Gas System Operator

Gas Ten Year Statement 2021

nationalgrid

Gas Ten Year Statement 2021

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Welcome

How to use this document

We have published the 2021 *Gas Ten Year Statement (GTYS)* as an interactive document.

Home

This will take you to the home page.

Arrows

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

Enlarge/reduce

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

Glossary

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

'Linked' content

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

Welcome
to our 2021 *Gas Ten Year Statement*

We are in the midst of an energy revolution. The economic landscape, developments in technology and consumer behaviour are changing at a remarkable rate, creating more opportunities than ever before for our industry. Our 2021 *Gas Ten Year Statement*, along with our other Gas Transmission publications, aims to encourage and inform debate, leading to changes that ensure a secure, sustainable and affordable energy future.

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

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

In this edition of the *Gas Ten Year Statement* we have, for the first time, included a preview of the latest flow data for the next ten years, based on the latest *Future Energy Scenarios (FES)* data. These flows are set against the assessment of Network Capability which we published in June 2021. We hope that they will provide a platform for future development discussions, prior to the publication of the more definitive Annual Network Capability Assessment Report, in June 2022.

In 2021,we are in a position where we need to proactively consider how the National Transmission System (NTS) can support the transition towards a net zero future by working with projects and research that enable low carbon emission processes to develop.

However, at the same time, we need to meet the challenge of today's customers' needs which include providing a safe, efficient and reliable natural gas network. This creates a significant and interesting challenge between providing for the needs of today and preparing for a lower carbon future.

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

Ian Radley
System Operations Director

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Welcome

to our 2021 *Gas Ten Year Statement*

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

- All graphs and tables contained in 2021 *GTYS*
- Actual demand for 2020 (TWh)
- Peak day, maximum and minimum physical NTS entry flows for Gas Year 2020/21
- Peak day, maximum and minimum physical NTS exit flows for Gas Year 2020/21
- 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 2031
- 1-in-50 peak day undiversified demand per scenario out to 2031
- Peak and annual supply by terminal out to 2050
- ANCAR FES 2021 updated Entry and Exit Frequency Data.

Introduction

Introduction

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

The *GTYS* is published annually as part 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?

We are the operator and owner of the gas NTS in Great Britain. Our licence is established under the Gas Act 1986. It requires us to develop, maintain, and operate economic and efficient networks and to facilitate competition in the supply of gas in Great Britain.

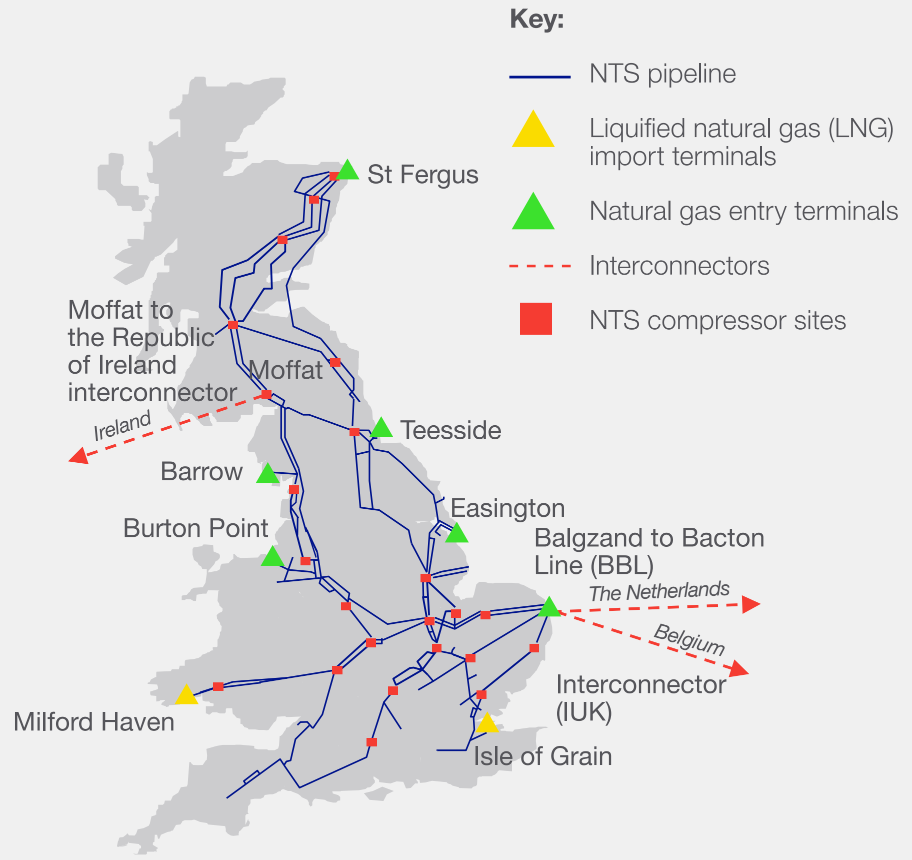
Our primary responsibility is to transport gas from supply points to exit offtake points safely, efficiently and reliably. We manage the day-to-day operation of the network. This includes maintaining system pressures with safe operating limits, ensuring gas quality standards are met and acting as the residual balancer for supply and demand when there is a market imbalance.

As the System Operator, we are responsible for identifying the long-term needs of the network. As Transmission Owner, we must make sure our assets on the NTS are fit for purpose and safe to operate. We develop and deliver effective maintenance plans and asset replacement schedules to keep the gas flowing.

Our network

The NTS plays a vital role in the secure transportation of gas and the facilitation of a competitive gas market. Our network includes approximately 7,630 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. At exit offtake points, gas is transferred to four distribution networks (DNs) for onward transportation to domestic and industrial customers, or to directly connected customers including storage sites, power stations, large industrial consumers and interconnectors.

Figure 0.1
The National Transmission System



Introduction
Key themes

The 2021 *Gas Ten Year Statement (GTYS)* provides an update on the current and future challenges which impact the way we plan and operate the National Transmission System (NTS). In addition, the *GTYS* outlines what we are doing to address them as the System Operator and Transmission Owner.

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

- customer needs
- asset management
- legislative change
- net zero by 2050.

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

Introduction
Key themes

Customer needs

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

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

Asset management

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

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

Introduction
Key themes

Legislative change

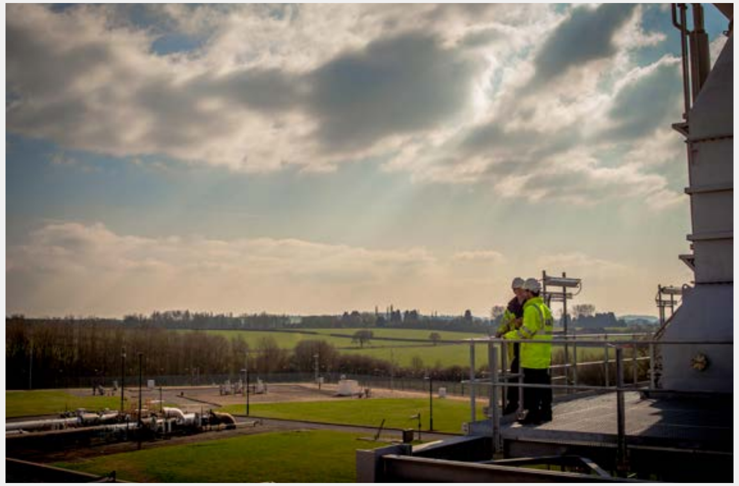
Legislative change plays a significant role in how we utilise our assets, plan and operate the NTS. Although we are no longer part of the EU, the EU Withdrawal Act 2018 ensures that existing EU environmental law will continue to have effect in UK law. The Industrial Emissions Directive (IED) is the mandatory minimum emission standard that all European countries must comply with by 2023. Work to ensure compliance will continue under RIIO-2 in accordance with Uncertainty Mechanism processes. Many of our smaller compression plants (thermal input <50MWth) are impacted by the Medium Combustion Plant Directive (MCPD), with compliance required by 2030. Again work will be progressing in RIIO-2 via Uncertainty Mechanism processes.

Following an Institute of Gas Engineers and Managers (IGEM) consultation in 2020 on a draft standard to amend the GB gas quality specification, IGEM submitted its proposal and evidence case to the Health and Safety Executive (HSE) for review. We currently expect that the proposed standard and other changes to Gas Safety (Management) Regulations 1996 (GS(M)R) will be subject to a government consultation and impact assessment process led by the HSE later in 2021. 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

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

We submitted our RIIO-2 business plan to Ofgem in December 2019 for the price control period 2021–2026. In this, we made some key commitments as part of our road map to net zero within our Environmental Action Plan. This plan spans five key areas with approximately 28 objectives to deliver for RIIO-2 and prepare us for RIIO-3. Our commitments in RIIO-2 are delivering emissions reduction programmes now, like gas turbine upgrades, electric vehicle roll-outs and own use renewable energy generation, whilst also continuing to investigate our emissions through innovation and investment to deliver future value.



Introduction
Key themes

Our key Gas SO publications

As part of our role as the Gas System Operator we publish a suite of documents during the planning process. The major documents that result are illustrated in figure 0.2. *FES* is produced by the Electricity System Operator (ESO), in July, and we are a major stakeholder in that process. The *GTYS*, published in November, details likely developments of the system over the next ten years. We engage stakeholders after its publication to gather their views. In June we publish the Annual Network Capability Assessment Report (ANCAR) in which we match the predicted future flows of gas against the physical ability of the network to undertake that task. We then engage with stakeholders on the ANCAR and the outputs from this work are fed back into the next *GTYS*.

Alongside these forward-looking documents, we publish the Gas Winter Outlook, Review and Consultation. These reports are designed to inform the gas industry of our view of security of supply for the gas system for the winter ahead, to review the previous winter and compare this to what was said in our forecasts.

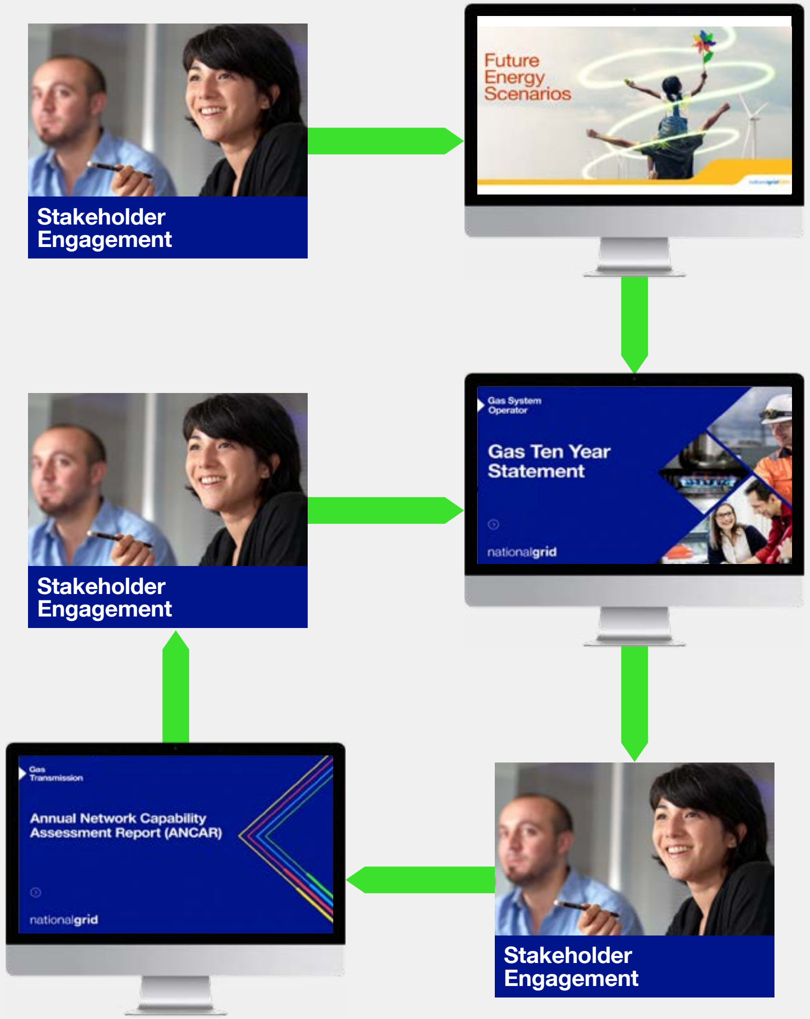
The Summer Outlook is also published to inform the industry and support its preparations for the summer ahead. The report presents our view of the gas system for April to September.

Every two years we publish the Transmission Planning Code that outlines the technical aspects, methodology and assumptions that we apply when planning the network. The next version is due in December 2021.

On an ad-hoc basis, we publish the Gas Future Operability Planning (GFOP) that describes how our changing customer and stakeholder needs may affect the future operability of the NTS. The GFOP acts as a vehicle for our customers and stakeholders to engage with us on topics exploring future operability challenges.

We continuously review the portfolio of Gas Transmission publications to ensure that they still meet regulatory and stakeholder needs whilst avoiding duplication.

Figure 0.2
The major publications in our annual planning process



1 Drivers of change

Drivers of change

1.1 Introduction

This chapter describes the drivers of change that can trigger stage 1 of our Network Development Process (NDP) (figure 1.1).

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

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

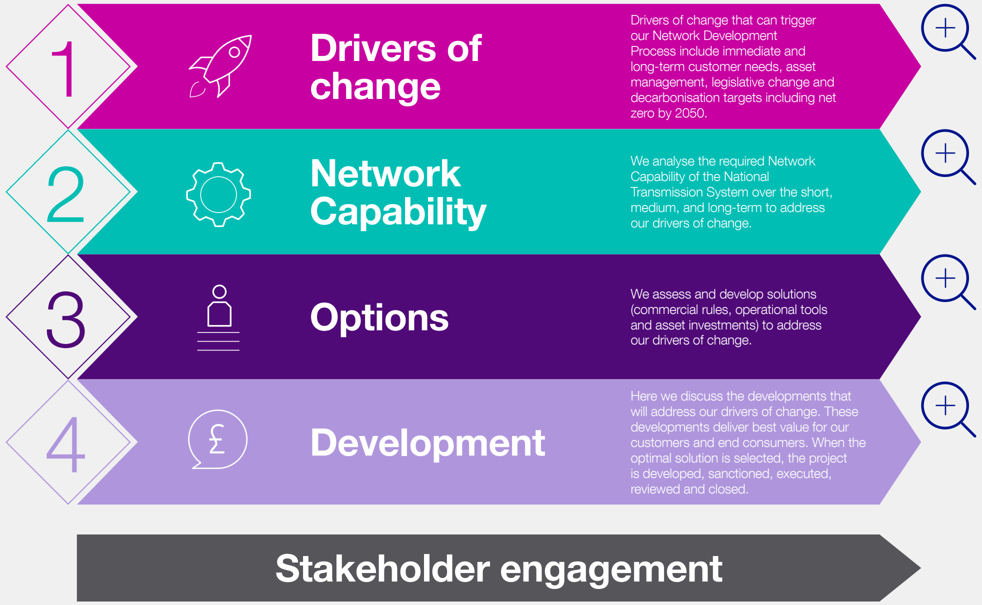
In this chapter we describe the drivers of change that can trigger stage 1 of our NDP. The chapter on Network Capability looks into how we analyse and assess the network to address these drivers. In subsequent chapters we describe projects which are currently in progress, with details of the drivers which triggered the projects together with information on progress against the NDP.

In summary, the drivers of change chapter focuses on the external stimuli that trigger the beginning of the NDP process. Network Capability looks into how we analyse and assess the network to address these drivers. Option Assessment relates to how we aim to develop solutions looking at rules, tools and asset solutions. The development stage of the NDP details solutions that have been identified as the preferred option to meet our stakeholders' needs.

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

- **Customers' immediate and future needs**
- **Asset management**
- **Legislative change**
- **Net zero by 2050**

Figure 1.2
Our Network Development Process



Drivers of change
1.2 Customer needs

Our 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 NDP. We need to assess what impact a connection (new or modified) or capacity change (supply or demand increase/decrease) will have on our current Network Capability and our operational strategies.

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

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

1.2.1 Connection and capacity application processes

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 4 and appendix 6.

If you have any queries about our connections or capacity processes please contact the Gas Connection Contracts team directly, you can find their contact details in appendix 5.

1.2.2 Western gas network (WGN) project

In 2018 a PARCA application was received for the Milford Haven Aggregated System Entry Point (ASEP). The application was to increase the current entry baseline from 88 mcm/d to 103 mcm/d. The impact on our Network Capability of the application is detailed here.

Drivers of change
1.2 Customer needs

1.2.3 Evolving our connections process
Historically, connection requests to the NTS were required to support typically large-scale entry and exit connections or facilitate storage. However, more recently, we have connected customers with 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 budget.

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 greener gas sources, for example, biomethane and hydrogen.

You can find out more information on where you can connect by viewing our new online NTS Gas Connections Portal.

Future developments for gas connections

Spotlight

We are always looking for opportunities to evolve the connection process to the National Transmission System (NTS) for our customers with the objective of being more efficient and improving on our commercial and engineering solutions.

The Gas Connection Portal enables customers to register to generate cost estimates and apply for a gas connection online. We have seen lots of interest in the use of the portal, and we currently have over 100 companies registered.

We have a number of potential new connections being considered, including interest from hydrogen and biomethane projects, and we are looking to continually evolve our processes by learning from projects we have delivered. This will include reviewing the services we offer to our increasingly diverse customer base and our costs on a regular basis. We held a customer connections webinar in May 2021 to gain more insight into what our customers want from our connections and future developments they would value.

Some developments we are currently progressing for the connections process are as follows.

No remote operable valve (ROV) at entry points

Building on removing the requirement for an ROV at new exit points modification, we are progressing a change to our approach at new entry points, to move to a risk-based process in a similar way. A UNC modification (0771S) is in progress to facilitate this change. It is estimated that this could save around 30 per cent on the cost of connecting a small entry project.

Self-lay

We have completed our first trial "self-lay project" where a customer completed their own connection to the NTS. We are now developing what we are able to offer customers in the future.

Customer-appropriate deviations

Listening to our recent connection customers we are building on the work so far to facilitate deviations to our policy and standards. We are considering how we can build this into our processes and shape our decision making to be more adaptive by potentially having some appropriate pre-approved deviations.

4G communication

Based on feedback from our previous trial projects we are continuing to use 4G communication solutions on several projects which result in large savings for the customer in avoided initial cabling costs and lower ongoing rental charges. Feedback in this area has been positive.

As the decarbonisation journey progresses, we will be looking at how to best facilitate new customers onto our network. For more information on gas connections, please contact the Gas Connections Contract team at Box.UKT.customerlifecycle@nationalgrid.com or via our website.

View our interactive Connections Flyer: Benefits of connecting to the NTS.

Drivers of change
1.2 Customer needs

1.2.4 *Future Energy Scenarios*

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

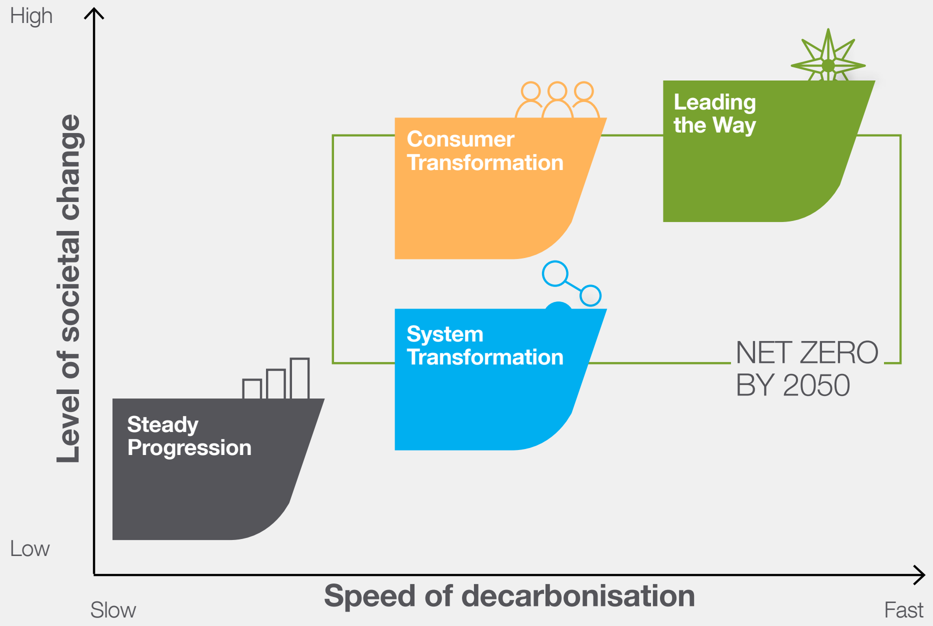
The *FES* are produced each year to identify a range of credible scenarios out to 2050 (figure 1.3). These scenarios consider how much energy might be needed and where it could come from. They look at what the potential changes over this time period might mean for the industry and for its customers.

The high-level scenario framework used in 2020 *FES* is unchanged for 2021 *FES* – with axes of "Speed of decarbonisation" and "Level of societal change" retained.

In the *GTYS* we only show the latest *FES* results as far as 2031* instead of 2050, as this period is of the greatest relevance to decisions that need to be taken on the gas network today. *GTYS* does not repeat *FES*, it instead uses the comparison between now and 2031 to highlight how key potential changes to gas supply and demand over the next decade could impact the gas transmission system.

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

Figure 1.3
The 2021 *FES* scenario framework



Drivers of change
1.2 Customer needs

1.2.5 Gas demand

Figure 1.4 shows a comparison of gas demand by scenario between 2020 and 2031. The following paragraphs detail the consumer choices and technological developments that influence the composition of GB gas demand for each *Future Energy Scenario* for 2031.

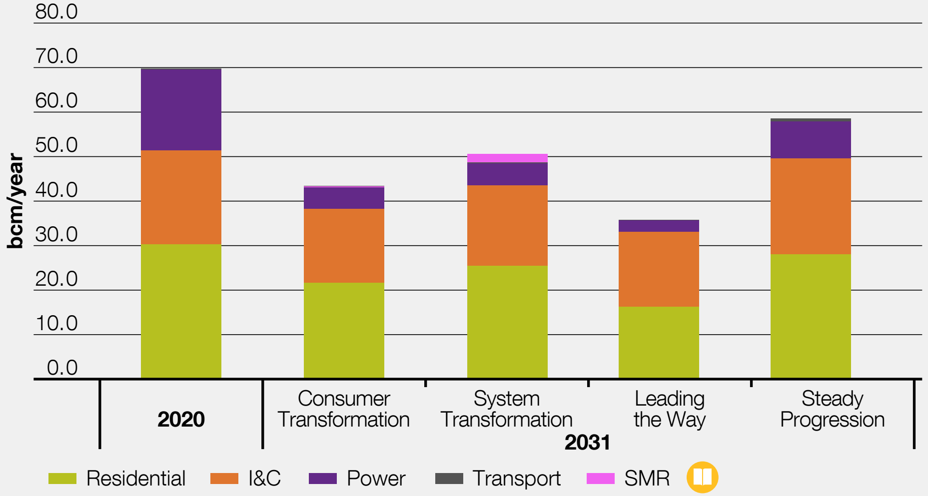
Consumer Transformation, a more electrified scenario, sees residential natural gas demand decline as homes become more thermally efficient and electric heat pumps start to replace gas boilers. This is alongside increased levels of energy efficiency and electrification in the Industrial and Commercial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

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

Leading the Way sees the quickest and largest reduction in natural gas demand of the four scenarios. This scenario will move to more hybrid solutions for heating (e.g. electric and hydrogen hybrids) in the years beyond 2031, with any hydrogen used being produced from electrolysis.

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

Figure 1.4
Comparison of gas demand by *Future Energy Scenario* between 2020 and 2031



Drivers of change
1.2 Customer needs

1.2.6 Peak daily demand

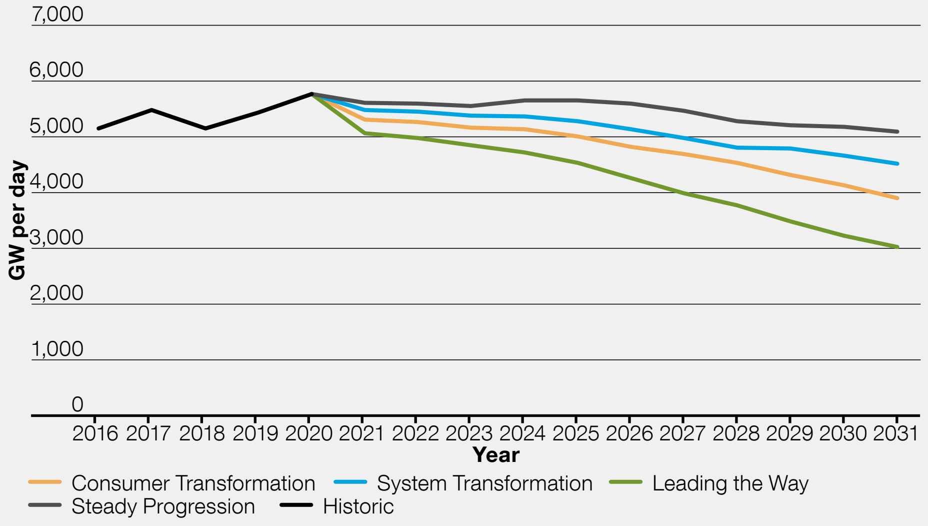
Gas peak day (1-in-20) demand is illustrated in figure 1.5.

Trends in peak natural gas demand generally mirror annual natural gas demand in each scenario, as many of the factors which influence annual demand also influence peak demand, but the declines are not as rapid. On cold winter evenings peak demand will continue to be high while large numbers of homes still rely on gas boilers. As the heat sector decarbonises in the net zero scenarios, with greater use of heat pumps and hydrogen boilers, the peak demand for natural gas will reduce.

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

The 1-in-20 peak demand projections are slightly lower than in last year's report, largely due to a reduction in the gas demand for power generation. We have undertaken a statistical analysis of the correlation between the demand for power generation and other demand which showed little correlation between the two. As a result we have amended the 'gas for power' element of our overall 1-in-20 demand calculations.

