexit-deal

[3] https://www.gov.uk/government/publications/trading-gas-with-the-eu-if-theres-no-brexit-deal/trading-gas-with-the-eu-if-theres-no-brexit-deal

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