Figure 1.5
Peak demand 1-in-20



Drivers of change
1.2 Customer needs

1.2.7 Gas supply

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

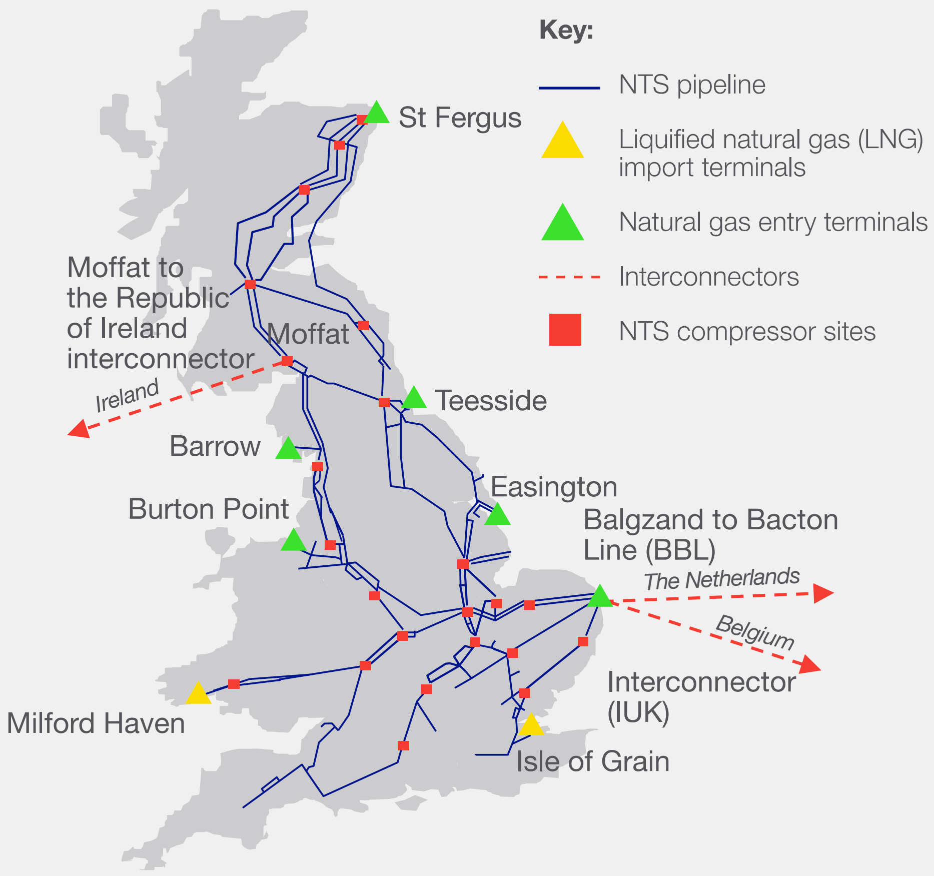
Over the past two decades, the UK has transitioned from being self-sufficient in gas (delivered from the UKCS) in 2000 to being dependent on imported gas for 57 per cent of our gas demand by 2020. On the following page, figure 1.7 shows a comparison of the UK's gas supply composition between 2020 and 2031 for each *Future Energy Scenario*. The current and potential sources of indigenous gas in the UK include:

- UK Continental Shelf (UKCS)
- Shale
- Biomethane

As the import dependency has increased, the use of the network has changed. The majority of the UKCS supplies were found on the east coast and in the north of the country. The reducing supply levels in the north led us to make the decision to reduce our capability to move gas from the north to south, with compression at Moffat and Warrington compressor stations being decommissioned during RIIO-2. This decision was supported by Ofgem reducing the St Fergus and Theddlethorpe baselines as part of the RIIO-2 Final Determinations.

We are now seeing a greater need for the compression that supports the flexible supply import terminals in the south at Bacton, Isle of Grain and Milford Haven. With some of the compression supporting these terminals impacted by emission legislation, it is critical we retain the correct level of Network Capability going forward.

Figure 1.6
NTS gas supply terminals



Drivers of change
1.2 Customer needs

1.2.7 Gas supply (continued)

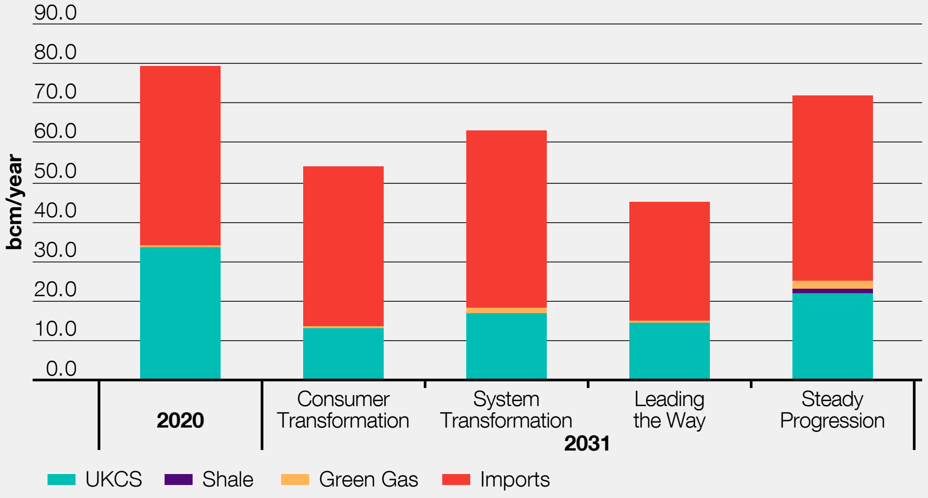
In **Consumer Transformation** (CT), the lower demands for natural gas start to necessitate more flexible supply and so this scenario sees the lowest level of supply from UKCS. This also corresponds to the highest proportion of import dependency across the scenarios.

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

Leading the Way (LW) has the lowest natural gas demand of the four scenarios in 2031 due to earlier decarbonisation and any hydrogen being produced derives from electrolysis rather than methane reforming. However, it sees a relatively slower UKCS decline than Consumer Transformation and so the import dependency is less.

Steady Progression (SP) has the highest demand for natural gas across the scenarios, due to slower decarbonisation, and the supply mix is the closest to today. It is the only one of the four scenarios not to reach net zero by 2050. UKCS supplies at 2031 are also highest in this scenario. There is a higher proportion of green gas supplied than the net zero scenarios where bio resources are valuable for meeting hard-to-decarbonise demand and for use in negative emissions technologies. Indigenous shale gas enters the supply mix in the early 2030s which helps to mitigate the risk of import dependency.

Figure 1.7
Comparison of gas supply by scenario between 2020 and 2031



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1.2.8 Peak supply

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

In figure 1.8 we show the margin of supply over peak demand under N-1 conditions. The figure shows that supply capacity exceeds peak demand in all scenarios out to 2050.

1.2.9 Scotland 1-in-20

In RIIO-1 we secured funding to ensure we can continue to meet our exit requirements in Scotland. The funding is to improve our Network Capability to move gas supplies from the south into Scotland and is required due to forecast declining entry flows into the St Fergus terminal. This capability has not been required in the past due to the high levels of supply from the terminal.

Figure 1.9 shows how the forecast peak day flows have changed between the 2020 and 2021 *FES*. The impact this has on our Network Capability is detailed in chapter 2 and can be found here.

Figure 1.8 Figure 1.9

Figure 1.8[1]
Peak supply margin under N-1 conditions

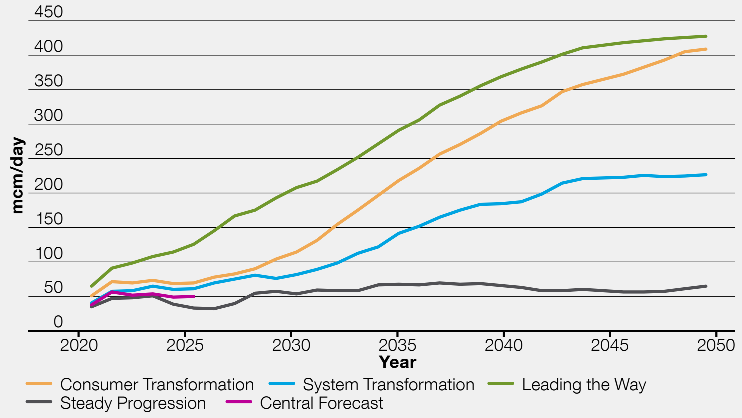
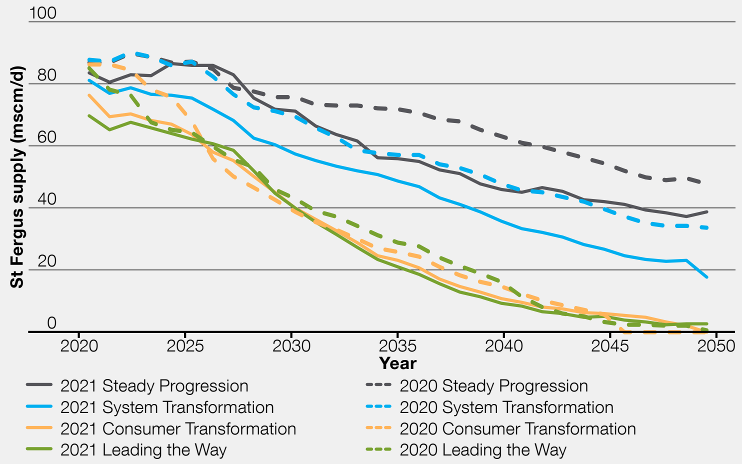


Figure 1.9
Peak day St Fergus comparison



1. The quoted numbers differ from those seen in the Winter Outlook publication due to a known Network Capability constraint being factored into the calculation for that document. The calculation in the *GTYS* has been completed in line with methodology set out in EU Regulation 2017/1938.

Drivers of change
1.3 Asset management

The NTS is ageing, and this means that managing our asset health is becoming an increasingly important driver of change and trigger for our Network Development Process. In 2020/21 we successfully delivered the majority of our planned asset health investment despite the impact of Covid-19. Our RIIO-2 Final Determination allows for investment of over £700m (subject to Uncertainty Mechanisms) on asset health over the next five years, which is 40% greater than our annual asset health investment from RIIO-1.

The NTS comprises approximately 7,630 km of pipeline, 24 compressor sites with 68 operational 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, a significant proportion of our network is now beyond its original life expectancy. 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 lifecycles. 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.

Our new monetised risk-based approach to investment planning has been central to the asset health element of our RIIO-2 business plan which identifies an increase in asset investment expenditure from our RIIO-1 levels of spend, driven by an increased volume of work to maintain current levels of network risk on our ageing asset base.

To provide further information, figure 1.10 describes the measures of risk that comprise our monetised risk-based asset management approach. This framework, now called Network Asset Risk Metrics (NARMs), is being used to consistently assess and prioritise all asset health investment on the gas NTS and ensure that we deliver work that is beneficial to our customers and stakeholders. For more information see section 3.4 Developing our asset management approach, here.

Figure 1.10
Measures of risk

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

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Drivers of change
1.4 Legislation change

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

1.4.1 Emissions directives, IED and MCP

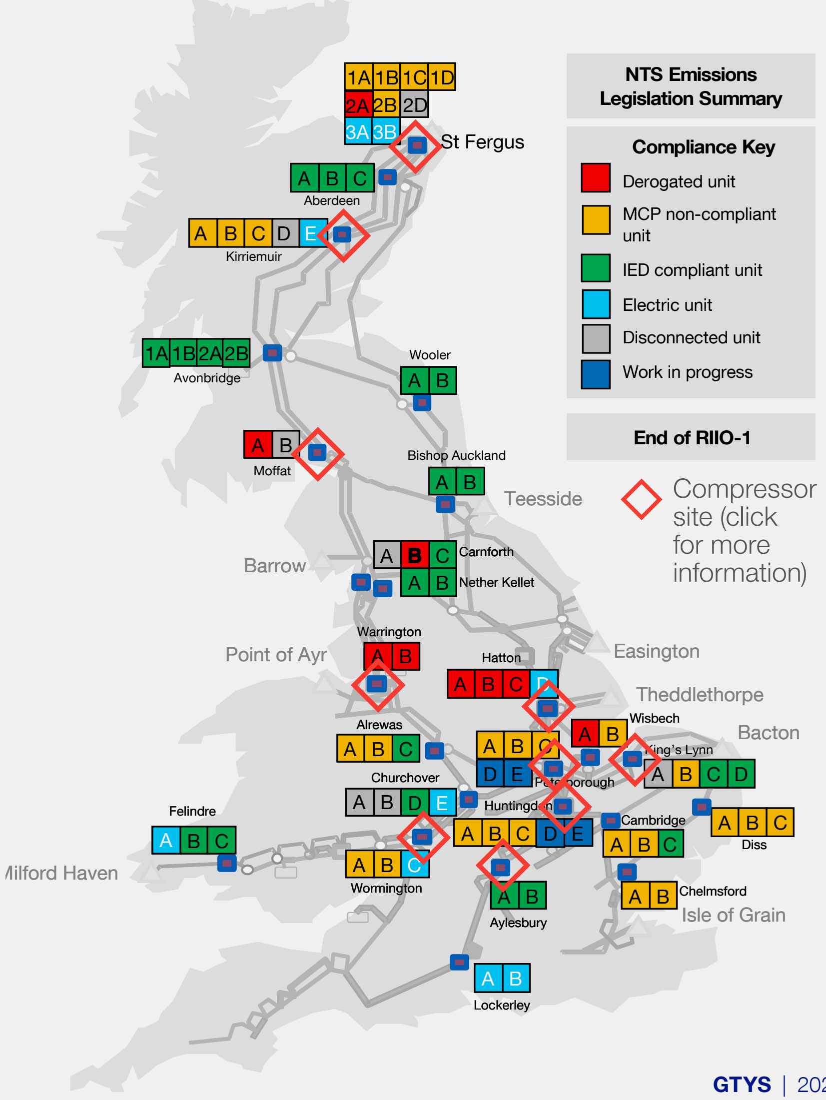
The Industrial Emissions Directive (IED) is the biggest change to environmental legislation in over a decade and consolidates several European emissions-related directives. These include the Integrated Pollution Prevention and Control Directive (IPPCD) and the Large Combustion Plant Directive (LCPD).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

The IED forms the new mandatory minimum emission standards that all European countries must comply with by 2023 and came into force on 6 January 2013. The IED heavily impacts our current compressor fleet (figure 1.11) with implications for everyone who relies on the NTS.

The Medium Combustion Plant (MCP) 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.

IED and MCP are discussed in more detail in subsequent chapters.

Figure 1.11
Impact of the IED on our current compressor fleet



Drivers of change
1.4 Legislation change

1.4.2 NTS cyber and external threats

The Network and Information Systems (NIS) Directive came into force in the UK on 10 May 2018 to co-ordinate and raise overall levels of cyber security across the European Union (EU).

As part of our programme of cyber-security investments, we have continual close engagement with Ofgem, BEIS and the National Cyber Security Centre (NSCS). As we are an operator of Critical National Infrastructure (CNI), we are increasing our cyber resilience in a proportional manner as part of our RIIO-2 business plan submission and in accordance with the Cyber Assessment Framework (CAF). For more information see chapter 3.

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Drivers of change
1.5 Net zero

The UK was the first major economy to set a legally binding target of net zero by 2050. Natural gas today plays a key role in the energy landscape. Today, gas delivers three times as much energy as electricity; it keeps 85 per cent of the UK's 28 million homes warm and comfortable, generates electricity and fuels industrial and manufacturing processes.

Alternatives to natural gas like hydrogen need to be considered if we are to reach net zero by 2050. Hydrogen, when burned, emits water only as a by-product, unlike natural gas which releases harmful carbon emissions into the atmosphere. Across all credible *Future Energy Scenarios*, hydrogen will play a crucial role in the future energy mix and will be required to decarbonise heat, transport, industry and power.

Since the publication of 2020 *GTYS*, the policy landscape has evolved significantly showing the Government's ambition on the role of hydrogen in the energy transition. A few of the policies published include the Prime Minister's Ten Point Plan for a Green Industrial Revolution, the Energy White Paper and the Climate Change Committee's (CCC) 6th Carbon Budget. Some of the key points are noted in the timeline (figure 1.12). Following extensive consultation with stakeholders we have also published our Hydrogen RoadMap to 2050 showing a potential timeline in the journey to net zero.

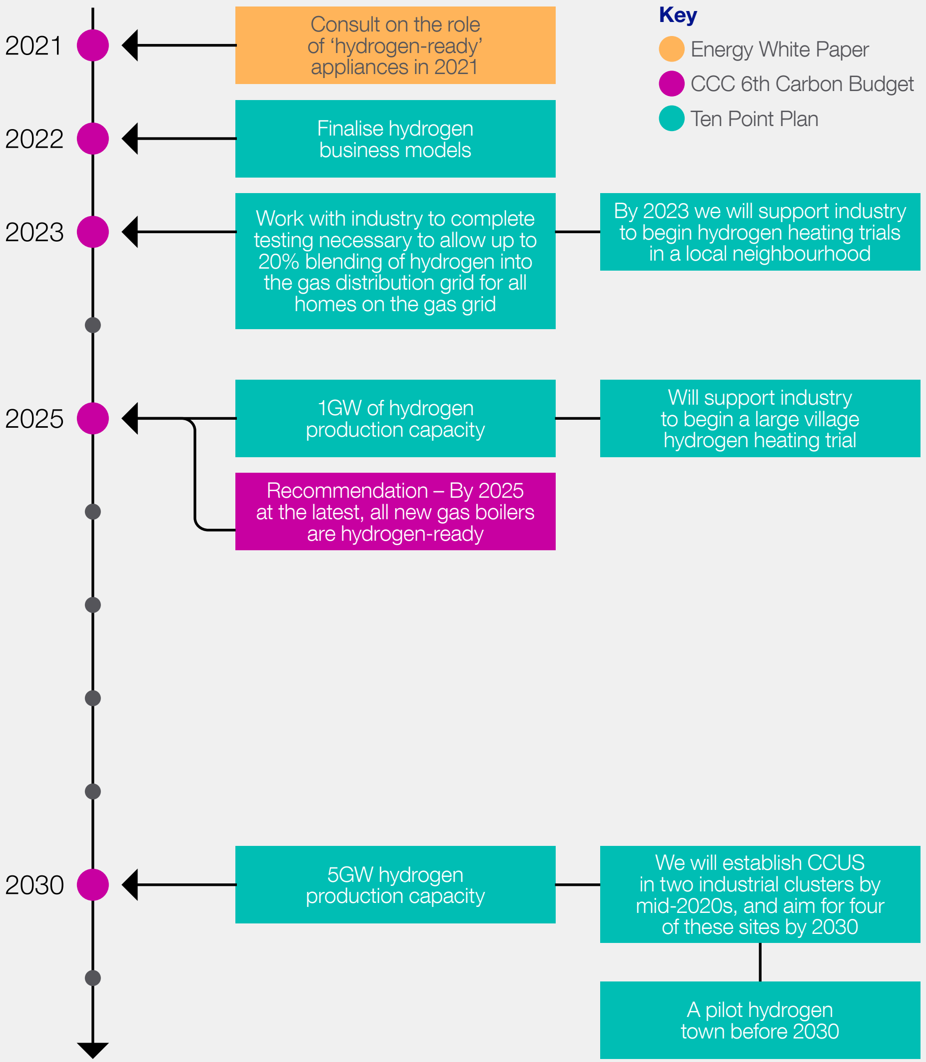
This year we saw the UK Government pass into law a new ambitious target to reduce emissions by 78 per cent by 2035, in line with the recommendation from the CCC. The new interim target and announcements from policy are positive steps to make sure the UK is on track to reach net zero. It is also a vital step to ensure the efforts of the Paris Agreement, a legally binding international treaty on climate change, are met. Its goal is to limit global warming to well below 2 degrees Celsius, preferably to 1.5 degrees Celsius, compared with pre-industrial levels.

Throughout 2021 and ahead of COP26, we have seen the publication of further policies including the UK Hydrogen Strategy, the Heat and Buildings Strategy and the Net Zero Strategy. These policies will assist in informing our programme of work for hydrogen. For more on net zero see chapter 3, here.

Government policy documents:

Energy White Paper | **CCC 6th Carbon Budget** | **Ten Point Plan**

Figure 1.12
Key hydrogen targets and actions from government policy documents



Drivers of change
1.5 Net zero

1.5.1 Innovation

Innovation is one of National Grid Gas Transmission's stakeholder priorities, supporting our business to deliver gas reliably and safely to our customers. The future of our network depends on finding a suitable 'green' alternative to natural gas that will continue to deliver heat and power to homes, businesses and industry. That's why innovation activities that focus on achieving net zero are central to our work.

The three RIIO-2 innovation themes are:

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

These focus not only on improving the efficiency of our day-to-day activities, but also on considering the future technologies that could be used to help us meet our objectives.

Drivers of change
1.5 Net zero

1.5.2 Gas Future Operability Planning

In addition to using *FES* data as the starting point for all of our network analysis, we also use *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 utilise the GFOP as a vehicle for our customers and stakeholders to engage with us and explore solutions to potential operability challenges on the NTS considering commercial options (rules), operational arrangements (tools) and physical investments (assets).

Drivers of change
1.5 Net zero

1.5.2.1 Hydrogen blends in the NTS

We recently published our latest GFOP, exploring the impact of potential hydrogen blends on the NTS in terms of the penetration into the network for different scenarios. We investigated the impact of the different blend scenarios on the NTS from theoretical hydrogen supplies at Bacton and St Fergus. We explored terminal injection blend percentages of 2, 5 and 20 by volume at each of the two terminals. We assessed the impact of users that engage in deblending activity on the blend percentages in the NTS.

The key messages are:

- The distance of penetration in the network is consistent regardless of the start percentage of the hydrogen blend injected into the network.
- Changes in the blend levels are dependent on the operating strategy and flow levels from terminals without a hydrogen blend.
- Maintaining a consistent entry blend could be a challenge if hydrogen production is static throughout the year. However, we believe hydrogen storage and adapting production profile are options that could be considered.
- In the case of deblending, re-injection of deblended hydrogen into the NTS could lead to localised higher concentrations of hydrogen. However, we believe there are many pathway options for deblended hydrogen asides re-injection back into the gas network.

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

Engage with us

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

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

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

2 Network Capability

Network Capability

2.1 Executive summary

This chapter explores the second stage of our Network Development Process (NDP) (figure 2.1). Here, we give details of how we use the Network Capability process to support our decision making process.

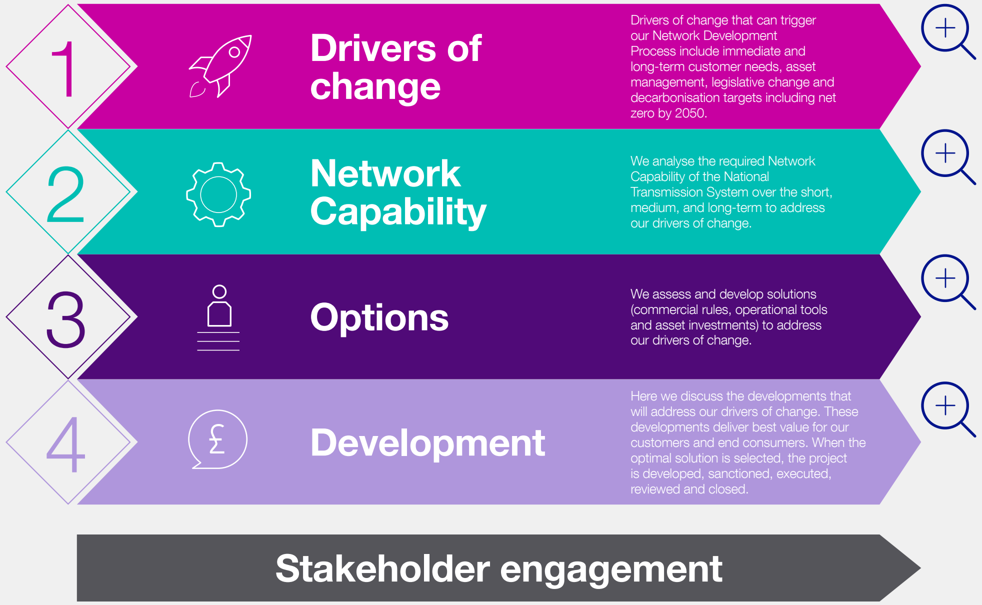
The capability, and the development, of the NTS is managed through the Network Development Process. This chapter describes how we analyse and assess the required capability of the NTS to address the drivers of change.

Last year we introduced a new way of sharing our Network Capability metric, aiming to increase the visibility and transparency of this process. This included the publication of the Annual Network Capability Assessment Report (ANCAR) Annex in February 2021 and subsequently in June 2021 we published the first edition of the ANCAR publication.

This year the ANCAR Annex is incorporated into this *GTYS* publication in appendix 4. In this section we will focus on the Network Capability requirements to meet the drivers of change.

In the next chapter, we discuss how we develop options once we have determined the capability that is required to fulfil the drivers of change, with details of the progress of current projects.

Figure 2.1
Our Network Development Process



Network Capability
2.2 Introduction

Network Capability refers to the process refined by National Grid during the RIIO-2 business planning process. It enables us to calculate and demonstrate the physical capability of the NTS and how that capability compares to the needs of our customers, now and into the future. This assessment is carried out against a range of future supply and demand scenarios using the *Future Energy Scenarios* (*FES*).

From 2021 we now publish an Annual Network Capability Assessment Report (ANCAR) in June of each year. The document includes information, at entry and exit zone level, on both the level of physical Network Capability and also the level of Network Capability that can be delivered using commercial tools. Included is an explanation of the changes to the level of physical Network Capability levels resulting from changes to the installed operational assets and a view of the required level of Network Capability in 10 years' time.

As part of our continual engagement, we present an initial view of Network Capability within the *Gas Ten Year Statement*. This view is based upon last year's Network Capability analysis superimposed upon this year's *FES* flow predictions. This allows early sight of any significant changes since last year's *FES* that could impact our investment decision, and of any new capability requirements.

Within this chapter we will discuss, in detail, some of the entry and exit zones which will require investment to maintain or improve our current Network Capability. All other exit and entry zones are shown in appendix 2.

Network Capability
2.3 Capability zones of interest

2.3.1 Scotland and the North (Zone 1)

Figure 2.2
Scotland and the North zone

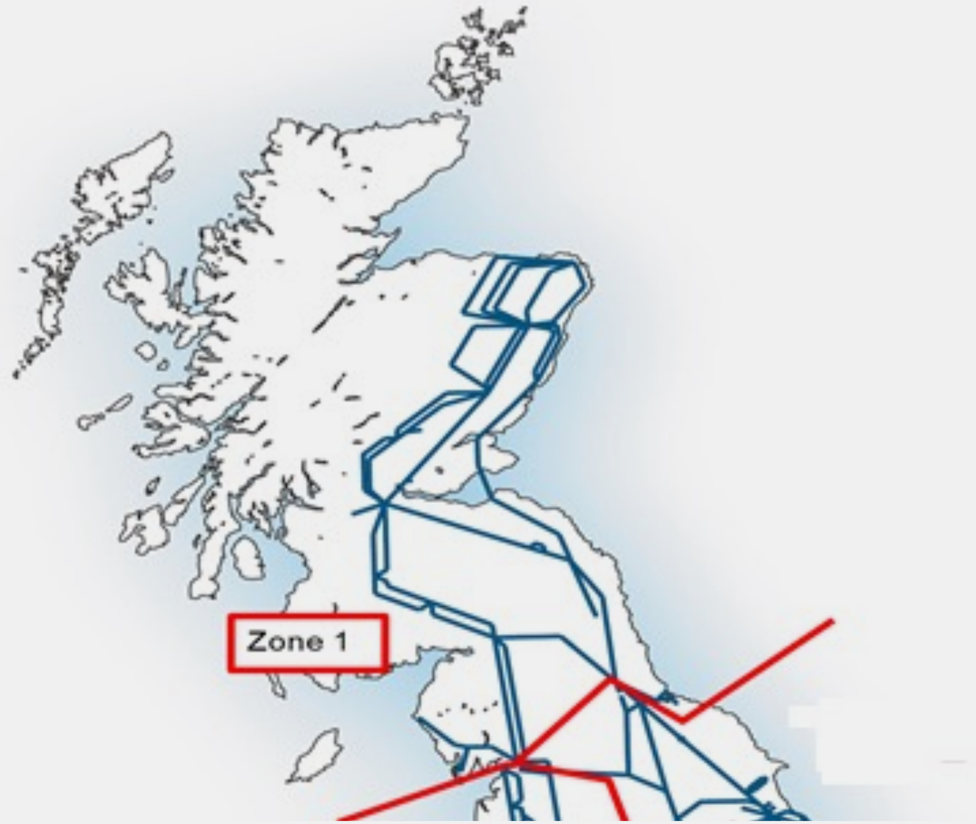
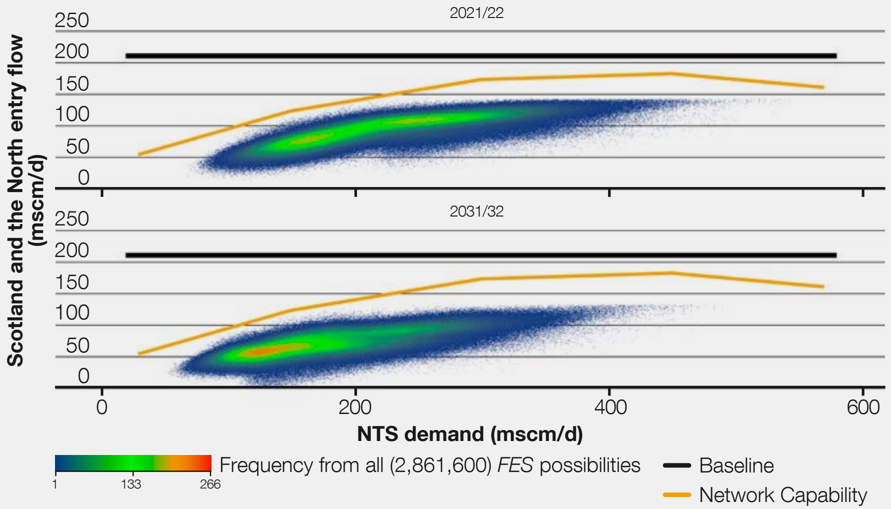


Figure 2.3 shows that we have sufficient entry capability in the zone over the next 10 years.

Figure 2.3
Scotland and the North entry heatmaps for 2021/22 and 2031/32



Network Capability
2.3 Capability zones of interest

2.3.1.1 Scotland 1-in-20

With the network having limited capability to transport gas from south to north the decline in entry flows will make it difficult for us to meet our exit commitments in Scotland. To assess the required capability, we need to review just the supplies from the St Fergus terminal against the demand in Scotland. This is because we have no compression capability to move the supplies from Teesside or Barrow towards the areas of high demand in the zone. Figure 2.4 shows that in 2031/32 we still expect the maximum flow through the terminal to be consistent to today, but there are now a number of scenarios with very low or zero flow. A number of these are beyond our current levels of capability and would lead to constraints on the system without intervention.

The options to ensure we continue to meet the 1-in-20 design standard are detailed in section 3 here.

2.3.1.2 MCPD – St Fergus

The St Fergus terminal receives gas from three sub-terminals (currently owned by Ancala, Shell and North Sea Midstream Partners (NSMP)/Gassco). Uniquely on the NTS, National Grid provides 24/7/365 compression services for gas received from the NSMP terminal under the terms of the Network Entry Agreement (NEA).

There are nine units across three current compressor plants at St Fergus. The bulk of the compression is provided by two electric variable speed drive (VSD) compressor units which were commissioned in 2015. The remaining seven are gas powered compressors from the original site (commissioned in 1978) on Plants 1 and 2 and are not compliant with emissions legislation. These compressors currently provide: the low flow capability, back up to the VSDs bulk flow and high capability when used with the VSD compressors.

Figure 2.5 shows that the range of flows thorough the NSMP sub-terminal are consistent in 2031/32 to those seen today. However we do see the frequency of higher entry flows reduce.

Figure 2.4 Figure 2.5

Figure 2.4
Scotland exit heatmap for 2021/22 and 2031/32

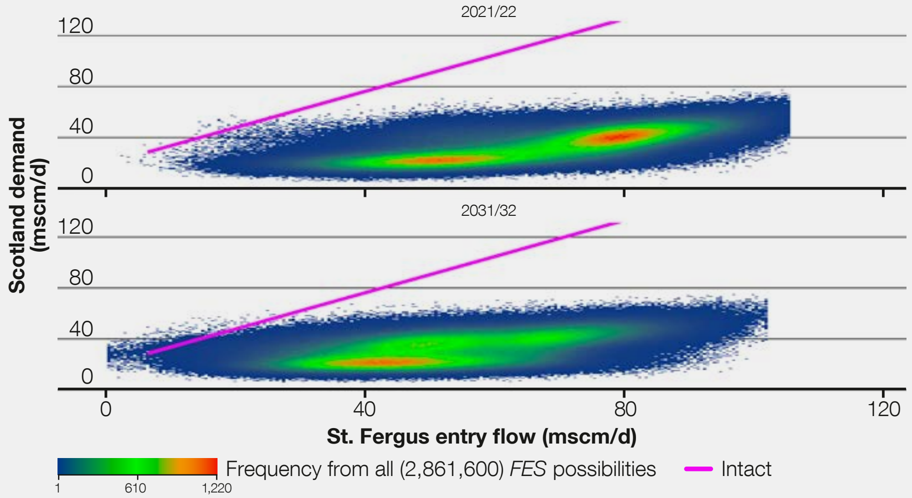
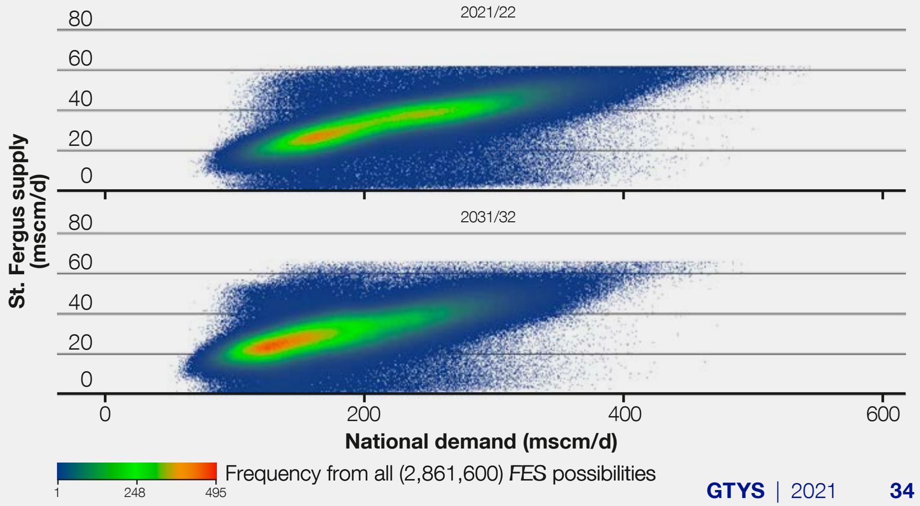


Figure 2.5
Scotland NSMP entry heatmap for 2021/22 and 2031/32



Network Capability
2.3 Capability zones of interest

2.3.2 South Wales

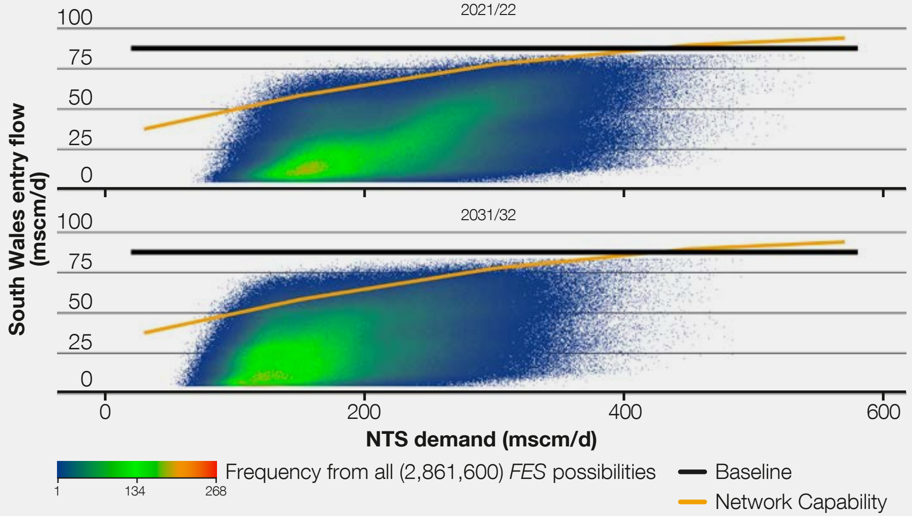
Figure 2.6
South Wales zone

2.3.2.1 South Wales entry

The entry capabilities for South Wales in the 2021 *FES*, figure 2.7, continue to show an increase in periods where supply is above capability. This is consistent with the 2021 ANCAR and shows the strongest indication of all the zones for an increased capability requirement.

In 2031, there are more periods where supply is above the capability than in 2021. This is caused by increased flows as a result of greater reliance on imports of LNG to offset the declining UKCS supplies. The number of flow dots above the capability line averages out to about three constraint days in one year.

Figure 2.7
South Wales entry heatmaps for 2021/22 and 2031/32



Network Capability

2.3 Capability zones of interest

2.3.2.2 Tirley AGI

During RIIO-1 we delayed filter maintenance at Tirley to avoid causing constraints on the network due to the inability to isolate individual filters for maintenance. Isolating the whole site restricts flow in South Wales, reducing entry capacity to ~20mcm/d. The restriction would also impact gas flows out of England and into South Wales to meet demand, should Milford Haven not be exporting LNG into the network.

Funding was awarded through our RIIO-2 submission to install new isolation valves. This will allow for individual filters at the Tirley site to be isolated and maintained without limiting capability.

2.3.2.3 Western gas network (WGN) project

In 2018 a PARCA application was received for the Milford Haven ASEP. The application was to increase the current entry baseline from 88 mcm/d to 103 mcm/d. Figure 2.8 shows our current view of the new flow distribution that could result from the WGN project. Overlaid on these flows are the current Network Capability (orange line) and the expected new capability from the preferred option (pink line), once the proposed upgrade has been completed.

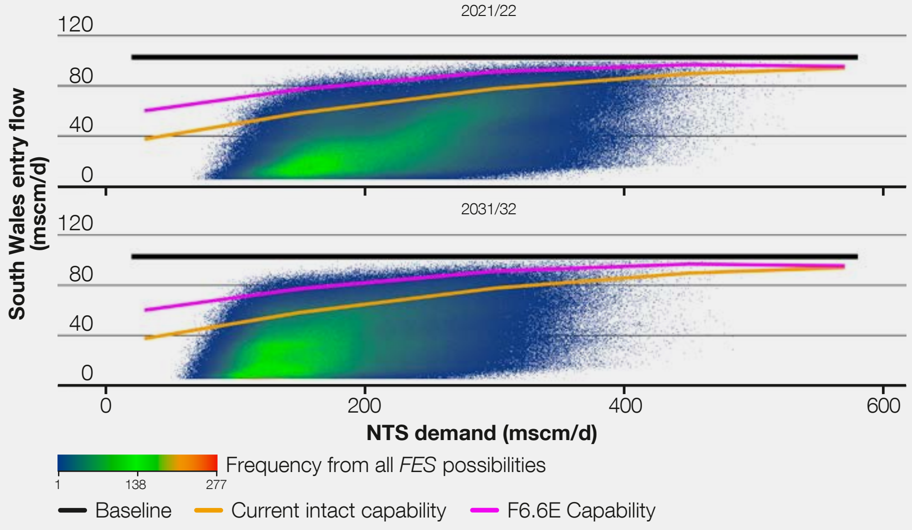
Following the increase, the number of supply/demand scenarios (notated by flow dots) above the current capability make it no longer possible to manage the increased flows with the use of short-term physical and commercial actions (constraint management contracts and location sells on the market). For this reason, Funded Incremental Obligated Capacity has been triggered. Details of the steps taken to select the preferred option are detailed in chapter 3 here.

In 2031/32 the preferred option (pink line) begins to see an increase in flow dots above the new capability. These flow dots only occur in one of the four *FES* scenarios, if this scenario occurs additional investment will be required during RIIO-3. We will continue to monitor the flows and review the need for further investment in this zone during RIIO-2.

2.3.2.4 MCP – Wormington

To provide the current level of entry capability both today and following completion of the PARCA, two units operating in parallel at Wormington are required. Two of the three units on site are impacted by the MCP Directive and if we choose to "do nothing" they will be placed on a limited run hour derogation. Those derogations will impact how often we can provide the full Network Capability and will drive the level of investment needed to support future entry flows from the terminal.

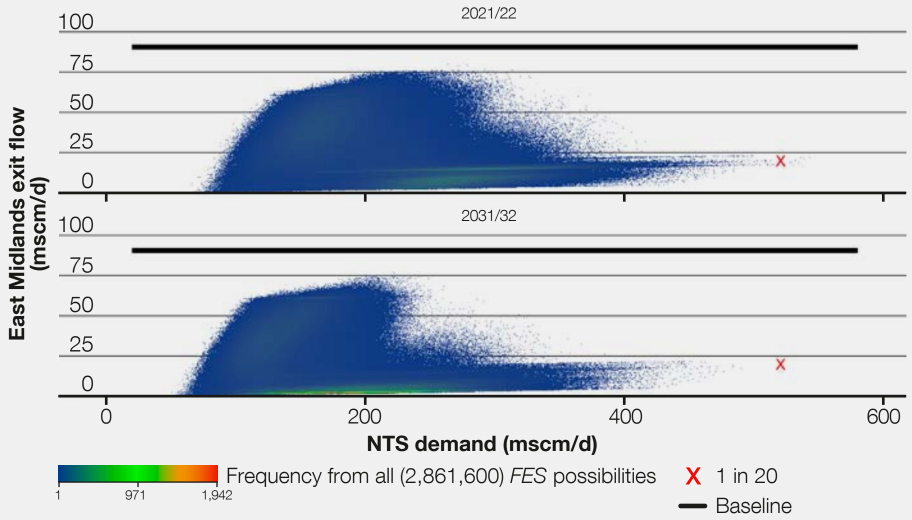
Figure 2.8
South Wales entry heatmaps 2021/22 and 2031/32 with the western gas network project



Network Capability
2.3 Capability zones of interest

Figure 2.9
East Midlands zone

Figure 2.10
East Midlands exit heatmaps for 2021/22 and 2031/32



2.3.3 East Midlands
Bacton is considered as an exit point for the East Midlands, as the gas it exports, via the interconnectors, is largely supplied by moving gas from the East Midlands using the King's Lynn compressor station.

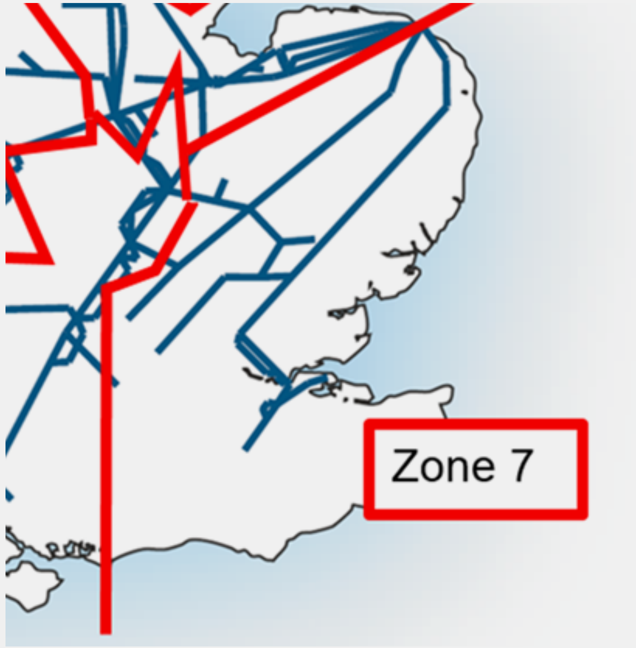
2.3.3.1 East Midlands exit
Figure 2.10 shows how we expect flow patterns in the zone to change between 2021/22 and 2031/2. The plateau shape present in the charts, as national demand increases, is caused by the transition of interconnection flows to the Continent from exit to entry via Bacton once national demand levels increase.

Network Capability

2.3 Capability zones of interest

2.3.4 South East entry

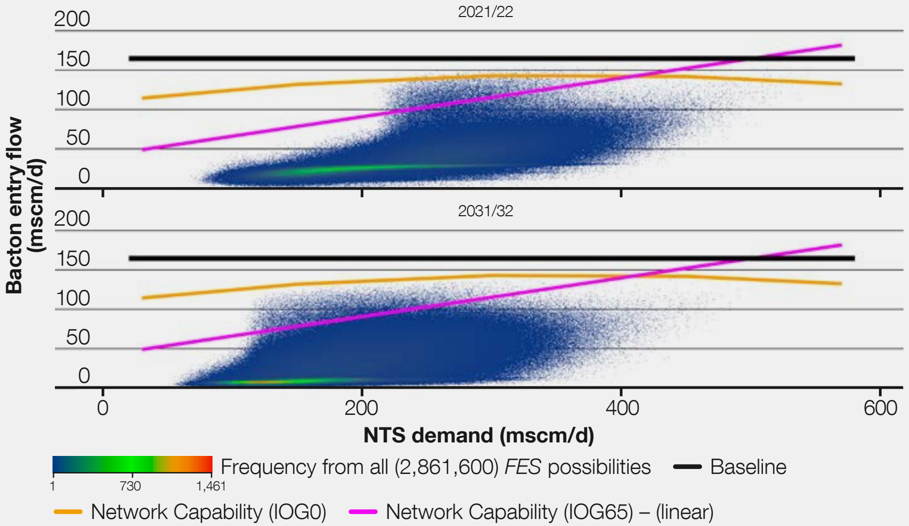
Figure 2.11
South East zone



2.3.4.1 South East entry

Figure 2.12 indicates that in the South East we have sufficient entry capability when entry flows are only seen from the Bacton terminal (orange line). However, if flows from the Isle of Grain terminal are also high (purple line) it would not be possible to maintain high entry flows at Bacton. Historically coincidental high entry flows from LNG and the interconnectors has been an unlikely scenario. But as UKCS supplies decline and we become increasingly reliant on imports, this risk of high flows from both terminals increases.

Figure 2.12
South East entry heatmaps for 2021/22 and 2031/32



Network Capability
2.3 Capability zones of interest

2.3.4.2 Bacton campaign and MCPD – King's Lynn compression

Bacton is considered as an exit point for the East Midlands zone and an entry point for the South East.

East Midlands exit capability

The highest level of exit capability in the East Midlands is when Bacton is exporting to Europe. Figure 2.10 shows that there will still be the need for Bacton to be able to support baseline levels of exit capability in 2030/31.

South East entry capability

Bacton is considered as an entry point for the South East, as the gas from the terminal is largely used to support the high demand centres in the zone. Figure 2.12 shows that we expect Bacton flows to remain high and close to the current baseline levels. It is therefore important that we retain the current entry capability at the Bacton terminal.

To provide the current level of entry and exit Network Capability in the two zones, we operate two units in parallel at King's Lynn. Two of the four units onsite are impacted by the MCP Directive and if we choose to "do nothing" they will be placed on a limited run hour derogation in 2030. Those derogations will impact how often we can provide the full Network Capability and will drive the level of investment needed to support future entry flows from the terminal.

We also need to consider if we need additional capability to support the possible increase in simultaneous entry flows from the Isle of Grain and Bacton terminal in the future, due to declining levels of UKCS supplies.

3 Options and developments

Options and development
3.1 Executive summary

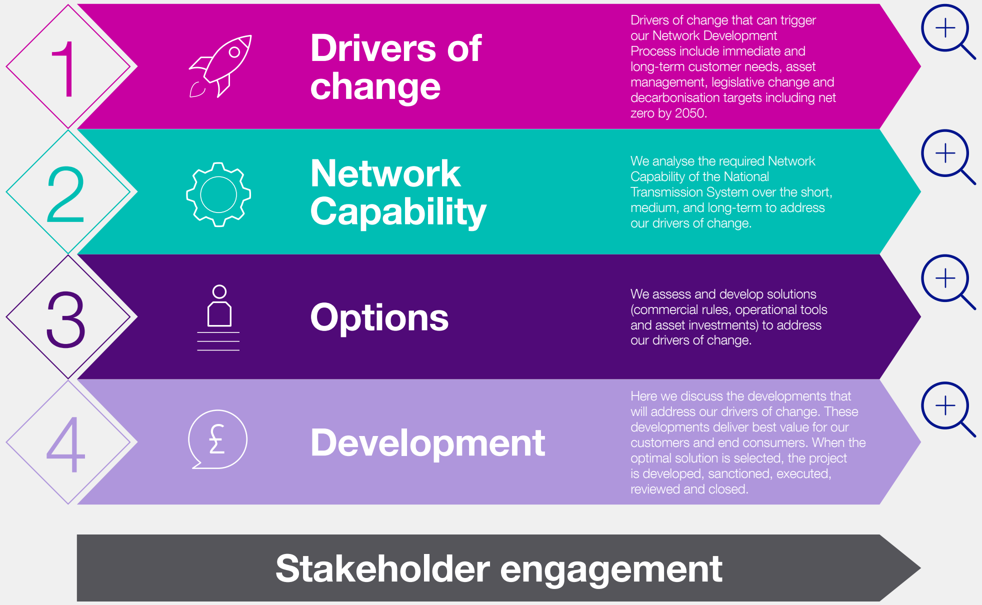
This chapter describes the Options and Development stages of our Network Development Process (NDP), where options are identified and the preferred option is progressed to address the drivers of change (figure 3.1). The chapter focuses on specific project details, how options have been identified and the current development status of projects.

Stage 3 of our NDP comprises the identification of options using a mix of rules (industry frameworks), tools (commercial arrangements and operational strategies) and asset (solutions to ensure we retain the required level of Network Capability). Each option will usually have a mixture of solutions, with elements of asset solutions alongside both rules and tools.

Stage 4 of our NDP is only reached if the optimal solution to a driver of change cannot be found within our existing Network Capability. The aim of this stage is to further develop the preferred options based on the direction of travel decided in stage 3. It may be necessary to progress multiple options at the same time to ensure the optimal final solution is progressed to completion.

This chapter details option selection together with the preferred options to address our drivers of change over the next 10 years and encourage feedback on the options being progressed. The developments have been categorised in line with our stakeholder priorities from our RIIO-2 submission.

Figure 3.1
The Network Development Process



Options and development
3.2 Western gas network project

As our assessment of the PARCA request at Milford Haven indicated investment would be required to provide the additional capacity, we undertook our Options Appraisal process to ensure we delivered the most efficient solution. As part of this process, we developed a Strategic Options Report to assess our long list of options against a wide range of criteria including environmental, socio-economic, technical and cost factors. The strategic options report considered over 70 (figure 3.2) potential options covering a range of commercial, regulatory and physical options aimed at enabling National Grid to accept the requested increase in entry capacity at Milford Haven ASEP. Figure 3.2 gives some examples of the range of options considered.

A shortlist of 11 options remained after the benefit and technical filters were applied. Figure 3.3 shows a visual representation of the network reinforcements which the shortlisted options comprise. Each option contains a subset of these common elements as detailed in the next section.

These shortlisted options were then developed to refine the costs to implement them along with their impact on capability.

Figure 3.2 Figure 3.3

Figure 3.2
Long list options covered many possibilities, beyond traditional reinforcement options

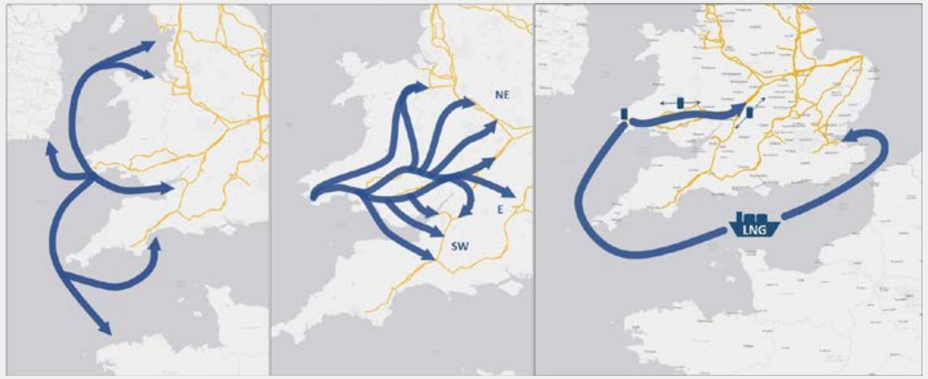
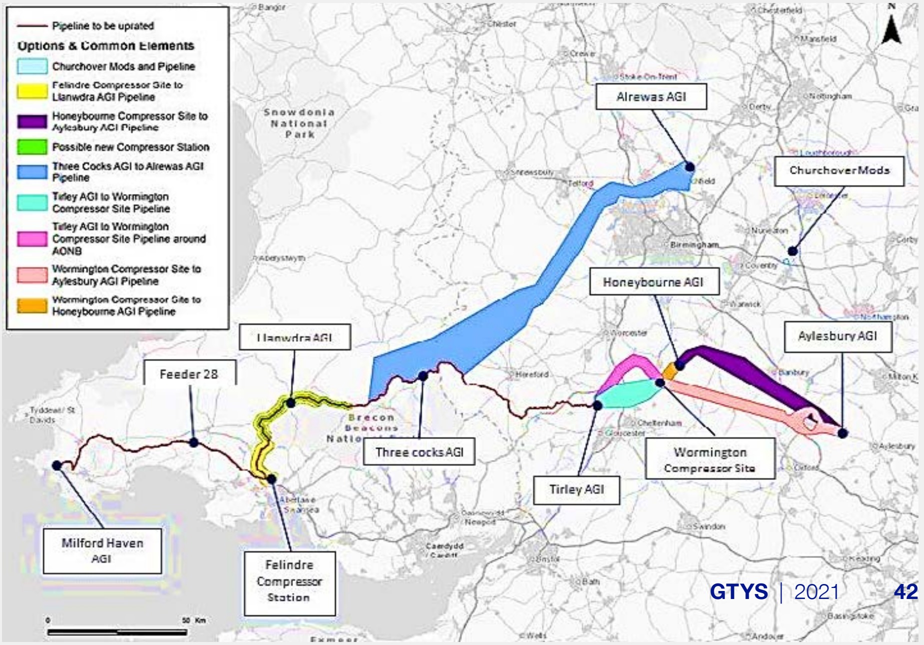


Figure 3.3
Common elements contained within shortlisted options



Options and development
3.2 Western gas network

The 11 shortlisted options were assessed against a no investment option using our cost benefit analysis (CBA) methodology. This compares the cost to implement each of the options against the constraint costs across all four *FES* scenarios.

The comparison between the options can be seen in figure 3.4. For each option a net present value (NPV) is calculated based on the relative benefits of each option compared to no investment. The higher the NPV the more beneficial the option.

Given the uncertainty in future energy flows, we assessed the options based on both flows to 2050 and 2035. This allows us to measure how the options perform over the first ten years, at this stage it may then be possible to expand an option if this is required by the level of flows.

Based on this approach option F6.6 was selected as the lead strategic option. This was the lead option when we consider constraints up to 2035, we retain the option to expand to option F6.1 later if required. By taking this approach we deliver the additional capability required in the short term and retain the option to expand this if required whilst avoiding the risk of over-investment.

The options assessed as part of the strategic options appraisal comprised certain distinct combinations of network reinforcements where some standard assumptions had been made about key parameters, such as pipe diameters and compressor station configuration. Once a clear preference (F6.6) had emerged from this process, it was then necessary to consider in more detail any potential for variation in the design of each specific reinforcement element, as such a variation might affect the investment cost, timeline, outage requirements and Network Capability. A number of sensitivity reviews were undertaken to investigate whether the detailed composition and scope of the preferred strategic option could be optimised. Key elements of the optimisation were:

- whether all sections of uprating should be taken forward,
- whether the assumed 1200mm new pipeline for Wormington to Honeybourne could be reduced to 900mm or 600mm,
- if more extensive or more localised arrangements were most appropriate at Three Cocks and Tirley PRS to address pressure boundary/flow issues,
- the project interface with the Medium Combustion Plant Directive upgrades scheduled to be undertaken at Wormington.

Figure 3.4
Relative NPV against all four *FES* scenarios, no constraints post 2035

Option	Steady Progression	Consumer Transformation	Leading the Way	System Transformation
F3.1 – CS near Llanwrda + 37km	£1036 m	£191 m	-£111 m	£67 m
F3.2 – CS near Llanwrda + 44km	£1009 m	£164 m	-£138 m	£40 m
F3.3 – CS near Three Cocks + 11km	£1099 m	£276 m	-£24 m	£153 m
F4.1–55km Felindre to Llanwrda + 37km	£1005 m	£154 m	-£146 m	£38 m
F4.2–55km Felindre to Llanwrda + 44km	£978 m	£127 m	-£173 m	£11 m
F6.1 – Uprating with MOP up to and including class limit + 37km	£1178 m	£340 m	£38 m	£215 m
F6.2 – Uprating with MOP up to and including class limit + 44km	£1151 m	£313 m	£11 m	£189 m
F6.6 – Uprating with MOP up to and including class limit + 11km	£1248 m	£426 m	£125 m	£302 m
F7.1 – Three Cocks to Alrewas	£891 m	£53 m	-£250 m	-£73 m
G1.1 – Wormington to Aylesbury	£999 m	£174 m	-£127 m	£49 m
G1.3 – Wormington to Aylesbury via Honeybourne	£962 m	£136 m	-£165 m	£12 m

Options and development
3.2 Western gas network

These refinements of the options were again assessed as part of our CBA process. As with the strategic option selection there were several sensitivities undertaken, based on when constraints occur, that were considered as part of the selection process. The key focus was on the 10-year view to 2035. As detailed in the strategic option selection, F6.6 is a modular option with the potential to expand post 2035 if required. As such, focusing on the period to 2035 was key to understanding the optimal configuration for the F6.6 option. An additional sensitivity was considered by only including constraints up to 2030. Based on the configurations of F6.6 it was clear some elements could be deferred and deployed by 2030 if required, so understanding the performance over the first five years of operation was key in evaluating the options.

The CBA demonstrated that, in the short term, F6.6e 900 Light was the most beneficial sub option to progress. When we consider the CBAs for both time horizons, it clearly represents the optimum balance between investment and capability. It is the lead option in three of the four scenarios in both assessments and could be expanded by applying uprating to the Milford Haven to Felindre section in 2030 if this is required, as it would be in the Steady Progression scenario.

The preferred strategic option includes modifications to the existing network and requires the least new infrastructure, therefore minimising the impact of the project on communities and the environment. This option has the lowest capital cost with the greatest consumer benefit and therefore represents the most economic and efficient solution for GB consumers. Subsequent to the CBA work, the option has continued to be refined in order to provide the optimum solution to meet the needs of the PARCA and has the potential to bring forward the capacity release date for the customer to 1 January 2025.

National Grid has undertaken engagement on the proposed option with a wide variety of stakeholders including relevant statutory bodies, the PARCA customer, political representatives, potentially affected landowners and the general public through a variety of approaches. Feedback from engagement will continue as design work matures and is being taken into account ahead of the planning submissions. This supports the acquisition of necessary rights for the construction and operation of the infrastructure through voluntary agreements or compulsory purchase where necessary.

Figure 3.5
Relative NPV against all four *FES* scenarios, no constraints post 2030

Option	Steady Progression	Consumer Transformation	Leading the Way	System Transformation
Counterfactual	£0 m	£0 m	£0 m	£0 m
F6.6c 1200 Base	£427 m	£162 m	-£11 m	£47 m
F6.6d 1200 Light	£433 m	£176 m	£4 m	£61 m
F6.6e 900 Light	£440 m	£183 m	£11 m	£68 m
F6.6f 900 Min	£396 m	£177 m	£14 m	£67 m

National Grid submitted the Funded Incremental Obligated Capacity (FIOC) Needs Case assessment in June 2021. This report detailed the options developed along with our justification for our preferred option. Ofgem launched a consultation on the report running from 13 October until 11 November. A decision on the needs case is expected in late 2021 or early 2022.

Options and development
3.3 Scotland 1-in-20

The continuous declining UKCS supply at St Fergus and the unclear pathway to meet the net zero carbon emission target in 2050 are making it increasingly difficult to meet our 1-in-20 winter demand obligations for customers in Scotland. A range of options were identified for investment, either in National Grid assets, or by taking the whole system option of investing within the distribution network. The most financially beneficial option from the CBA is to invest in the National Grid network, giving a clear direction of travel for the project.

Based on the update this year, the recommendation is to defer asset investment. However, there are a number of reasons that could trigger the need to deliver the works earlier. These include an increase in the rate of decline of entry flows at St Fergus, or investments to deliver on our net zero commitments. The impact on existing Network Capability of investments to deliver net zero, such as repurposing feeders for Carbon Capture Usage and Storage (CCUS) or Hydrogen, will be assessed as part of any project proposals.

Options and development

3.4 Developing our asset management approach

We manage our assets as efficiently as possible. Through our ISO55001 accreditation, we are continuously improving our asset management processes to ensure we effectively manage network risk and deliver value for our customers. During 2020/21 we continued to improve our approach within an end-to-end Asset Investment Planning and Management (AIPM) process in readiness for RIIO-2. This includes the implementation of a monetised risk-based approach to the planning and targeting of investments and the reporting of investment outcomes to Ofgem. We have also implemented further developments to our Defects, Operational Risk Assessment and Mitigation process. 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.

3.4.1 Key asset investment works

3.4.1.1 Feeder 9 project – Humber Crossing

Our river Humber Gas Pipeline Replacement project to replace an underwater section of the NTS with a tunnelled solution reached a major milestone during 2020/21. 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.

Pipeline insertion commenced 22 June 2020. Making good progress, the pipeline arrived ahead of schedule in the reception shaft on 9 July 2020. Following this we completed the construction and commissioning of the pipeline tie-ins at either end of the crossing, with the replacement pipeline becoming fully operational on 10 December 2020. With the majority of the construction works completed, the project team have continued the demobilisation and project closure phases of our project.

In RIIO-2 we will be delivering increased levels of asset health investment, targeted and prioritised utilising our new risk measures.

Options and development

3.4 Developing our asset management approach

3.4.1.2 St Fergus

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

Through 2020/21 we have continued to deliver our asset health investment despite some impacts from Covid-19. Our RIIO-2 plan for St Fergus seeks to optimise investment aligned with managing safety and reliability risks on ageing assets with the efficient delivery of our future compression strategy for the terminal. We are submitting this to Ofgem as an Uncertainty Mechanism in 2022.

3.4.1.3 Bacton campaign

The Bacton terminal is a key strategic gas terminal and will continue to operate until at least 2050 under our current *FES* scenarios. The site commenced operation in 1968 in a coastal environment which accelerates degradation, and has operated continuously since, with no site-wide outages. Examination of the risks and consideration of the needs case work at Bacton have identified issues that should be prioritised in the short term and NGGT are considering options to retain safe operation of the site for the long term, and in consideration of net zero.

We are proposing significant investment at Bacton to deliver service risk benefits and contribute to an improvement in reliability for customers. In RIIO-2 we will be assessing the long-term options for the Bacton terminal, and whether a continuation of our asset health approach or a terminal redevelopment is the most beneficial approach. We are submitting this to Ofgem as an Uncertainty Mechanism in 2022. Whilst this option selection phase is ongoing, we will also carry out “least regrets” asset health works to maintain the safety and reliability of the current assets.

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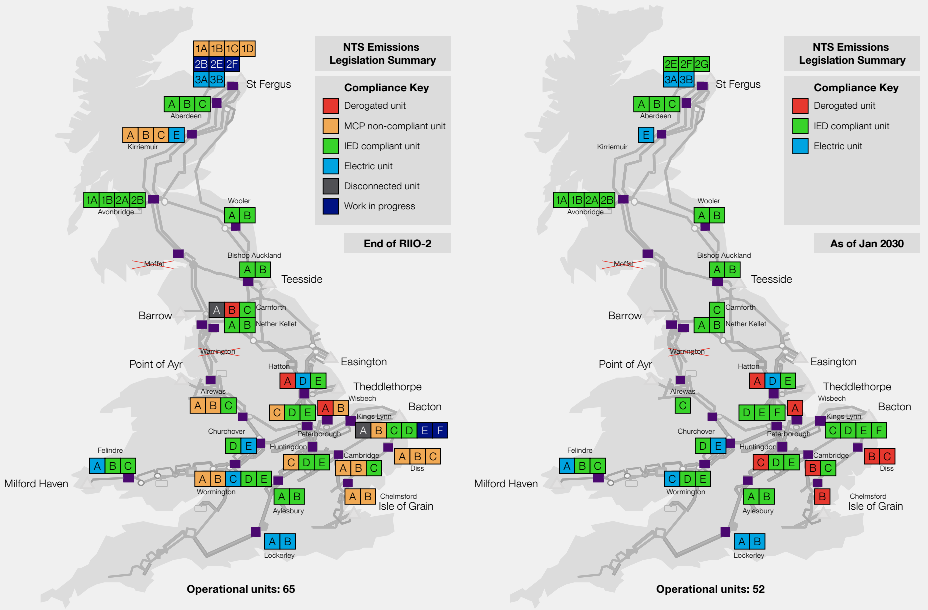
Options and development
3.5 IED – Pathway to compliance

To ensure we remain compliant with the IED as detailed in section 1.4.1, and ensure we continue to meet our customers' and stakeholders' needs, we have developed a pathway to compliance for all compression impacted by the legislation. At the start of RIIO-2[1] we had 68 operational compressors. At the point of MCPD being implemented our fleet will have reduced to 52 operational units, 13 new compressors will have been installed and 36 compressors will have been decommissioned. These figures may change as part of our ongoing assessment of Network Capability.

Figure 3.6 shows site by site which compressor units are compliant with emissions legislation, those that are non-compliant (and with which set of regulations), those that are under derogation and units proposed to be decommissioned.

Figure 3.6
Emissions compliance across the NTS at the end of RIIO-2 and the MCPD compliance date 1 January 2030*



[1] Operational totals include King's Lynn Unit A, an Avon unit disconnected in 2018. It is shown as operational due to the timing of our business plan creation.
* As published in our RIIO-2 submission Business Plan, December 2019.

Options and development
3.5 IED – Pathway to compliance

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

3.5.2 Hatton
At Hatton compressor station, we are progressing delivery of a new, IED compliant, compressor machinery train following approval of the needs case by Ofgem in 2019. Funding was awarded through RIIO-2 Final Determination for a single large gas turbine driven compressor. The investment will be completed by the end of the RIIO-2 period.

3.5.3 MCPD
Medium Combustion Plant Directive (MCPD) emissions limits will come into effect on 1 January 2030 impacting all assets with a rated thermal input equal to, or greater than, 1 Megawatt thermal (MWth) and less than 50 MWth.

It was proposed that during RIIO-2 two new MCPD compliant compressor units would be installed at Wormington and that we would begin construction of two new units at King's Lynn. In RIIO-3 we also propose to install three new units at St Fergus as part of the wider site investment plans as detailed in section 3.4.1.2. These will not be operational until RIIO-3 in 2029. A third unit was proposed to be installed at Peterborough during RIIO-3 to comply with the legislation.

All of these proposals are subject to Uncertainty Mechanisms over the next 12 months and could change as options are further refined.

Options and development
3.5 IED – Pathway to compliance

3.5.4 Redundant assets

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

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

We have identified a range of redundant assets, sites and groups of assets, and engaged with a range of stakeholders to gather insights from across the industry around the management of our redundant assets.

Our RIIO-2 plans, based on this insight, propose to decommission these identified redundant assets to reduce the environmental and health and safety risk, ensuring customers who have benefitted from these redundant assets pay for the decommissioning of them rather than deferring to later consumers. This is aligned with the Polluter Pays Principles. In the RIIO-2 Final Determination, allowances were awarded for this investment plan and the programme will be delivered across the RIIO-2 period.

Options and development
3.6 Asset maintenance

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

Examples of the application of the strategy are:

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

3.6.1 Our investment programme

Where an asset investment is required to address our drivers of change, similar works are bundled together into campaigns to ensure their cost-effective delivery. We simplify scopes of work for our contractors, use standard designs, and streamline project documentation to drive down costs. This approach makes better use of network outages to ensure that our asset delivery isn't constrained, or customers unnecessarily impacted. During 2020/21, we continued to deliver our asset investment programme, investing £55m in the health of our assets to keep our network running safely and reliably. Our current asset health investment campaigns are included in table 3.1.

Table 3.1
Key asset health campaigns

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

Options and development
3.7 Protection of the NTS from cyber and external threats

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

The Physical Security Upgrade Programme (PSUP) is a Department for Business, Energy and Industrial Strategy (BEIS) led national programme to enhance physical site security, commencing in RIIO-1.

In RIIO-2 our investments cover the latest phase of sites agreed with the Government. Additionally, given the relatively short asset lives of the IT hardware and technical assets within these solutions, we will also commence a rolling asset replacement programme at the sites where solutions were installed in the early phases of the PSUP.

As we are an operator of Critical National Infrastructure (CNI), we are increasing our cyber resilience in a proportional manner as part of our RIIO-2 business plan submission and in accordance with the Cyber Assessment Framework (CAF). We have substantially completed our CAF improvement plan and have sanctioned the strategic investment plan.

Options and development
3.8 Transitioning to net zero

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

In this rapidly changing energy sector we need to keep pace, evolving our organisational capability so that we're set up to deliver against our vision, which is to be at the heart of a clean, fair and affordable energy future.

We have already made good progress on reducing our emissions – by 68 per cent since 1990. This is well ahead of our original target of 45 per cent by 2020. In the longer term we have targets to reduce our greenhouse gas (GHG) emissions by 90 per cent by 2040 and to net zero by 2050. We will lead the way in the decarbonisation of gas, investing in a range of solutions like renewable natural gas, blending hydrogen in our network and carbon offsetting.

Further details of the activities we are undertaking to meet this challenge can be found in the drivers of change chapter. As this work progresses into investment plans we will utilise regulator flexibility through Uncertainty Mechanisms or our future business plans to deliver them.

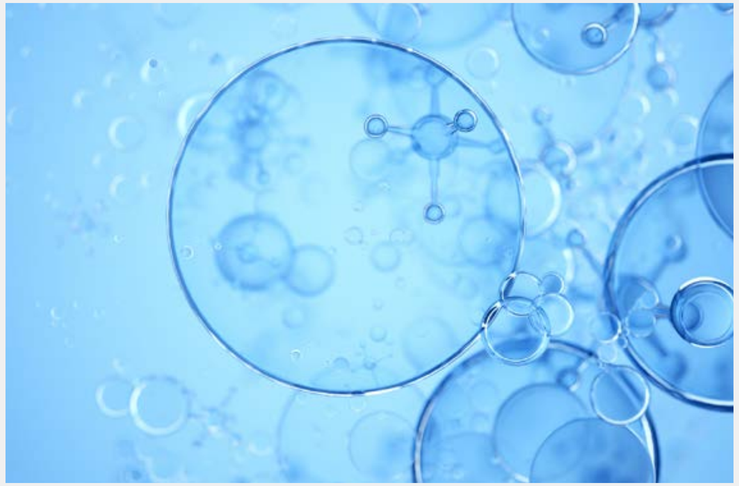
Over the next decade, we will continue to anticipate and adapt to changes in faster and smarter ways, remaining at the cutting edge of engineering and asset management, innovating more sustainable energy solutions.

3.8.1 Hydrogen developments
Alternatives to natural gas like hydrogen need to be considered if we are to reach net zero by 2050. Across all credible *Future Energy Scenarios*, hydrogen will play a crucial role in the future energy mix and will be required to decarbonise heat, transport, industry and power.

Examples of hydrogen projects underway or being developed include:

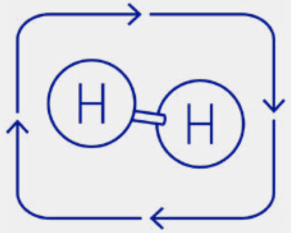
- FutureGrid
- Acorn
- Project Union
- East Coast Hydrogen
- Project Centrum
- FutureGrid Phase 2

More details of these projects are given on the following pages.

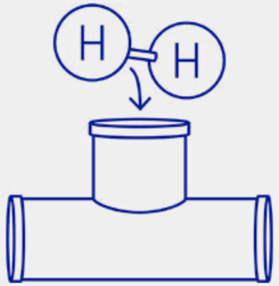


FutureGrid

An ambitious programme to build a hydrogen test facility from decommissioned assets at DNV's facility in Cumbria to demonstrate the National Transmission System (NTS) can transport hydrogen. Testing will be completed in two parts:



Offline hydrogen test facility
NTS assets of different types, sizes, and material grades will be tested with 2, 20 and 100 per cent hydrogen.



Standalone hydrogen test modules
Standalone hydrogen test modules will provide key data required to feed into the main facility.

This will help us understand how hydrogen interacts with our assets, so that we can develop the appropriate safety standards required to operate our network.

Construction is now underway with testing on the main offline hydrogen test facility set to begin mid 2022.

Researching a hydrogen future

Projects underway in 2021

FutureGrid

An ambitious programme to build a hydrogen test facility from decommissioned assets at DNV's facility in Cumbria to demonstrate the National Transmission System (NTS) can transport hydrogen. Testing 2, 20 & 100 per cent hydrogen and developing our hydrogen safety case.

Project Union

Exploring the development of a GB hydrogen 'backbone', which aims to join together industrial clusters around GB, potentially creating a 2,000km hydrogen network. It's anticipated that the backbone could carry at least a quarter of the gas demand in GB today.

acorn Hydrogen

This development is preceded by the Acorn CCS project, which will provide the route to permanently sequester CO_2 emissions generated from reformation of natural gas into hydrogen, aiming to blend up to 2 per cent hydrogen into the NTS from 2025.

East Coast Hydrogen

Working with NGN and Cadent to develop GB's hydrogen network and simultaneously decarbonise a large proportion of the GB's homes and industry. ECH2 includes the entire NGN region, the Cadent Eastern region and a proportion of the NTS.

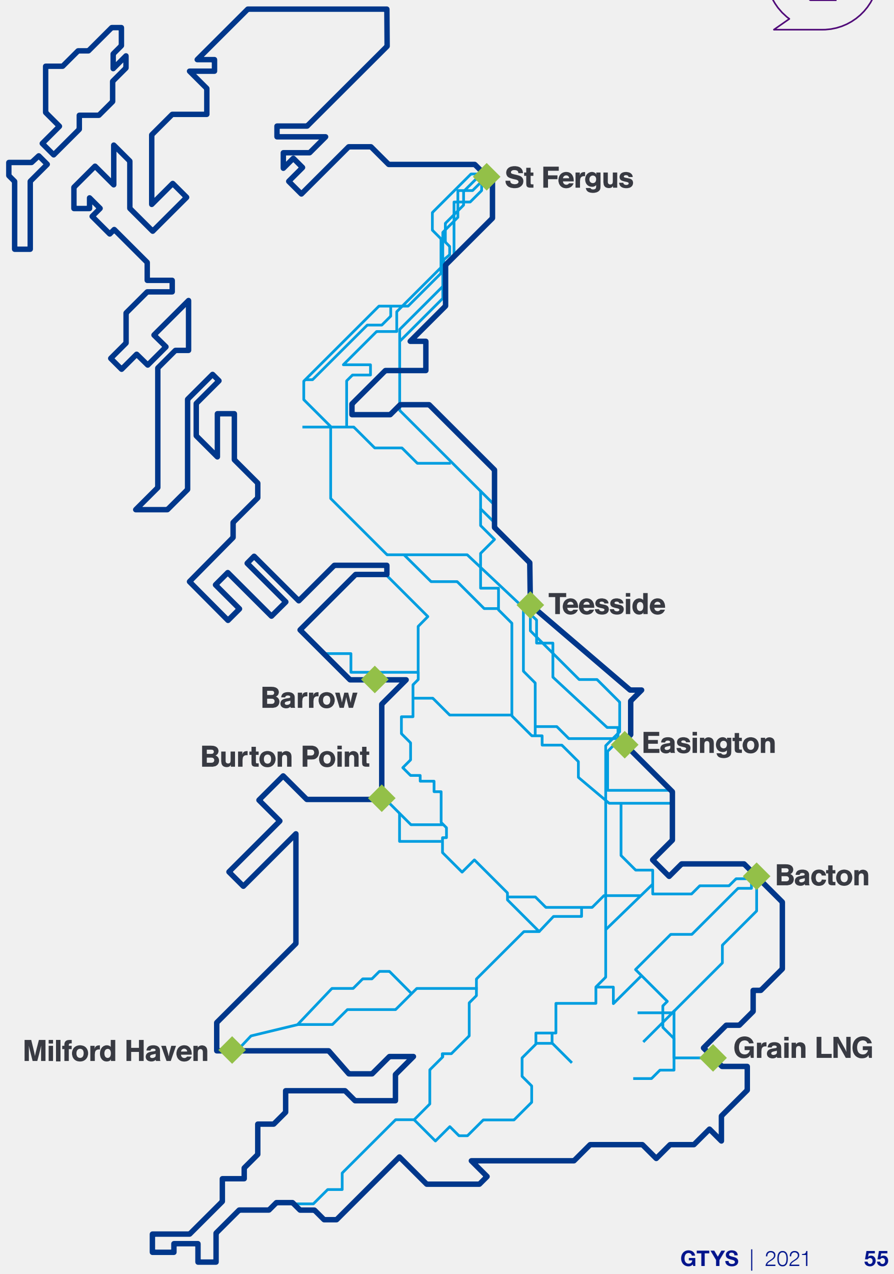
Projects in development

Project Centrum

Hydrogen production to unlock the decarbonisation of the Midlands. Concept project identified that Theddlethorpe and Bacton could play a key role in the build out of 'second phase' hydrogen. Strategy project to be launched once Union is underway.

FutureGrid Phase 2

Expansion of the Phase 1 facility to incorporate hydrogen deblending and compression, storage and build demonstrations for ongoing GDN projects such as Cadent's Purification and SGN's LTS Futures projects.



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Options and development
3.9 Innovation

During 2020/21, we continued focusing on innovation activities that will help achieve the Government's net zero carbon emissions target by 2050. Throughout the year, we undertook 31 NIA projects, and spent £4.9m.

Innovation is one of National Grid Gas Transmission's stakeholder priorities, supporting our business to deliver gas reliably and safely to our customers. The future of our network depends on finding a suitable 'green' alternative to natural gas, that will continue to deliver heat and power to homes, businesses and industry. That's why innovation activities that focus on achieving net zero are central to our work.

The three RIIO-2 innovation themes: Fit for the Future, Ready for Decarbonisation and Decarbonised Energy System focus not only on improving the efficiency of our day-to-day activities, but also on considering the future technologies that could be used to help us meet our objectives.

We've also established five innovation technology portfolios, each with its own technology roadmap and specific project pipeline. These portfolios align to all three RIIO-2 innovation themes and set the direction for innovation projects we'll deliver throughout RIIO-2.

These technology portfolios are:

- Asset development for risk mitigation
- Automation and measurement
- Digital systems and simulation
- Materials and processing
- Business process.

A core component of our overall innovation portfolio looks at increasing the efficiency of our maintenance and operational activities, using innovative tools and methods. Three such project examples are:

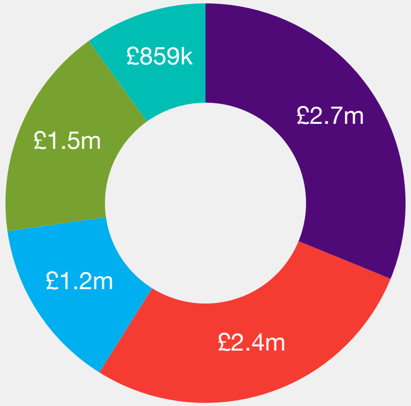
- In Line Flow Stop
- Analytical approach for vegetation management
- Geopolymer injection for ground stabilisation.

Alongside projects such as these, that focus on improving business-as-usual activities, we have concentrated on projects that look at the reduction of carbon emissions and will help to achieve the net zero target. Therefore, all five of the innovation technology portfolios focus on net zero in some way, across their project pipeline.

Throughout RIIO-2, we'll be focusing on developing a greater understanding of the potential future of our network, looking specifically at the role hydrogen could play in a decarbonised gas industry. Innovation is at the heart of this challenge.

31
NIA projects run this year

£4.9m
spent this year



Total spend per technology portfolio in 2020/21

- Asset development for risk mitigation
- Automation and measurement
- Digital systems and simulation
- Materials and processing
- Business process and management

£27.7m
amount of benefits realised

11
projects originated from another project

8
projects focused on hydrogen

4 Looking forward

Looking forward

4.1 Introduction

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

Key message:
We want to continue to work with you and involve you in our Network Development Process (NDP) considering the drivers of change that we have highlighted in this 2021 *GTYS*.

4.2 Your feedback

We welcome your feedback and comments on this interactive edition of the *GTYS*. It helps us to better tailor the document to include information you value, and to format the document to make it easier for you to navigate. Over 2021/22, we are keen to hear your views on the following areas of our gas transmission business:

- Future system operability challenges
- Asset management
- Network Capability Assessment Report (ANCAR)
- GB gas quality specifications development
- Network Development Process.

4.3 Continuous development of the *GTYS*

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

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

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

Looking forward
4.4 Our future engagement

We welcome your feedback on whether the *GTYS*:

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

We also welcome your feedback on:

- Which areas of the *GTYS* are of most value to you?
- Which areas of the *GTYS* can we improve?
- Is there any additional information you would like to see included in the *GTYS*?

If you would like to provide feedback, please contact us.

We look forward to hearing from you.

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Supporting information/ Appendices

Appendix 1
National Transmission System maps

Figure A1.1
Scotland (SC) – NTS

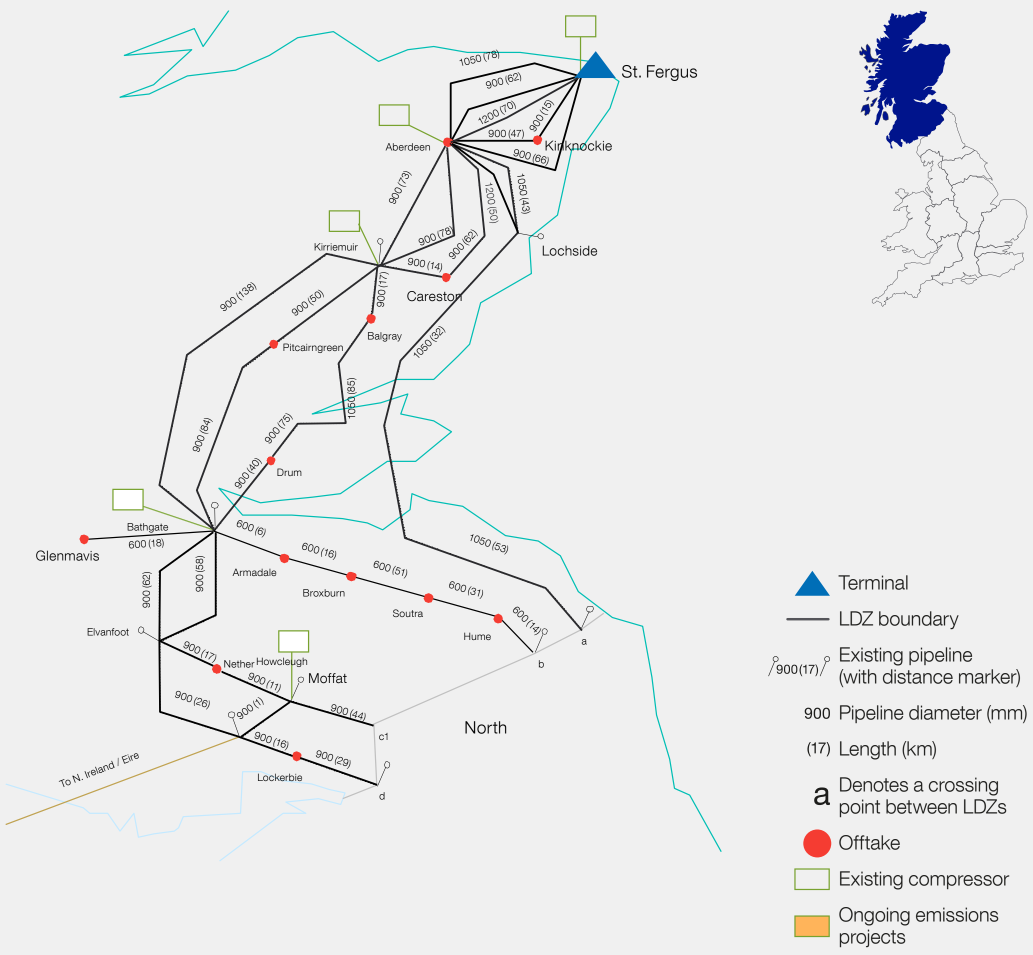

Figure A1.2
North (NO) – NTS

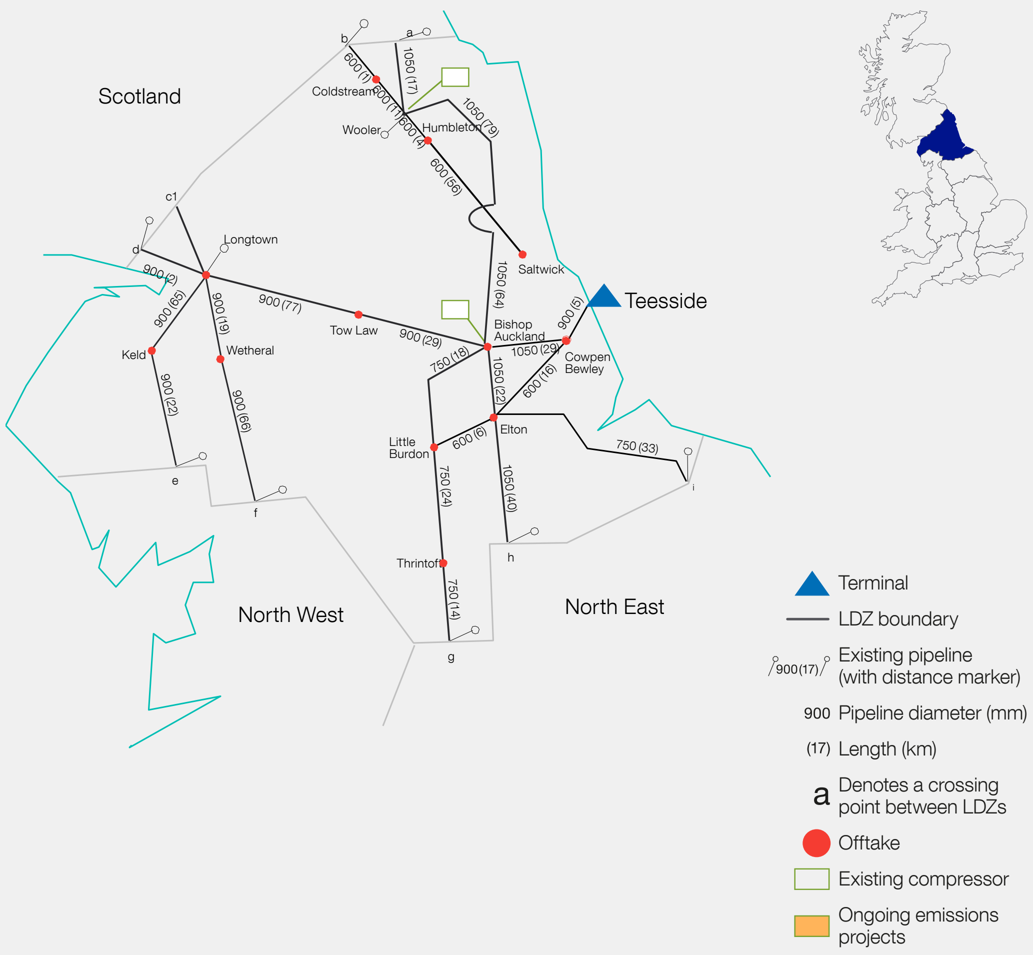

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Figure A1.3
North West (NW) – NTS

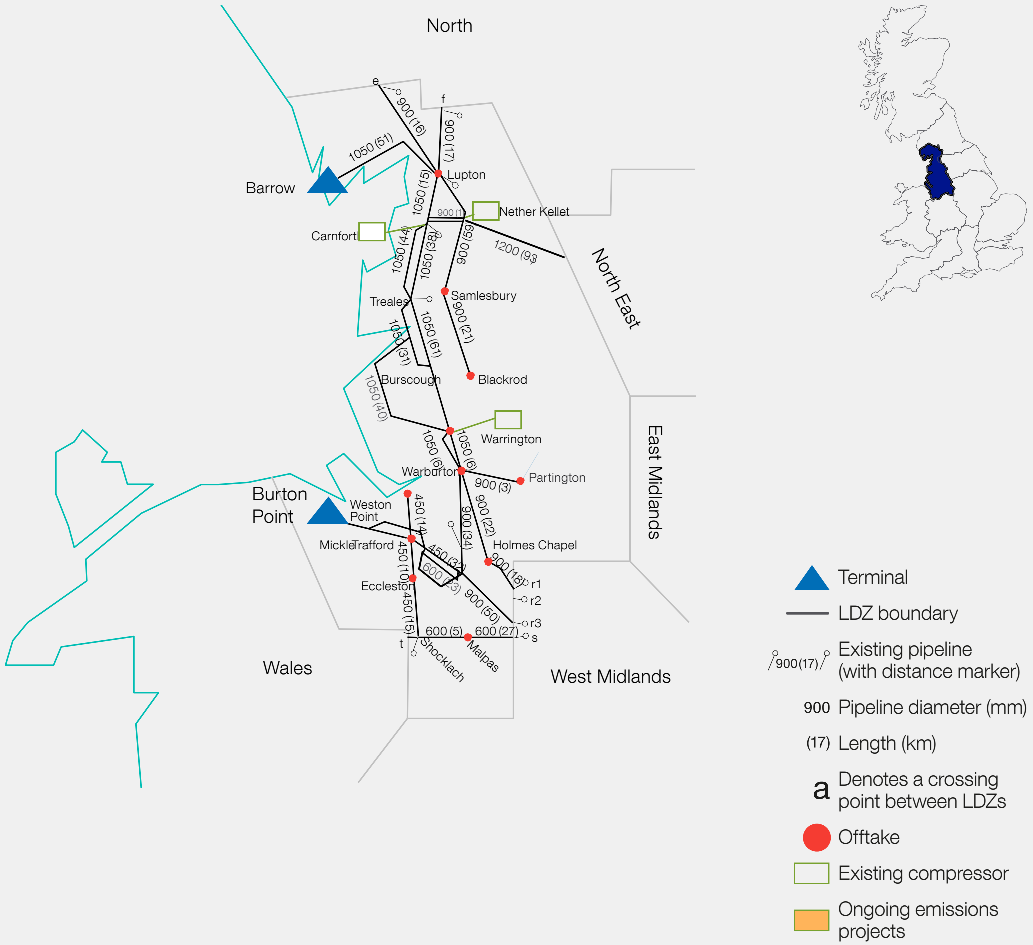

Figure A1.4
North East (NE) – NTS

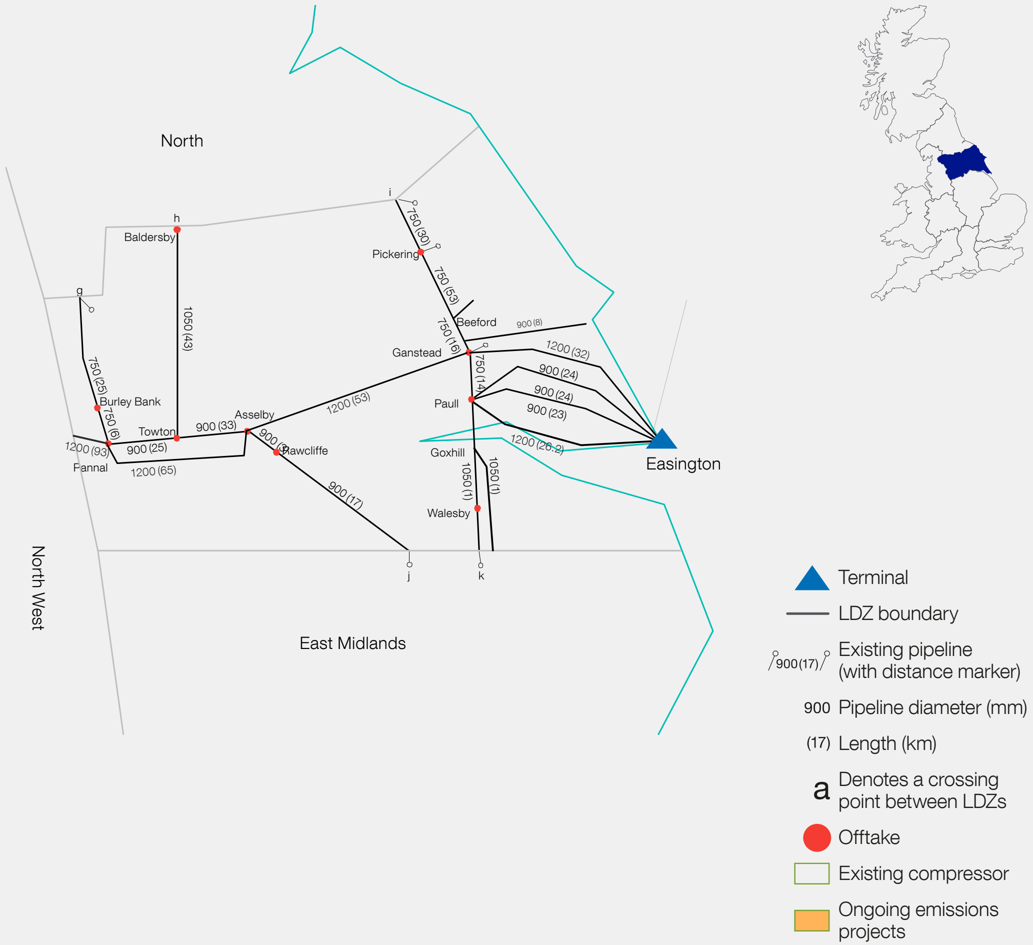

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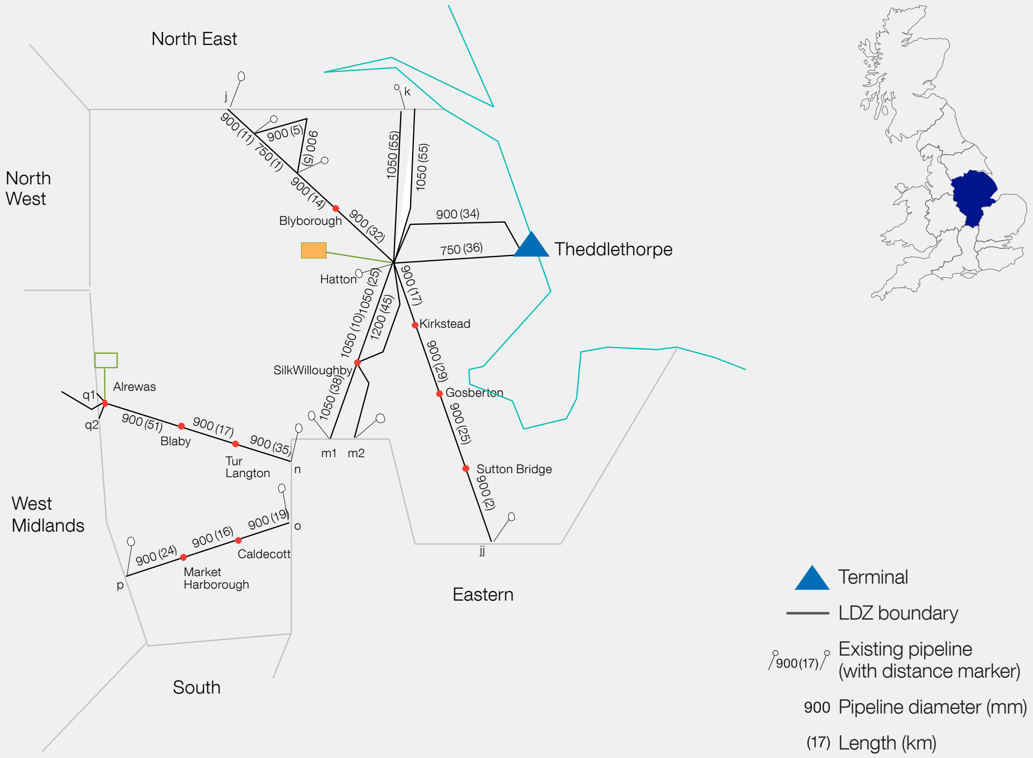
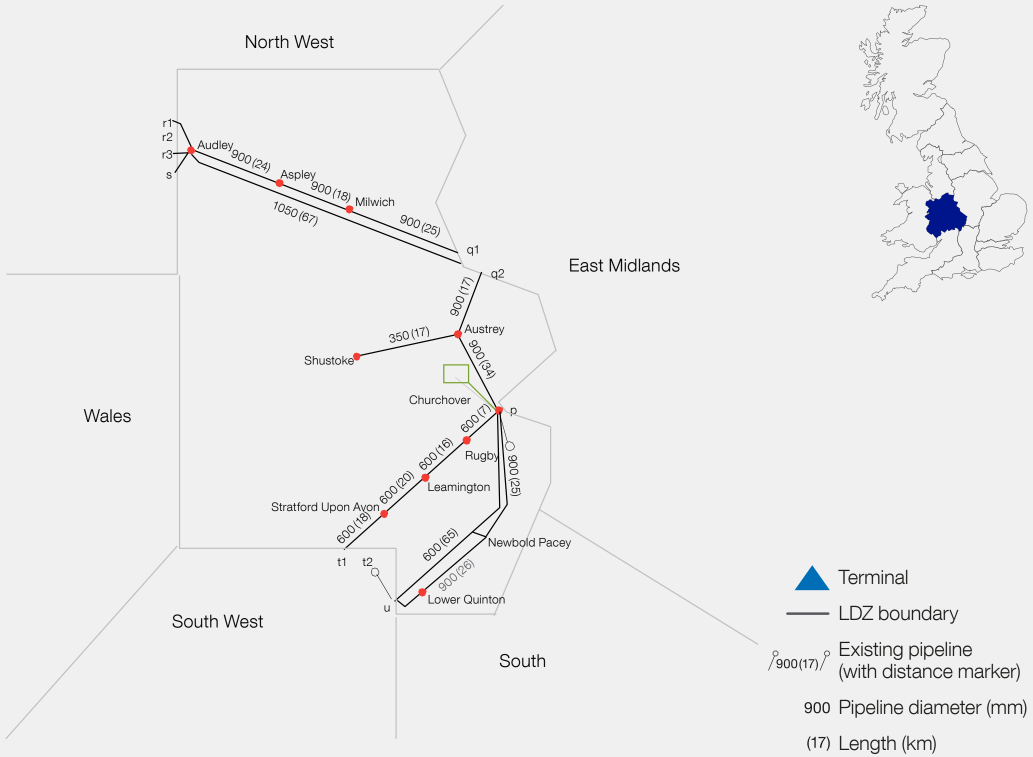
Figure A1.5
East Midlands (EM) – NTS



Terminal
LDZ boundary
900(17) Existing pipeline (with distance marker)
900 Pipeline diameter (mm)
(17) Length (km)
a Denotes a crossing point between LDZs
Offtake
Existing compressor
Ongoing emissions projects

Figure A1.6
West Midlands (WM) – NTS



Terminal
LDZ boundary
900(17) Existing pipeline (with distance marker)
900 Pipeline diameter (mm)
(17) Length (km)
a Denotes a crossing point between LDZs
Offtake
Existing compressor
Ongoing emissions projects

Appendix 1
National Transmission System maps

Figure A1.7
Wales (WN & WS) – NTS

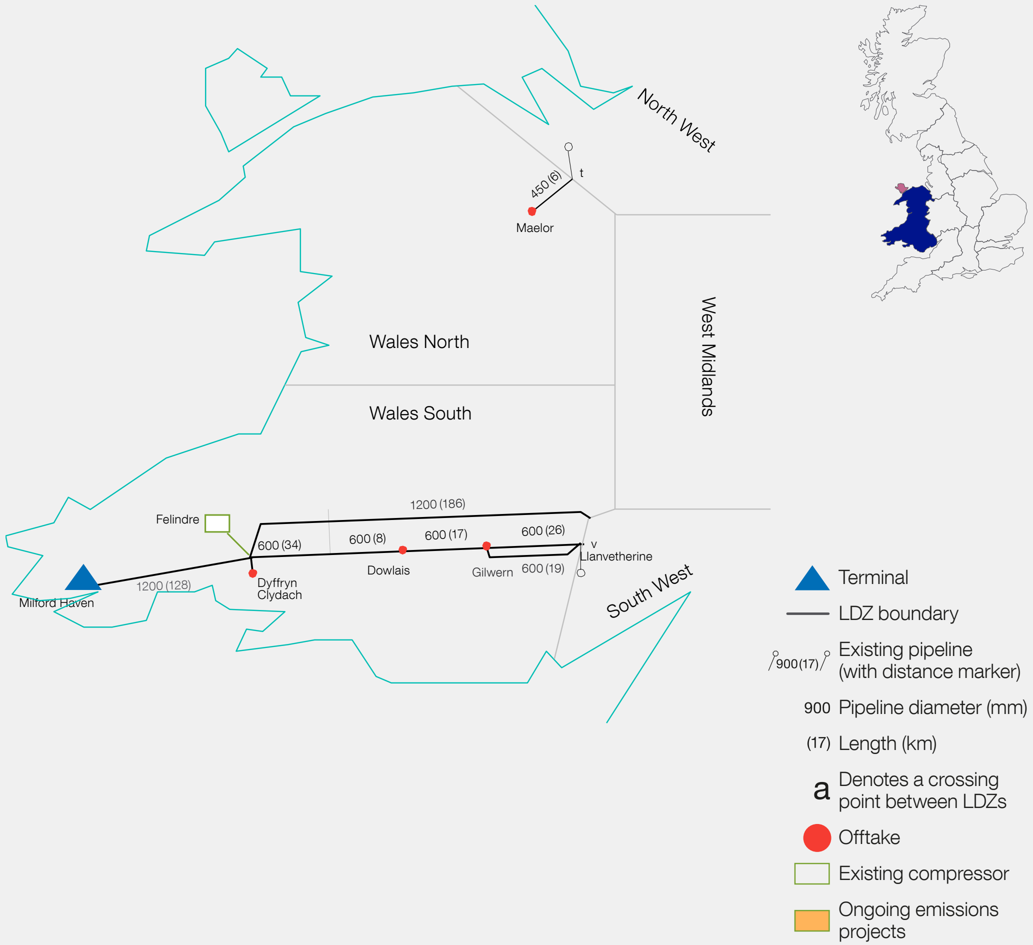
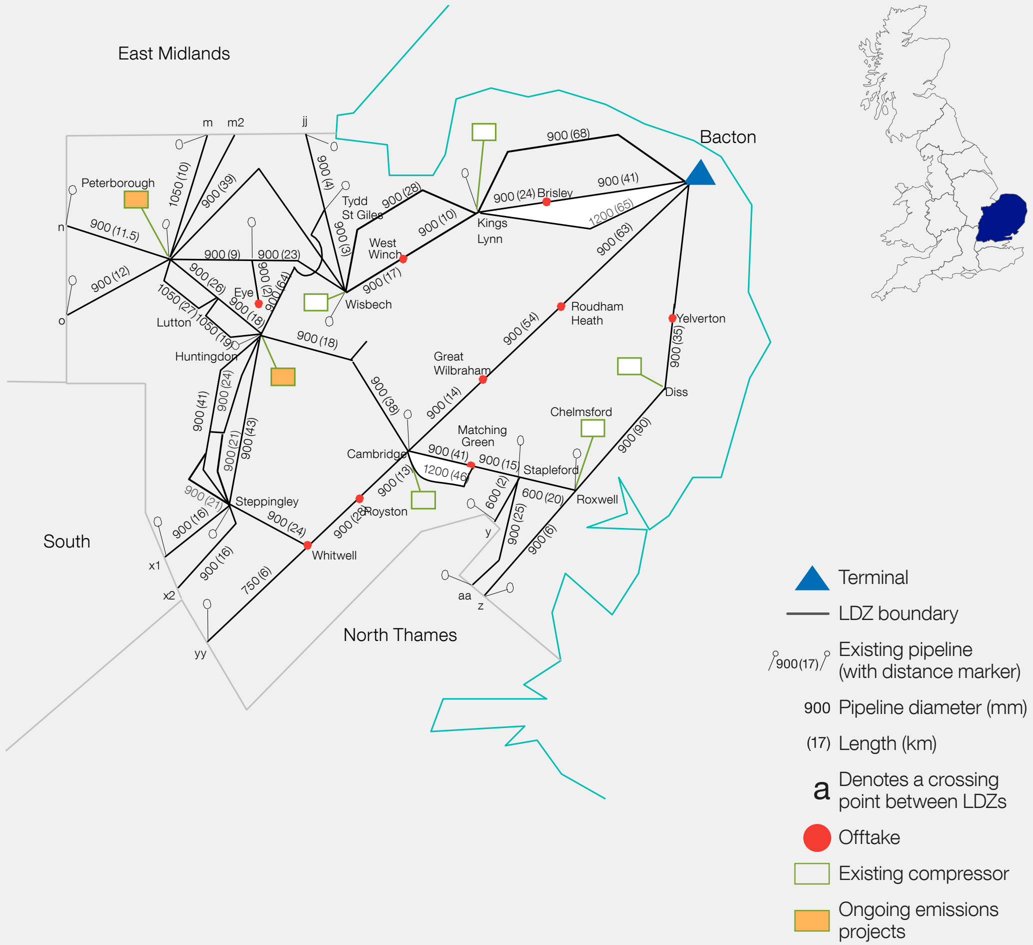


Figure A1.8
Eastern (EA) – NTS



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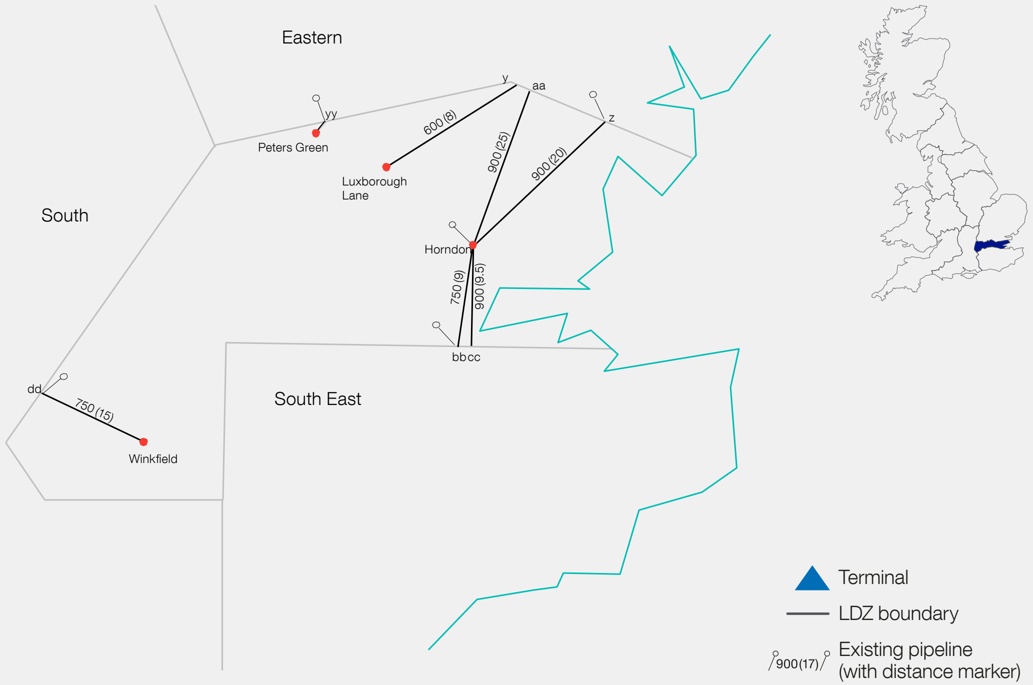
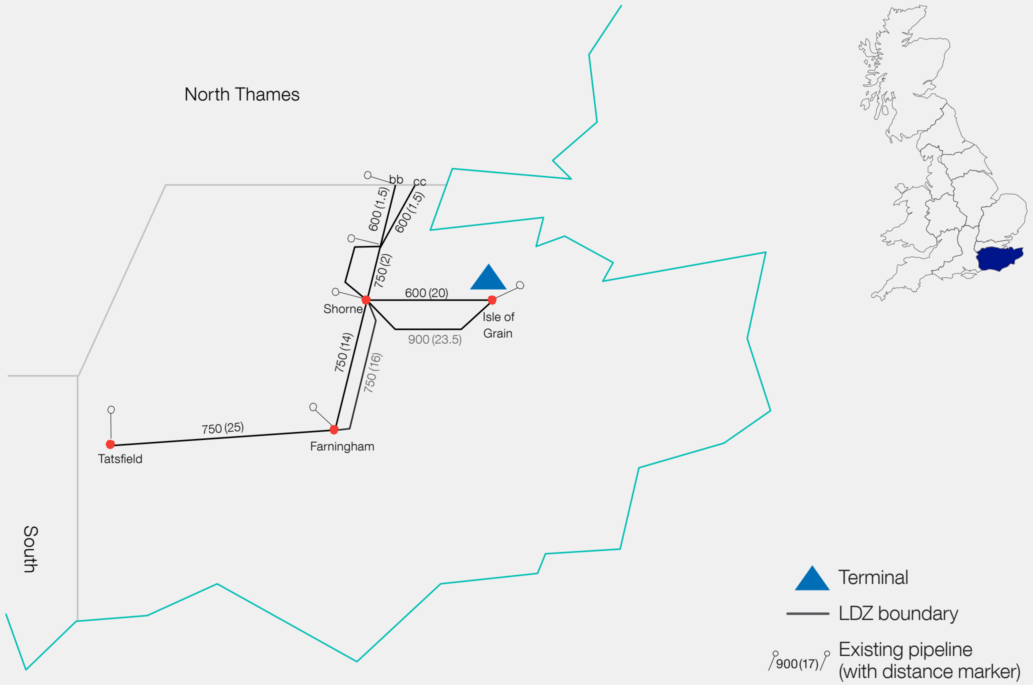
National Transmission System maps

Figure A1.9
North Thames (NT) – NTS



- Terminal
- LDZ boundary
- 900 (17) Existing pipeline (with distance marker)
- 900 Pipeline diameter (mm)
- (17) Length (km)
- a Denotes a crossing point between LDZs
- Offtake
- Existing compressor
- Ongoing emissions projects

Figure A1.10
South East (SE) – NTS



- Terminal
- LDZ boundary
- 900 (17) Existing pipeline (with distance marker)
- 900 Pipeline diameter (mm)
- (17) Length (km)
- a Denotes a crossing point between LDZs
- Offtake
- Existing compressor
- Ongoing emissions projects

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Figure A1.11
South (SO) – NTS

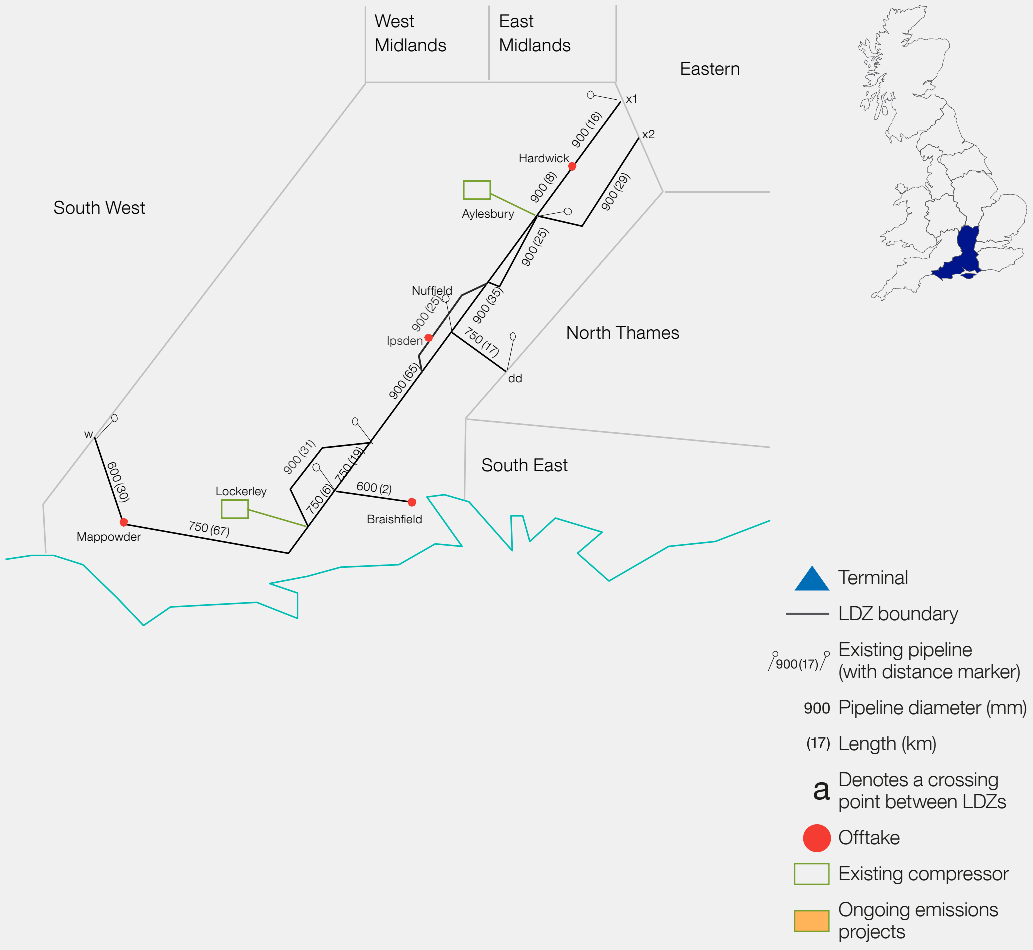
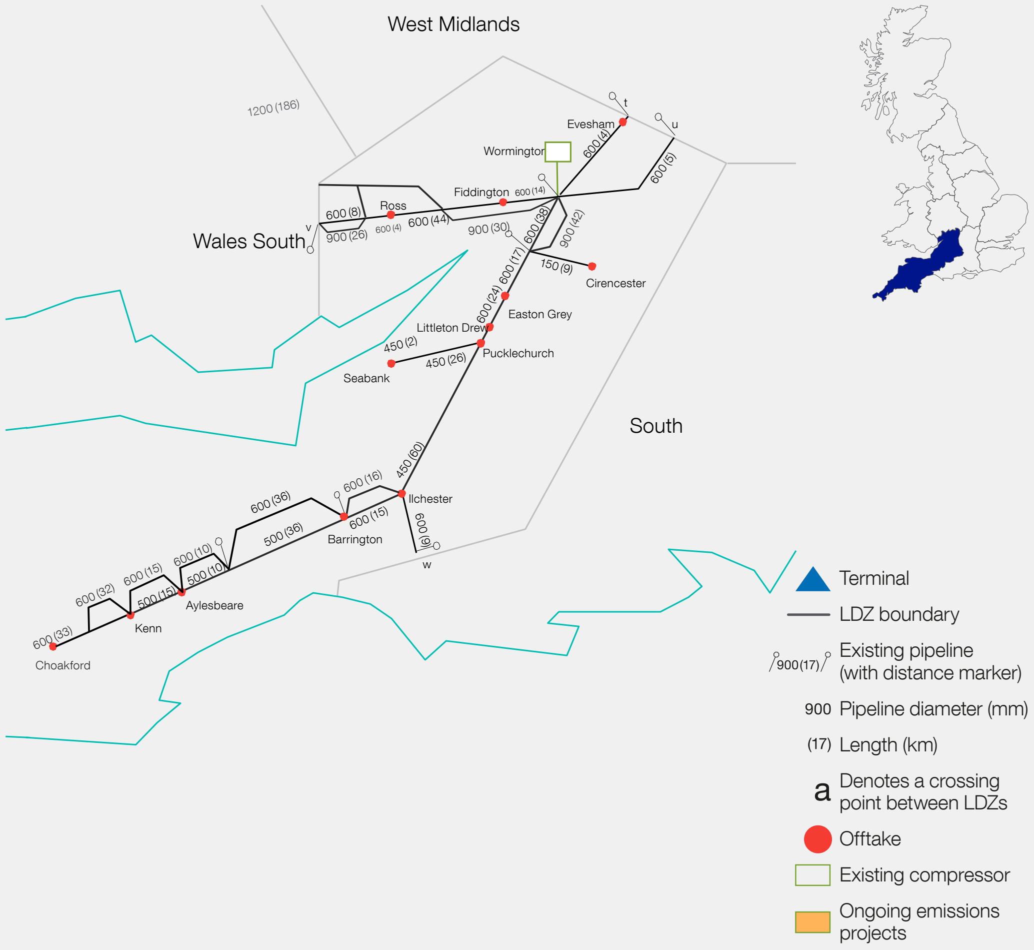


Figure A1.12
South West (SW) – NTS



Gas Ten Year Statement 2021

Appendix 2 – Network Capability

2.1 Network Capability Zones

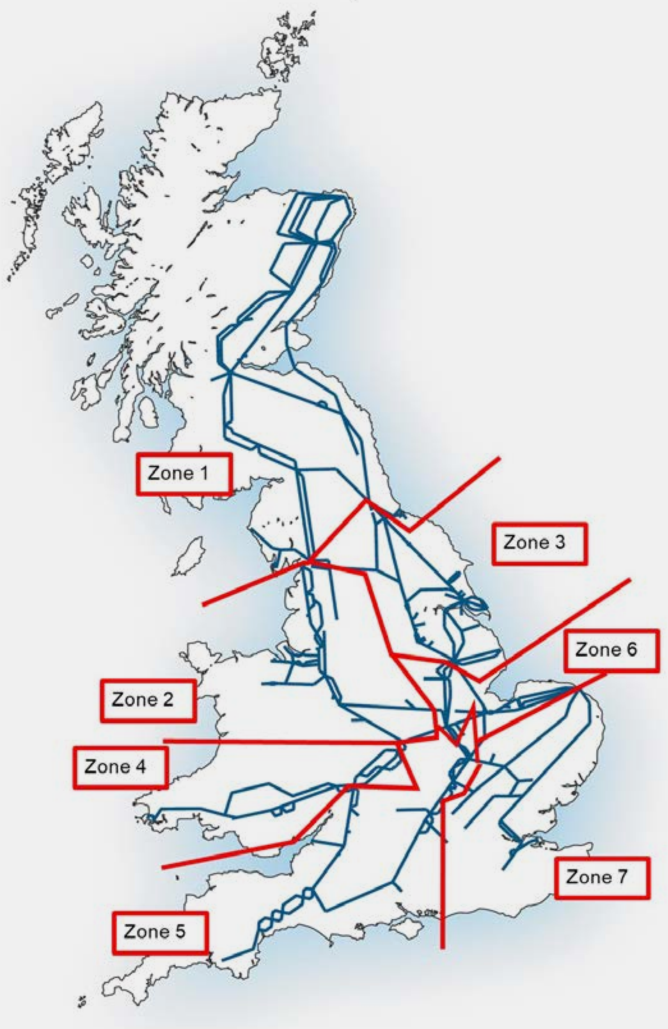
The National Transmission System (NTS) is a complex system of physical assets such as pipes, compressors, valves, supply points and offtakes. In order to simplify this, the analysis of the NTS has been partitioned into zones that correspond to the way in which gas flows through it. Figure A2.1 gives a simplified view of the NTS and the zones.

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

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

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

Figure A2.1
Network Capability entry and exit zones



Appendix 2 – Network Capability

2.2 Network Capability visualisations

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

The vertical axis reflects the absolute level of entry flow for the zone under consideration. The horizontal axis reflects the assumed pattern of national demand.

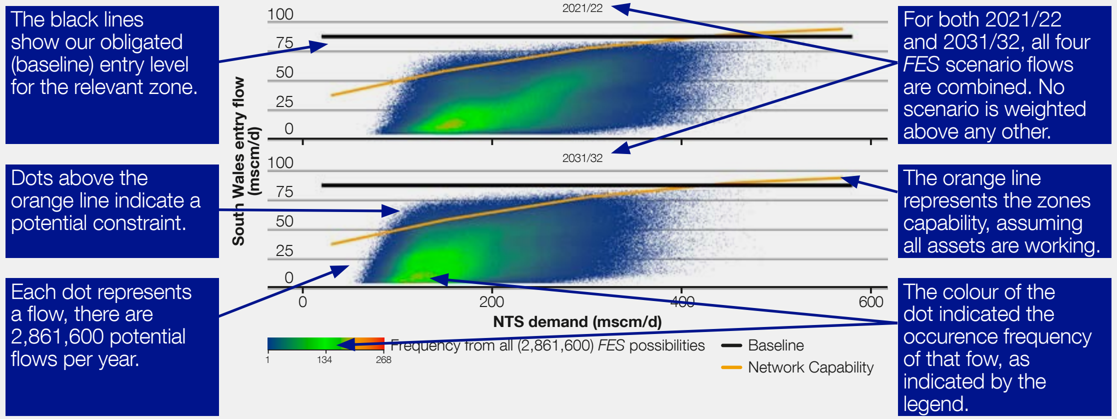
We analyse capability at a minimum of three different demand levels, Summer (low demand), Winter (high demand) and a midpoint demand. By interpolating these points we create Network Capability curves.

As each of the *Future Energy Scenarios* are equally plausible, and broadly similar for the next decade, we have combined all the flow data for the year 2021/22 into one heatmap and the flow data for 2031/32 into a second heatmap.

Figure A2.2 gives an explanation of what we show on the Network Capability charts.

For exit we do not use a line but instead a single figure per zone which is the 1-in-20 peak demand day level. This aligns closely with our Pipeline Security Standard obligation, and the exit design criteria for the NTS.

Figure A2.2
Entry Network Capability visualisation



Appendix 2 – Network Capability

2.2 Network Capability visualisations

Figure A2.3
Scotland and The North entry heatmap 2021/22 and 2031/32

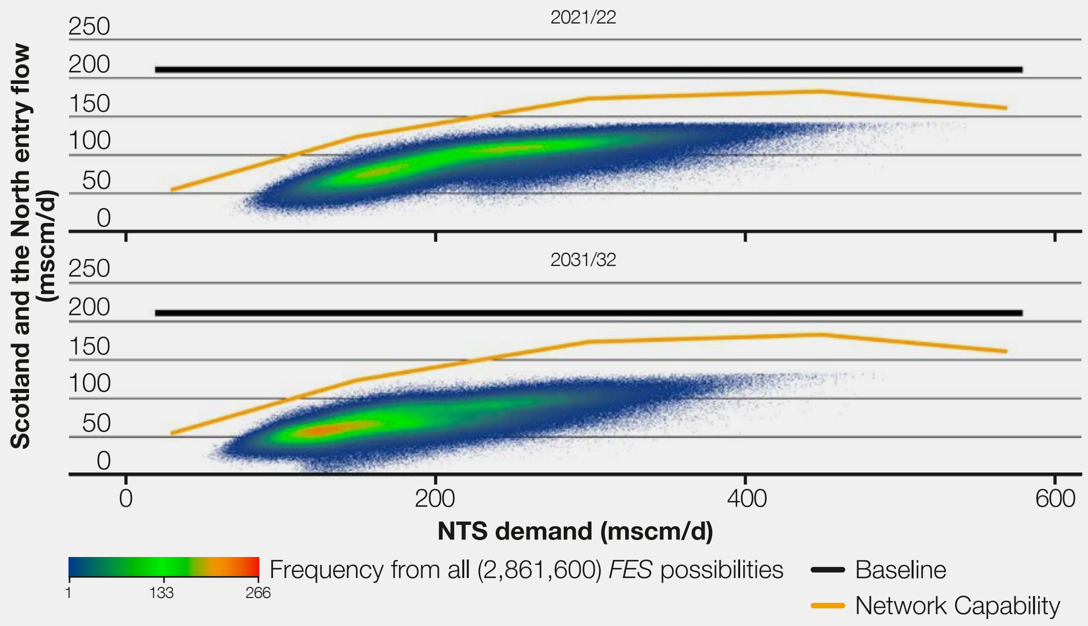
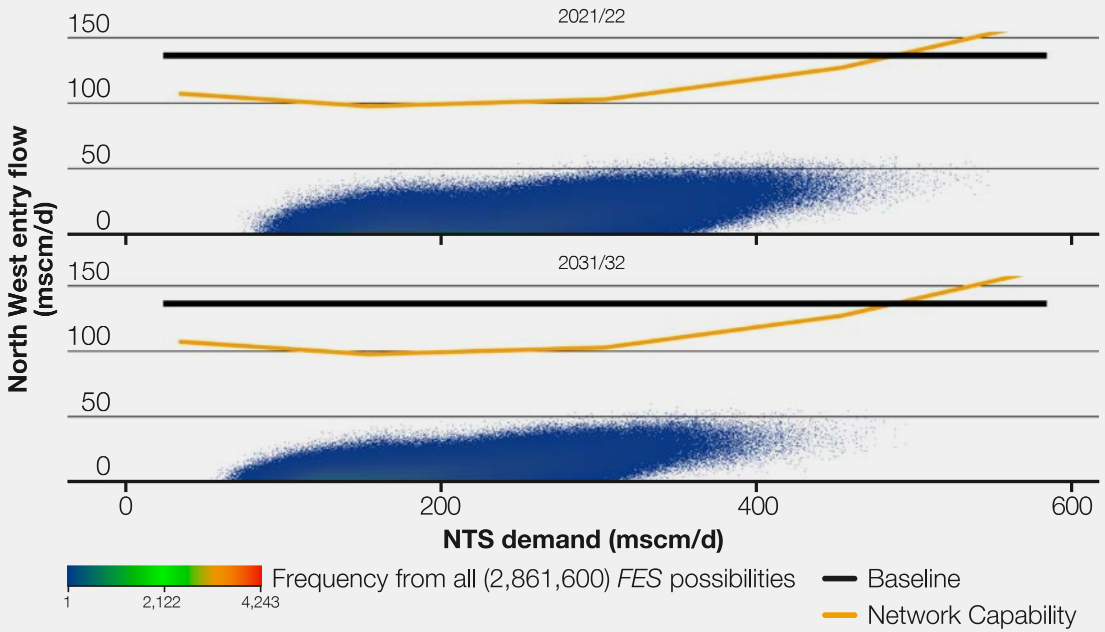


Figure A2.4
North West entry heatmap 2021/22 and 2031/32



Appendix 2 – Network Capability

2.2 Network Capability visualisations

Figure A2.5
North East entry heatmap 2021/22 and 2031/32

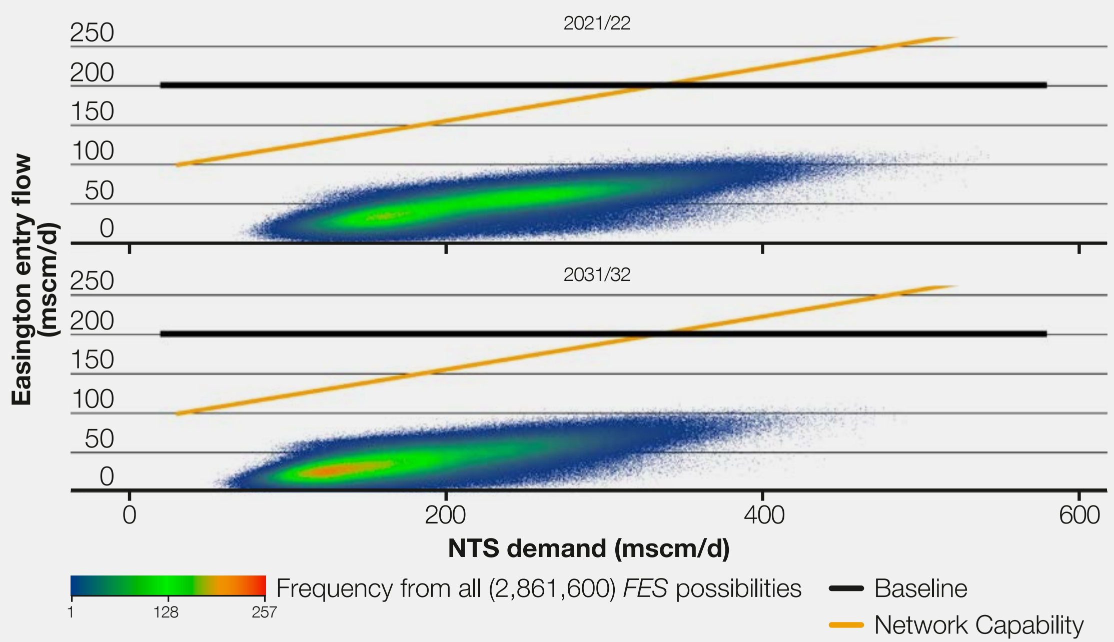
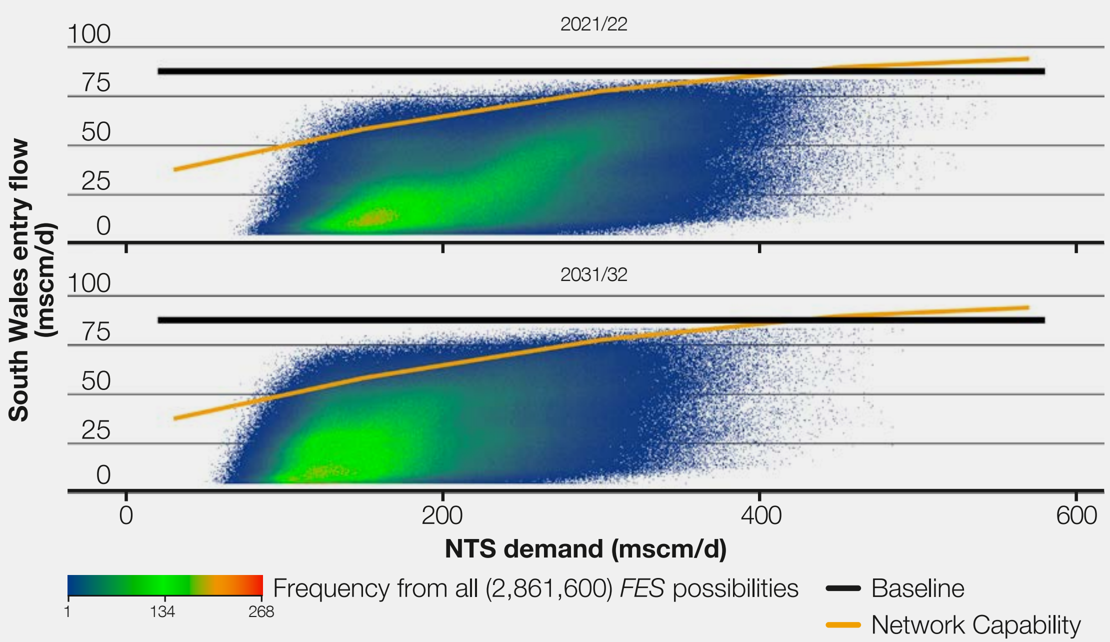


Figure A2.6
South Wales entry heatmap 2021/22 and 2031/32



Appendix 2 – Network Capability
2.2 Network Capability visualisations

Figure A2.7
South East entry heatmap 2021/22 and 2031/32

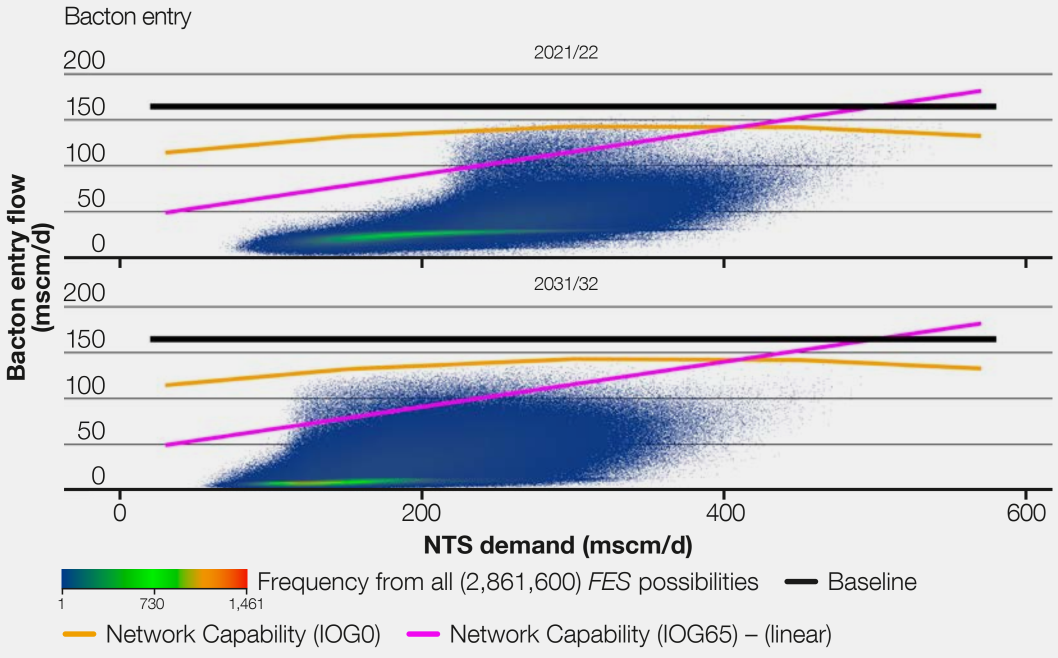
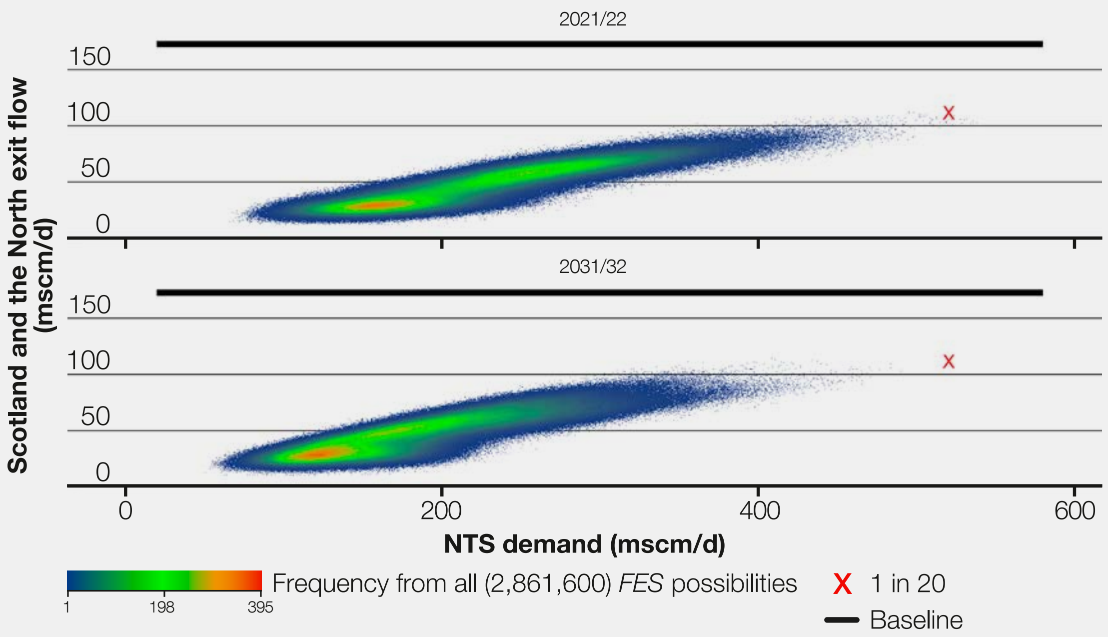


Figure A2.8
Scotland and The North exit heatmap 2021/22 and 2031/32



Appendix 2 – Network Capability
2.2 Network Capability visualisations

Figure A2.9
North West exit heatmap 2021/22 and 2031/32

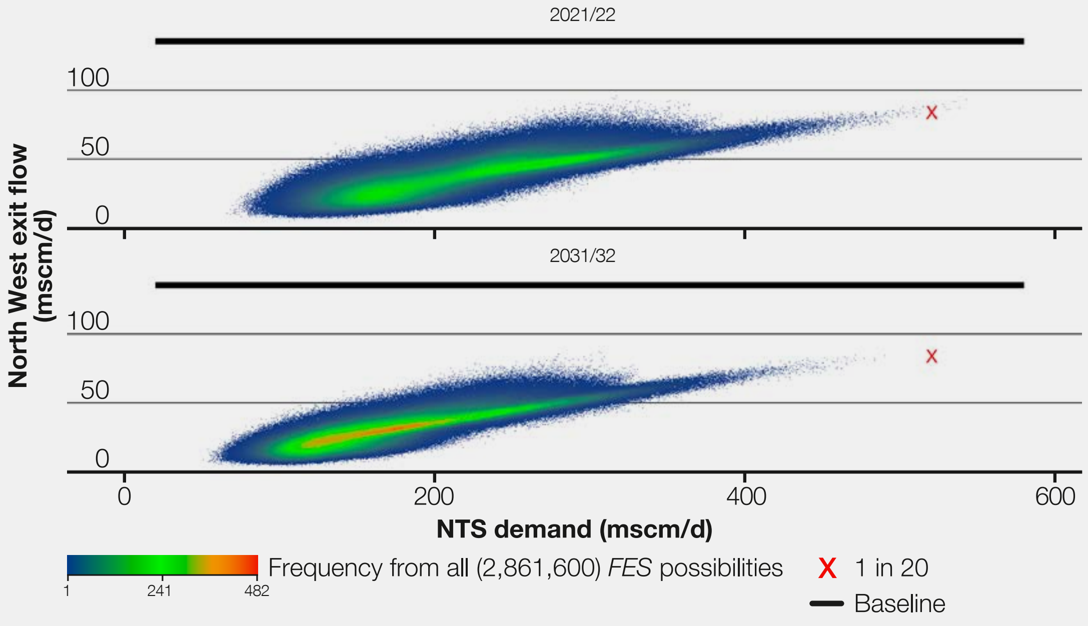
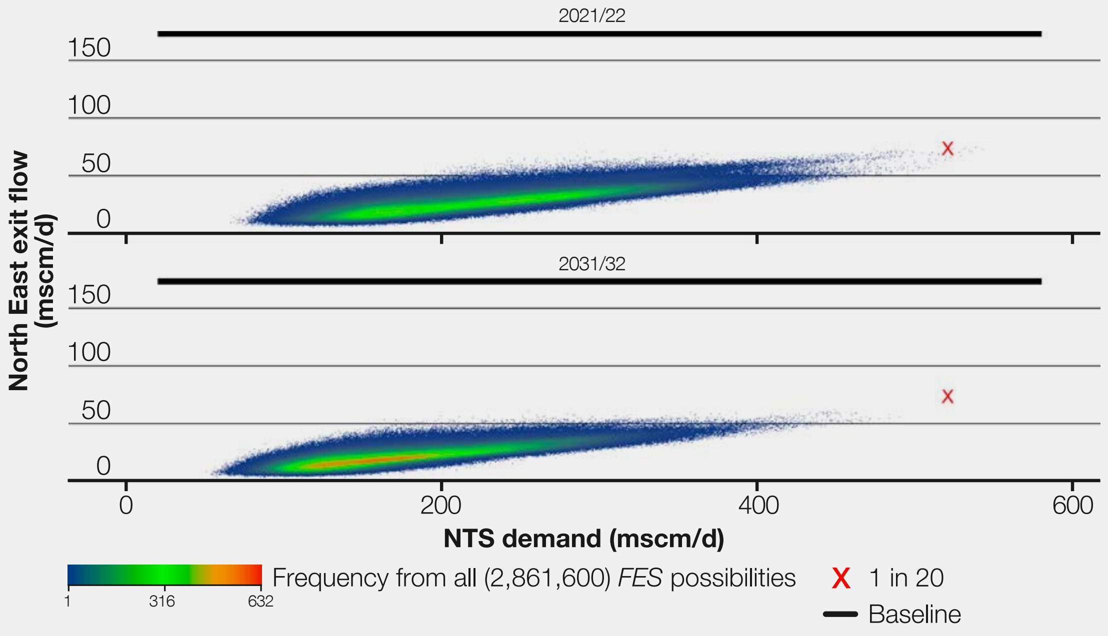


Figure A2.10
North East exit heatmap 2021/22 and 2031/32



Appendix 2 – Network Capability

2.2 Network Capability visualisations

Figure A2.11
South Wales exit heatmap 2021/22 and 2031/32

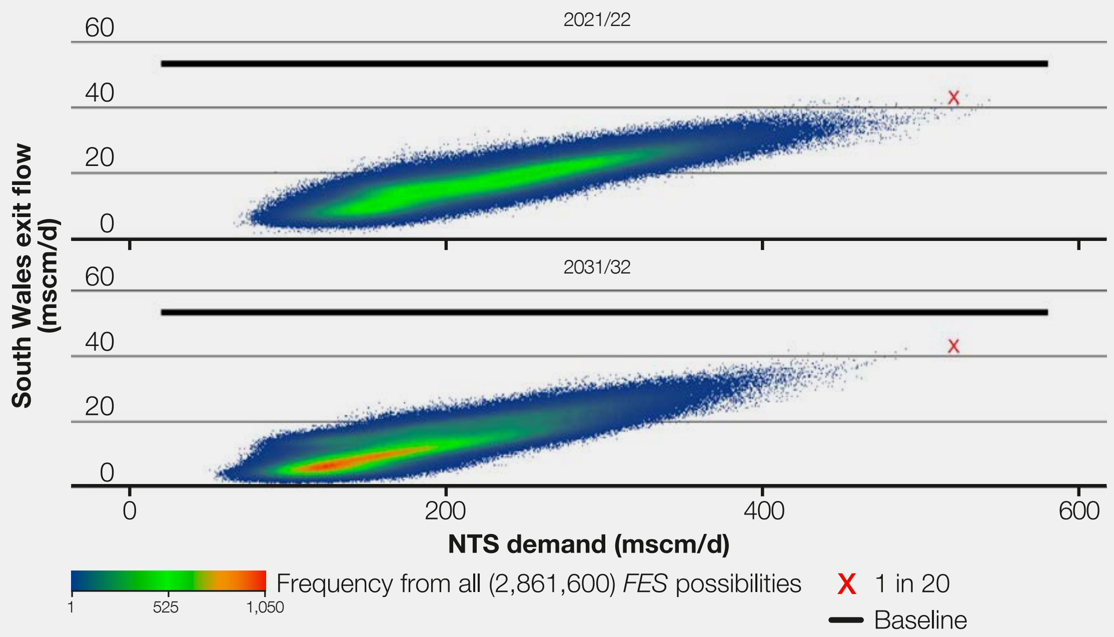
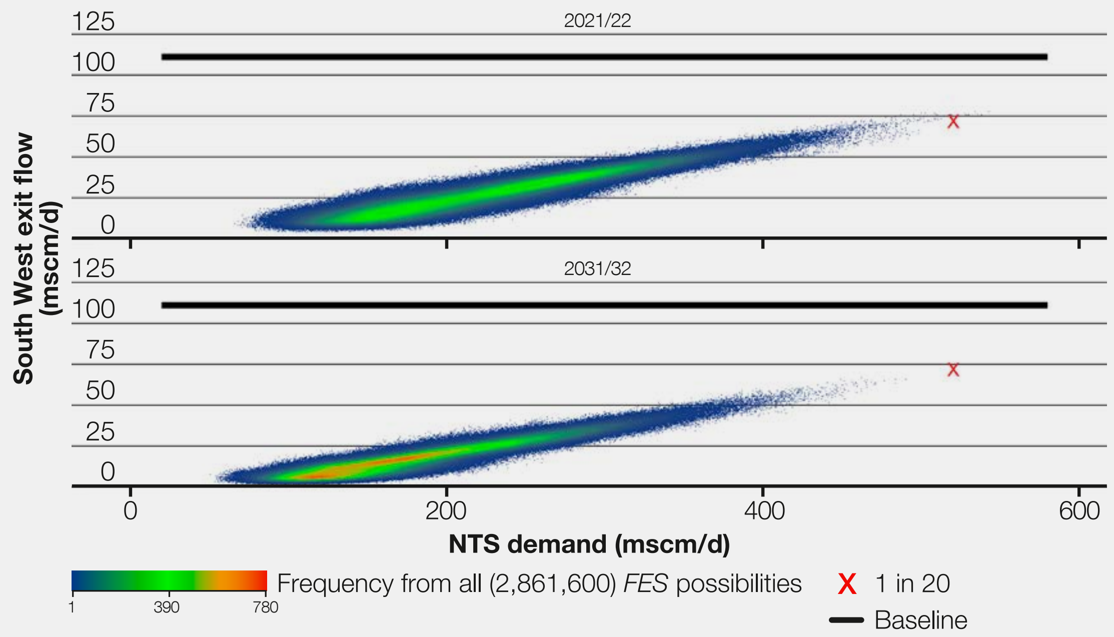


Figure A2.12
South West exit heatmap 2021/22 and 2031/32



Appendix 2 – Network Capability

2.2 Network Capability visualisations

Figure A2.13
East Midlands exit heatmap 2021/22 and 2031/32

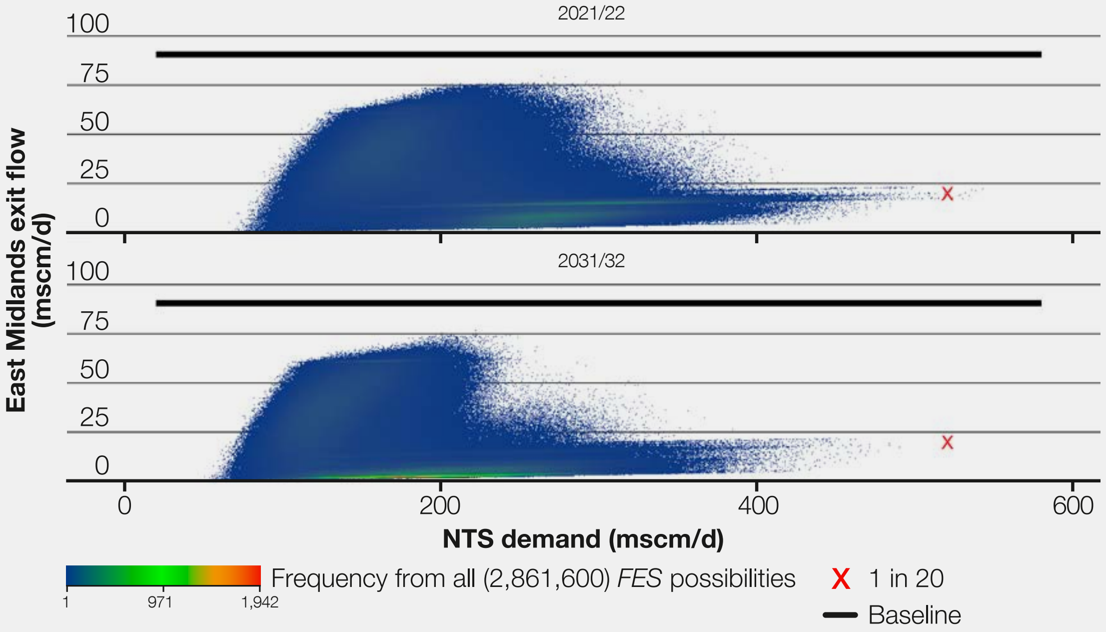
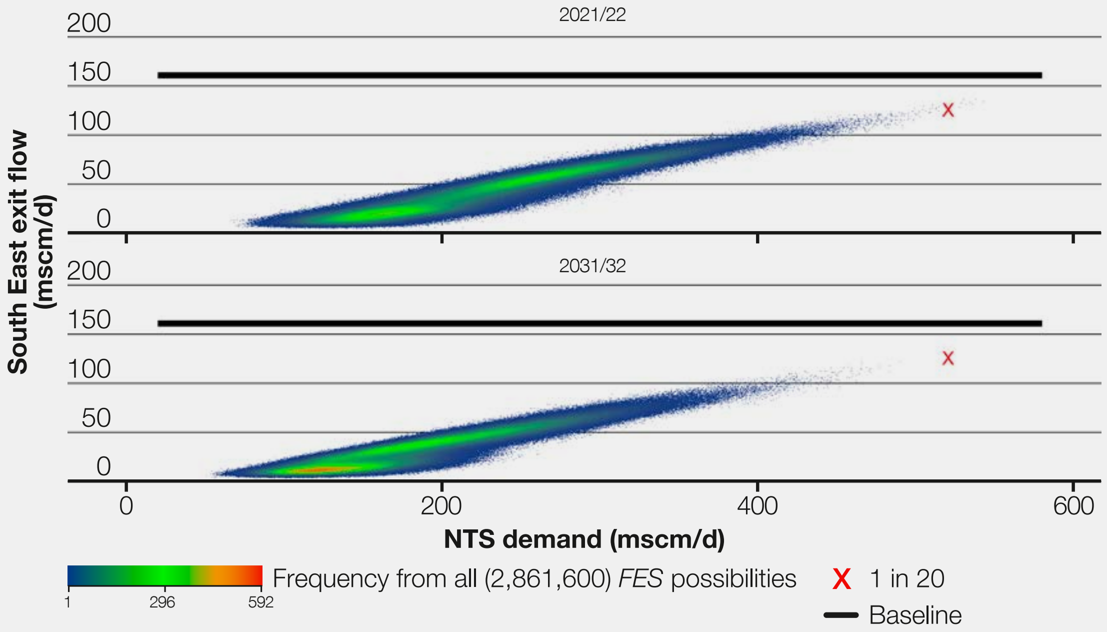


Figure A2.14
South East exit heatmap 2021/22 and 2031/32



Appendix 3 – Network entry quality specification

3.1 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 A3.1 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.

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

The Calorific Value (CV) of gas, which is dry, gross and measured at standard conditions of temperature and pressure, is usually quoted in Megajoules per cubic metre (MJ/m3). CV shall normally be in the range of 36.9MJ/m3 to 42.3MJ/m3 but the Wobbe number provides the overriding limit.

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

Table A3.1
Gas quality specifications

Parameter	Quality requirement
Hydrogen sulphide	Not more than 5 mg/m³
Total sulphur	Not more than 50 mg/m³
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/m³
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)
Contaminants	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/m³
Radioactivity	Not more than 5 becquerels/g
Odour	Gas delivered shall have no odour that might contravene any statutory obligation. The odourisation requirements in GS(M)R do not apply where the gas is at a pressure above 7 barg.
Pressure	The delivery pressure shall be the pressure required to deliver natural gas at the delivery point into our entry facility at any time, taking into account the back pressure of our system at the delivery point, which will vary from time to time. The entry pressure shall not exceed the maximum operating pressure at the delivery point.
Delivery temperature	Between 1°C and 38°C
Mercury	No more than 10 µg/m³
*Requests for higher limits will be considered	

Appendix 3 – Network entry quality specification
3.2 Gas quality developments

EU developments

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

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

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

This challenge has led to a proposal to de-couple the entry and exit specifications with a wide range at entry and offtakes categorised according to the Wobbe Index of the gas they are expected to receive, with TSOs having a role in determining and monitoring this. ENTSOG has also been leading a stakeholder group to develop a roadmap across the gas value chain towards increasing concentrations of hydrogen in gas networks.

The European Commission (EC) issued a consultation on Hydrogen and Gas Market Decarbonisation, in which it sought views on how best to coordinate the admission of low carbon gases, manage increased fluctuations and deliver greater transparency in relation to gas quality to inform proposals to review the Gas Directive and Gas Regulation later in 2021.

Appendix 3 – Network entry quality specification
3.2 Gas quality developments

GB developments

Following an IGEM consultation in 2020 on a draft standard to amend the GB gas quality specification, IGEM submitted its proposal and evidence case to the HSE for review. The proposals seek to widen the Wobbe Index range, replace the soot index and incomplete combustion factor parameters with relative density and increase the legal limit for oxygen content from 0.2 mol per cent to 1.0 mol per cent on below 38 bar systems. We currently expect that the proposed standard and other changes to GS(M)R will be subject to a government consultation and impact assessment process led by the HSE later in 2021. If the Government concludes that the proposals for change should be implemented then we expect a parliamentary process to change GS(M)R in 2022 and a subsequent process to amend NTS connection agreements to enable wider specification gas to enter the NTS.

As part of our Gas Markets Plan (GMaP) programme, we concluded a project which reviewed the UNC process for implementing gas quality changes with industry stakeholders and will also soon be launching a new GMaP project, looking at how adverse impacts of a wider Wobbe range on industrial and commercial users might best be mitigated.

In 2021, we also implemented a temporary gas quality blending arrangement at Bacton to enable gas from the Cygnus field to be delivered to the NTS that would otherwise have been locked out due to a planned outage of the SEAL gas fields that normally serve as a blending source to enable compliance. We worked with the Bacton operators to design and implement new operational controls such that the risk of non-compliant gas entering the NTS was not increased and secured the necessary regulatory approvals for this to proceed. A wider project to explore the potential for National Grid to offer a gas quality blending service at suitable NTS entry terminals where multiple sources of gas are delivered into and comingled within the National Grid terminal prior to being discharged onto NTS pipelines was also completed. From this we concluded that it would not be feasible to offer this as an enduring service arrangement at NTS entry terminals but remain open to consider short-duration requests.

Appendix 4 – Connection and capacity application process

4.1 Introduction

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

We have produced a high-level overview of our connection and capacity application processes in table A4.1 with links to help you to navigate to the relevant section of this year's *GTYS*. Our customers have the flexibility to initiate these two processes at their discretion. However, the two processes can become dependent on each other.

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

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

Table A4.1
Our connection and capacity application process

Click on the icon below for more information

	Our connection and capacity processes				
	Our customers and their key service requirements:	Find more information in *GTYS*:	Gas shipper	Distribution network (DN)	Customers
Connections	Application to offer (A2O)	Appendix 4, section 4.2	✗	✓	✓
	Disconnection/ Decommissioning	Appendix 4, section 4.2	✗	✓	✓
Entry and exit capacity	Quarterly System Entry Capacity Auctions	Appendix 4, section 4.3	✓	✗	✗
	Exit Application Windows	Appendix 4, section 4.4	✓	✓	✗
	Exit Application Window Enduring annual NTS exit capacity	Appendix 4, section 4.4	✓	✓	✗
	Flexible capacity for flow changes	Appendix 4, section 4.4	✗	✓	✗
	Entry/Exit Planning and Advanced Reservation of Capacity Agreement	Appendix 4, section 4.6	✓	✓	✓
CAM incremental	Incremental entry/ exit capacity trigger process for interconnection points (IP). This follows the principles of PARCA	Appendix 4, section 4.5 and 4.7	✓	✗	✓

Appendix 4 – Connection and capacity application process

4.2 Connecting and disconnecting to/from our network

Connection and disconnection

Table A4.2 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 A4.2
NTS gas connection and disconnection

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

Appendix 4 – Connection and capacity application process

4.2 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)
- definition of the content of an initial connection offer
- definition of the content of a full connection offer
- how to request a modification to a full connection offer
- timescales for National Grid to produce a connection offer
- timescales for customers to accept initial/full connection 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 connections process. You can register for our Gas Connection Portal for a free cost estimate if you have a potential connection project. The portal is also used to make applications.

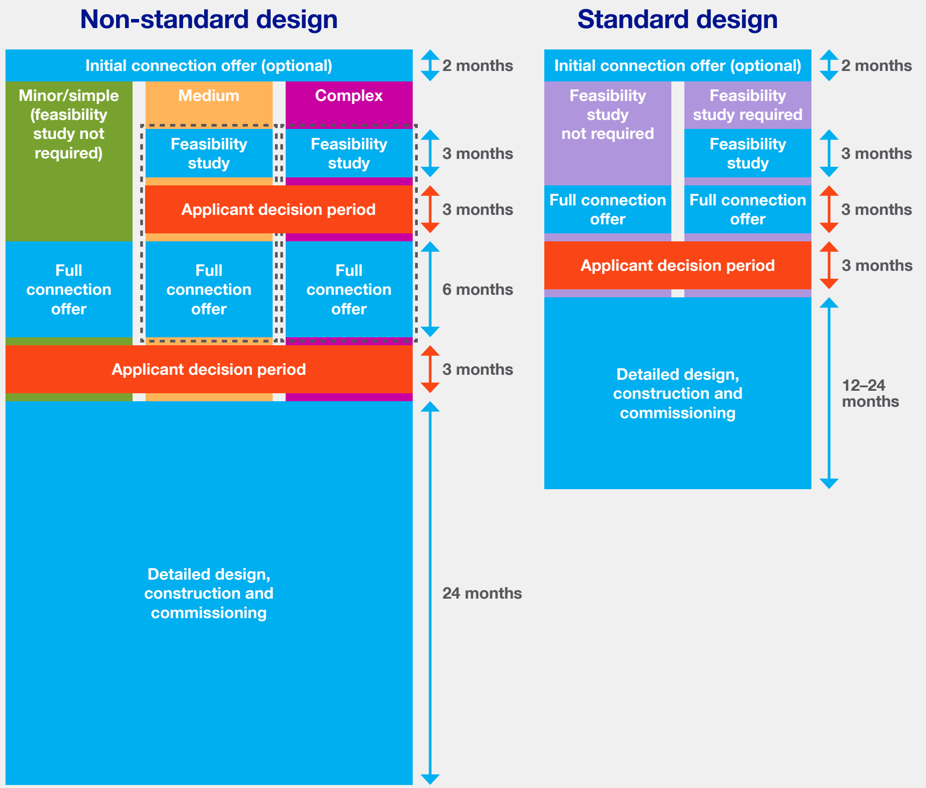
Figure A4.3 summarises the A2O process and the timescales associated with each stage. These timescales are indicative for construction, and each connection project has a bespoke programme for the detailed design, construction and commissioning phase.

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.

Figure A4.3
Application to offer (A2O) process



Appendix 4 – Connection and capacity application process

4.2 Connecting and disconnecting to/from our network

Connections 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 4 – Connection and capacity application process

4.2 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 4.6). 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 4 – Connection and capacity application process

4.3 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)
- Incremental NTS Entry Capacity (obligated)
- Non-Obligated Incremental 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.

Interruptible capacity rights may be curtailed by National Grid if there are high pressures on the network and an entry constraint is forecast.

Appendix 4 – Connection and capacity application process

4.3 NTS entry capacity

NTS entry capacity auctions

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

- Quarterly System Entry Capacity (QSEC) Please see figure A4.4 for more information on the results from this year's QSEC.
- Annual Monthly System Entry Capacity (AMSEC).
- Rolling Monthly Trade & Transfer (RMTnTSEC).

Any unsold quantities of Firm NTS entry capacity from the AMSEC auctions are made available as a monthly strip for M+1 (where M = current month). The RMTnTSEC auction is a 'pay as bid' auction and is subject to a minimum reserve price.

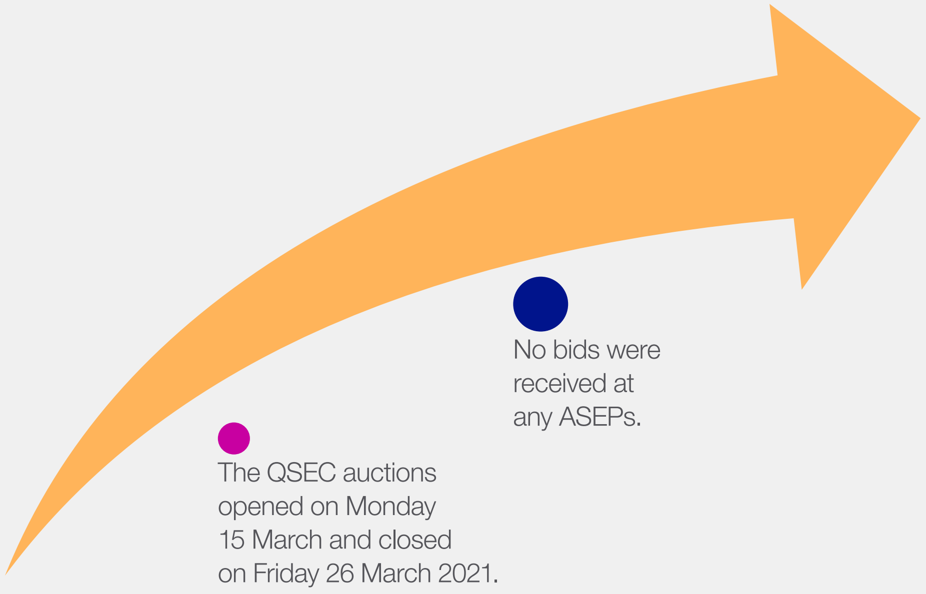
Information on interconnection points entry capacity auctions can be found in appendix 4, section 4.5 and 4.7.

Incremental obligated capacity

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

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

Figure A4.4
2021 QSEC auction



Appendix 4 – Connection and capacity application process

4.4 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)
- Incremental NTS Exit Capacity (Non-obligated).

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 if there are low pressures on the network and an exit constraint is forecast.

NTS exit capacity application windows and auctions

To obtain firm exit capacity, a shipper can bid for capacity on the Gemini system through a series of auctions. For long-term capacity shippers can bid in the following auctions:

- 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 1–31 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 4 – Connection and capacity application process

4.5 Capacity at interconnection points

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

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

Entry:

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

Exit:

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

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

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

- The first 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 held on the 1st Tuesday of November**, capacity will be auctioned for the quarters January–March, April–June and July–September.
- The third held on the 1st Monday of February, capacity will be auctioned for the quarters April–June and July–September.
- The fourth held on the 1st Monday of May, capacity will be auctioned for the last quarter (July–September).

The rolling monthly capacity auction will be held once a month. It will open on the third Monday of each month, for capacity rights in the following month.

* Firm capacity will be automatically bundled in the PRISMA system, where corresponding capacity is also being made available by the adjacent Transmission System Operator.

** moved from the 1st Monday in 2021 due to All Saints' Day and a bank holiday in Europe.

Appendix 4 – Connection and capacity application process

4.6 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).

4.6.1 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 A4.5). This phased structure gives the customer natural decision points where they can choose whether to proceed to the next phase of activities. The PARCA process is flexible to allow the customer to leave the process at any time before full financial commitment to the capacity through capacity allocation. Please note, a reservation of capacity through a PARCA does not provide an NTS connection.

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

Appendix 4 – Connection and capacity application process

4.7 Incremental capacity at interconnection points

Figure A4.5
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 allocates 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)

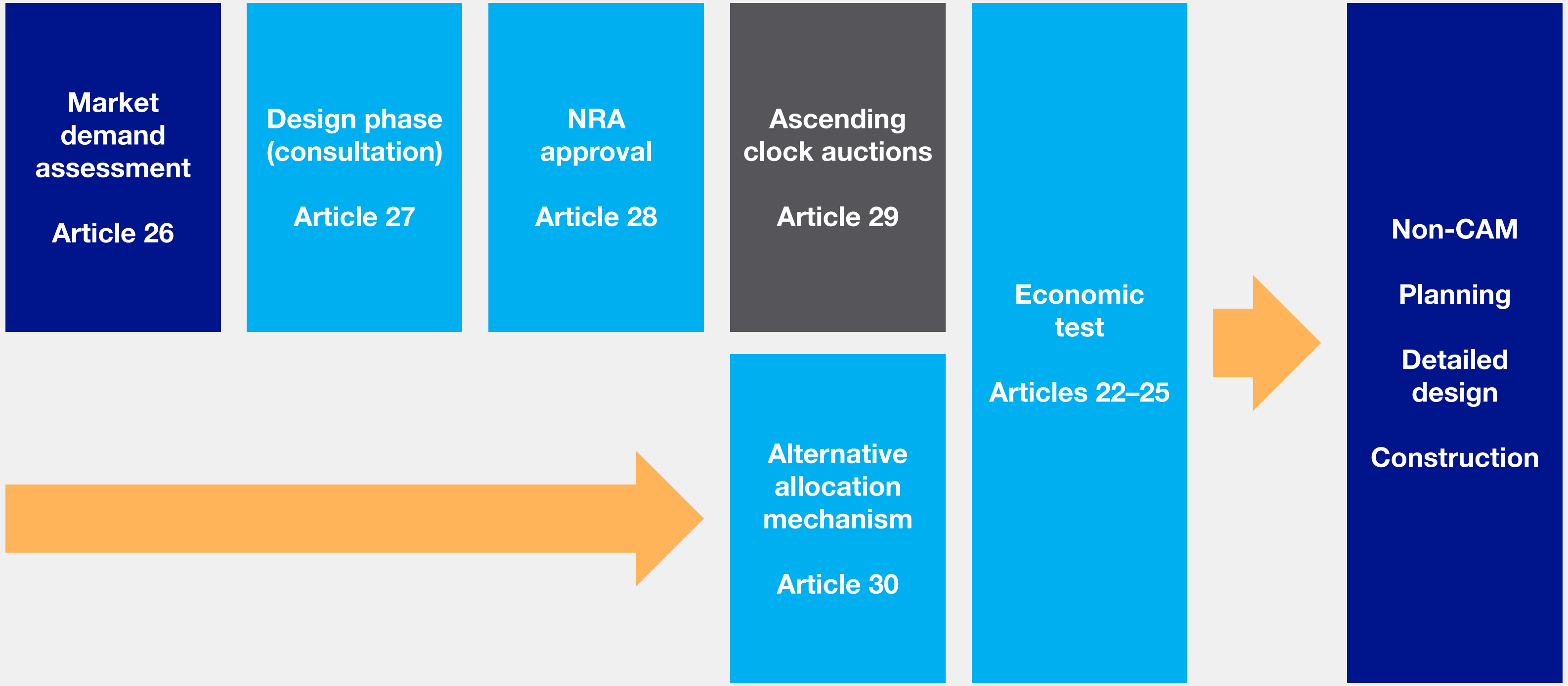
Appendix 4 – Connection and capacity application process

4.7 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 A4.6). 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. This is a bi-annual process for which a window was last opened in July 2021.

Figure A4.6
Phases of releasing incremental capacity



Appendix 5
Meet the teams

5.1 Gas Connections Contracts team

Our role within the Gas Connections Contracts 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 Contracts team
box.UKT.customerlifecycle@nationalgrid.com

5.2 Operational Liaison and Business Planning team

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

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

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

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

The Operational Liaison team
Box.OperationalLiaison@nationalgrid.com

Appendix 6
Exit and entry capacity application process

6.1 Exit capacity on the NTS

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

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

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.

Figure A6.1
Capacity lead times

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Exit and entry capacity application process

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 show how unsold capacity has changed since the publication of the *2020 Gas Ten Year Statement*.

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

Region Number	Region	Obligated	Unsold % change since 2020		
		(GWh/d)	(GWh/d)	% of unsold capacity	Unsold % change since 2020
1	Scotland & the North	718	235	33	+3
2	North West & West Midlands (North)	1110	413	37	-1
2.1	North Wales & Cheshire	315	197	63	-2
3	North East, Yorkshire & Lincolnshire	1600	718	45	+1
4	South Wales & West Midlands (South)	567	216	38	+10
5	Central & East Midlands	260	107	41	-2
6	Peterborough to Aylesbury	126	17	13	0
7	Norfolk	366	142	39	+1
8	Southern	526	205	39	+1
9	London, Suffolk & the South East	1405	513	37	+6
10	South West	458	114	25	+13

Appendix 6
Exit and entry capacity application process

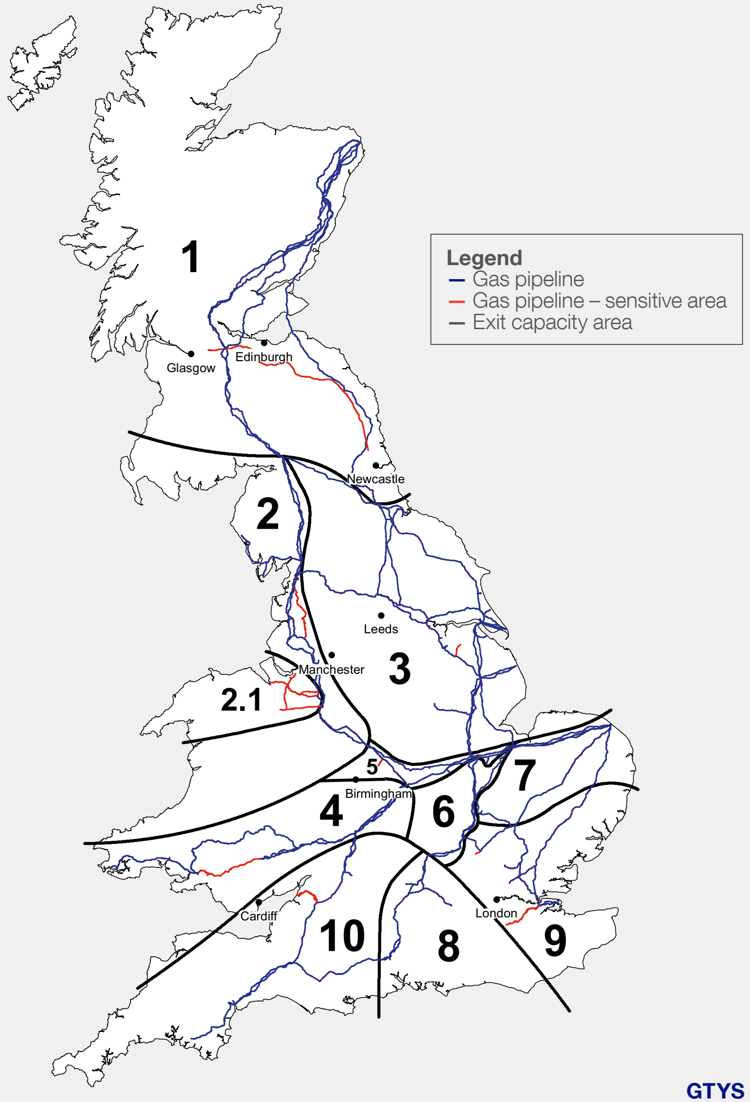
6.1.2 NTS exit capacity map

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

Figure A6.2
NTS exit capacity map



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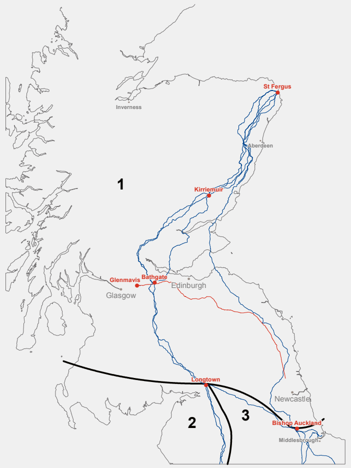
Exit and entry capacity application process

Figure A6.3
Region 1 – Scotland and the North



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

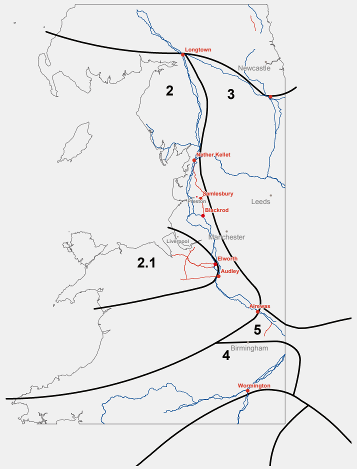
NTS location:
North of Longtown and Bishop Auckland

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

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

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

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



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

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

NTS/DN exit zones:
NW1, WM1

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

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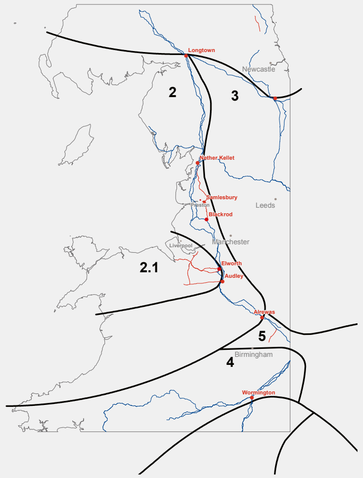
Exit and entry capacity application process

Figure A6.5
Region 2.1 – North Wales and Cheshire



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

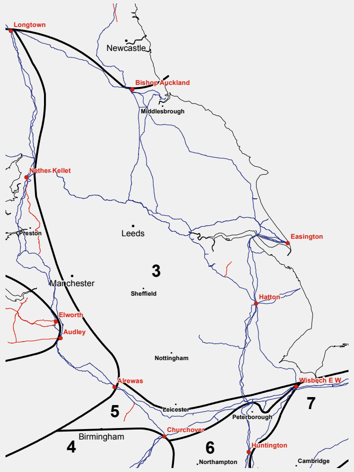
NTS location:
West of Elworth and Audley (Feeder 4)

NTS/DN exit zones:
NW2, WA1

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

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

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



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

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

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

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

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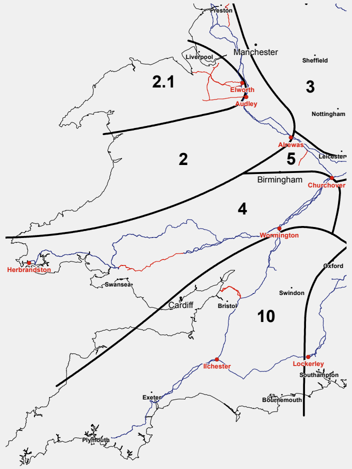
Figure A6.7
Region 4 – South Wales and West Midlands (South)



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

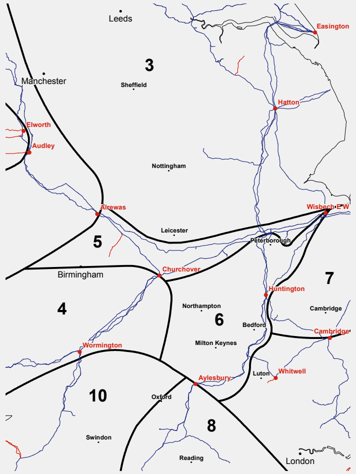
NTS location:
West of Churchover

NTS/DN exit zones:
WM3, SW1, WA2

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

Potential non-Planning Act reinforcements could release small quantities of capacity, but significant pipeline reinforcement would be required, particularly in the sensitive area on Feeder 2, south of Cilfrew between Dyffryn Clydach and Gilwern, due to the different pressure ratings.

Figure A6.8
Region 5 – Central and East Midlands



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

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

NTS/DN exit zones:
EM3, 4, WM2

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

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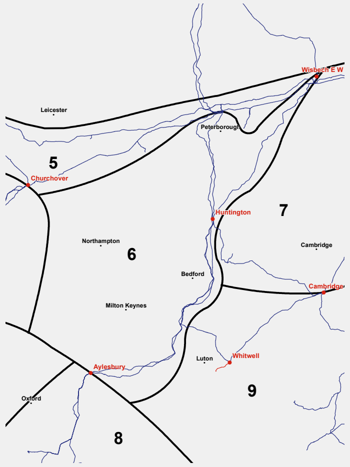
Figure A6.9
Region 6 – Peterborough to Aylesbury



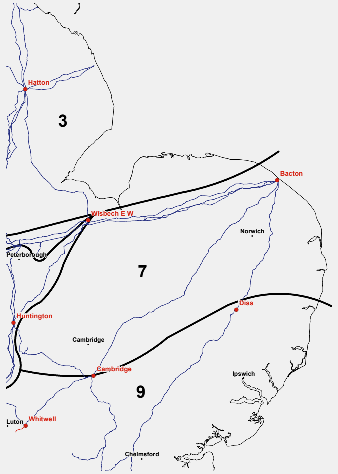
Legend
- Key sites
- Gas pipeline
- Gas pipeline – sensitive area
- Exit capacity area

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

NTS/DN exit zones:
EA6, 7

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

Figure A6.10
Region 7 – Norfolk



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

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

NTS/DN exit zones:
EA1, 2, 3

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

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

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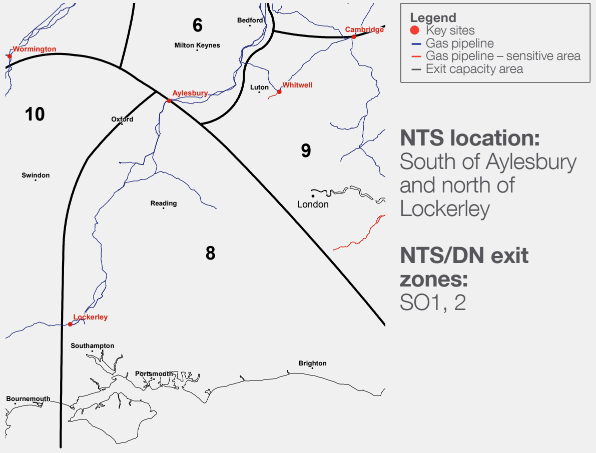
Figure A6.11
Region 8 – Southern

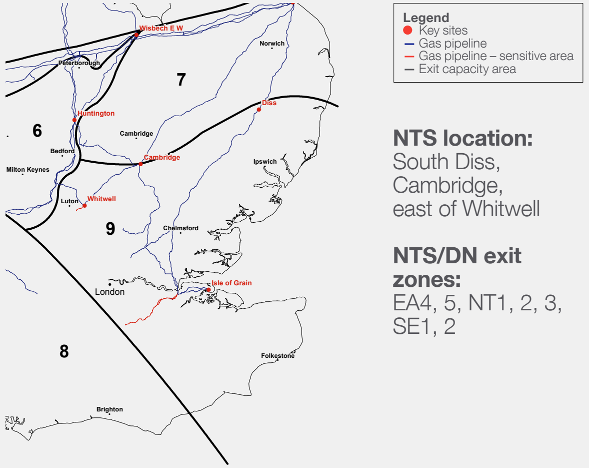


NTS location:
South of Aylesbury and north of Lockerley

NTS/DN exit zones:
SO1, 2

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

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



NTS location:
South Diss, Cambridge, east of Whitwell

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

The region is sensitive to Isle of Grain flows, with low flows limiting capacity. Capacity may be more limited in the sensitive areas at the extremities of the system, for example at Feeders 5 and 18 from Shorne to Tatsfield, and Feeder 3 from Whitwell to Peters Green. The significant number of power stations in the region may impact on future ramp rate agreements. Unsold capacity indicates some capacity could be made available via exit capacity substitution; however, exchange rates may vary between locations. Potential non-Planning Act reinforcements could be carried out to release small quantities of additional capacity but significant pipeline reinforcement would be needed.

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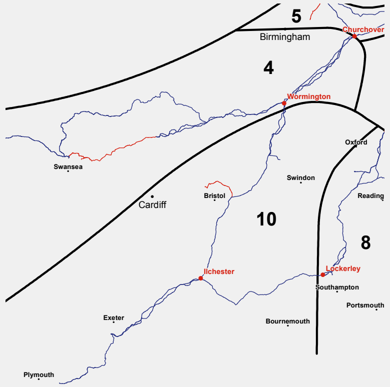
Figure A6.13
Region 10 – South West



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

NTS location:
South of Wormington and Lockerley

NTS/DN exit zones:
SW2, 3

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

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6.1.3 Directly connected exit points

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

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

Region	Offtake
1	Blackness (BP Grangemouth)
	Fordoun Industrial
	Glenmavis (Storage)
	Gowkhall (Longannet)
	Moffat Irish Interconnector
	St Fergus (Peterhead)
	St Fergus (Shell Blackstart)
2	Barrow (Bains)
	Barrow (Blackstart)
	Barrow (Gateway)
	Carrington (Partington) Power Station
	Ferny Knoll (AM Paper)
	Fleetwood (Preesall) Storage
	Roosecote Power Station
	Sandy Lane (Blackburn) Power Station
	Sellafield Power Station
2.1	Burton Point (Connahs Quay)
	Deeside Power Station
	Harwarden (Aka Shotton Paper)
	Hill Top Farm Storage
	Hole House Farm Storage
	Holford Storage
	Hollingsgreen (Hays Chemicals)
	ICIR (CastnerKelner_ICI_Runcorn)
	King Street Storage
	Pickmere (Winnington Power Station)
	Shellstar (Aka Kemira)
2.1	Shotwick (BridgewaterPaper)
	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
	Keadby 2 Power Station
	Phillips Petroleum Teeside
	Rosehill (Saltend) Power Station
	Rough Storage
	Saltend BPHP
	Saltfleetby Storage
	Saltholme Power Station
	Spalding 2 (South Holland) Power Station
	Stalingborough
	Staythorpe
3	Sutton Bridge Power Station
	Teeside (BASF)
	Teeside Hydrogen
	Teeside (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
	Drakelow Power Station
	Peterborough Power Station
7	Bacton (Baird) Storage
	Bacton (Deborah) Storage
	Bacton (Esmond Forbes) Storage
	Bacton Great Yarmouth
	Bacton IUK Interconnector
	Palm Paper
	Saddle Bow (King's 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

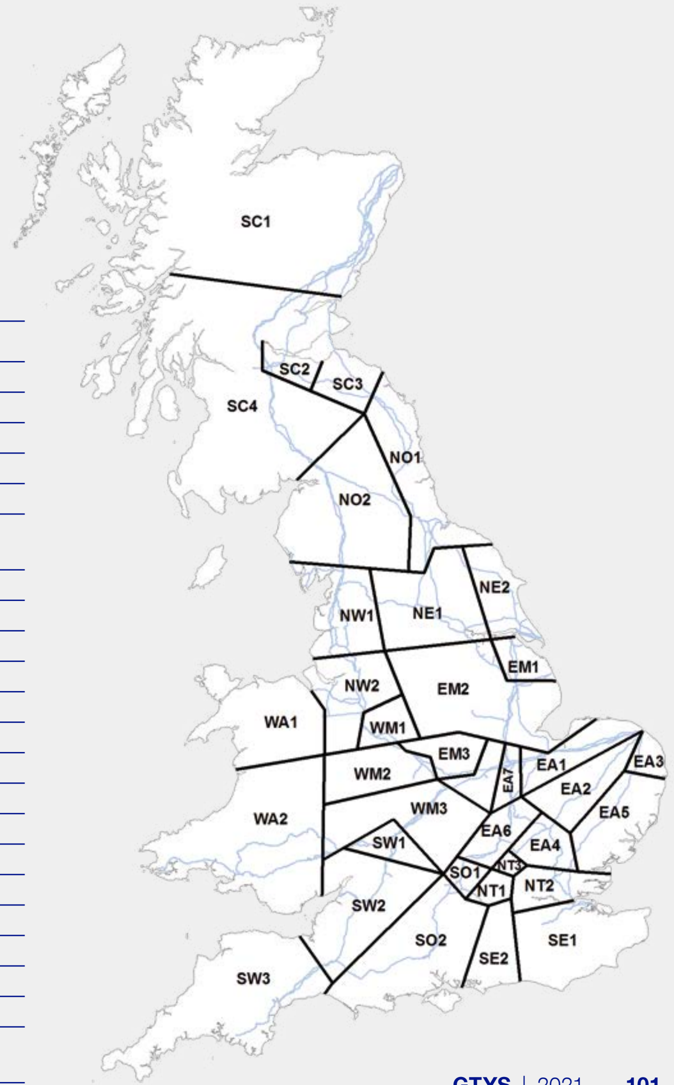
6.1.4 NTS/DN exit zones

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
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
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
	St Fergus
	Mosside
SC2	Broxburn
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
	Ross (SW)
SW2	Littleton Drew
	Easton Grey
	Cirencester
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



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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 section contains information about capacity availability and the lead time for providing NTS entry capacity as a guide for shippers and developers. Unsold NTS entry capacity available at an existing 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.

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

6.2.1 Gas supply diversity

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

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

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

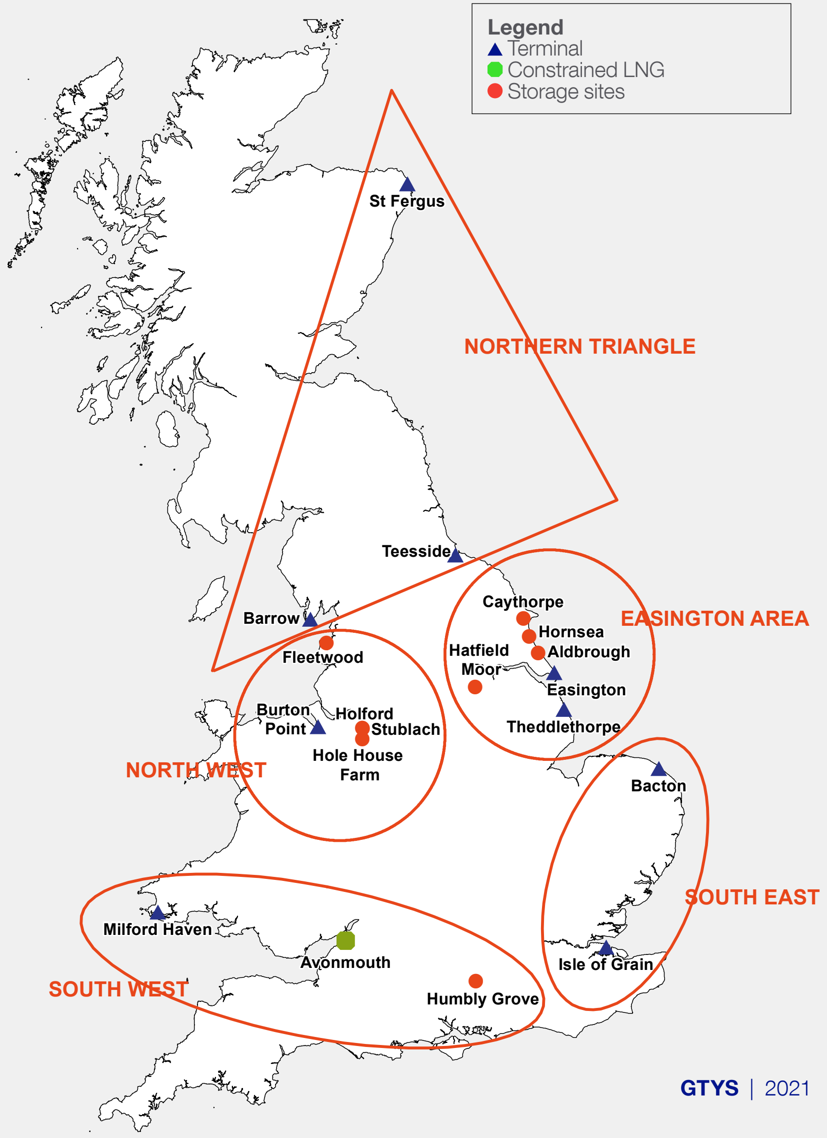
We are continuing to develop our processes to better manage the risks that arise from such uncertainties as part of our Gas Future Operability Planning (GFOP) work.

6.2.2 Entry capacity zones

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

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

Figure A6.15
Zonal grouping of interacting supplies



Appendix 6 – Exit and entry capacity application process

6.2 Entry capacity on the NTS

6.2.3 Customer entry capacity applications

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

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

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

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

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

6.2.4 Available (unsold) NTS entry capacity

Table A6.4 contains the ASEP names as defined in the NTS Licence, and indicates the quantities of obligated and unsold NTS entry capacity at each ASEP within each entry zone. This table has been updated to show how unsold capacity has changed since the publication of the 2020 *Gas Ten Year Statement*.

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

Appendix 6 – Exit and entry capacity application process

6.2 Entry capacity on the NTS

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

Table A6.4
Quantities of entry capacity by zone

Entry zone	ASEP	Obligated capacity	Unsold capacity		
		GWh/day	2021/2022 GWh/day	2025/2026 GWh/day	2026/2027 GWh/day
Northern Triangle	Barrow	340.01	269.94	340.01	340.01
	Canonbie	0	0	0	0
	Glenmavis	99	99	99	99
	St Fergus	1,670.70	1,624.86	1,666.94	1,670.70
	Teesside	445.09	322.13	399.5	407.31
North West	Burton Point	73.5	73.5	73.5	73.5
	Cheshire (includes Holford and Stublach storage facilities)	556.27	28.59	28.59	28.59
	Fleetwood	350	329.55	70	35
	Hole House Farm (includes Hill Top Farm storage facility)	296.6	13.16	13.16	178.16
	Partington	201.43	201.43	201.43	201.43
Easington Area	Caythorpe	90	0	90	90
	Easington	1,407.15	140.72	647.48	771.66
	Garton (includes Aldborough storage facility)	420	0	420	420
	Hatfield Moor (onshore)	0.3	0.3	0.3	0.3
	Hornsea	233.1	27.31	233.1	233.1
	Hatfield Moor (storage)	25	3	25	25
	Theddlethorpe	610.7	610.7	610.7	610.7
South West	Avonmouth	179.3	179.3	179.3	179.3
	Barton Stacey (includes Humbley Grove storage facility)	172.6	100.6	172.6	172.6
	Dynevor Arms	49	49	49	49
	Milford Haven	950	95	95	95
	Wytch Farm	3.3	3.3	3.3	3.3
South East	Bacton IP	1,297.80	1,146.30	1,297.80	1,297.80
	Bacton UKCS	485.60	0.00	180.02	485.60
	Isle of Grain	699.68	35.38	277.08	277.08

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Appendix 6 – Exit and entry capacity application process

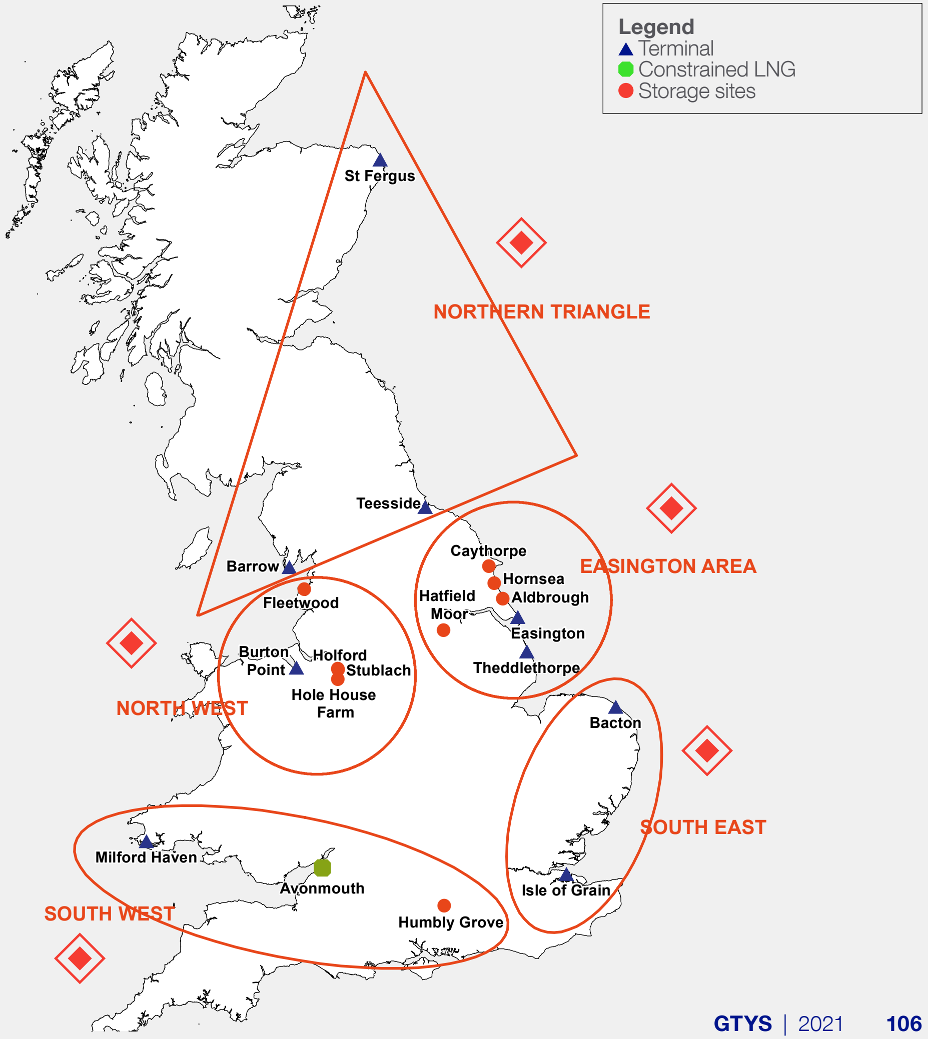
6.2 Entry capacity on the NTS

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

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

Figure A6.16
NTS entry capacity by zone

Click icon for more information



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/m³.

GWh = Gigawatt hours

mcm = Million cubic metres

Thousand toe = Thousand tonne of oil equivalent

MJ/m³ = 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 146 bcm/year, split into three near equal parts: Continental Europe (43 bcm/year), Norway (55 bcm/year)* and LNG (48 bcm/year).

Table A8.1 shows existing import infrastructure and table A8.2 shows proposals that we, the NTS, have been officially made aware of.

Table A8.1
Existing import infrastructure (Source: National Grid)

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	19.3
South Hook 1–2	Qatar Petroleum and ExxonMobil	LNG	Milford Haven	19.9
Dragon 1	Shell / Petronas	LNG	Milford Haven	8.9
Langeled	Gassco	Pipeline	Easington	24.9
Vesterled	Gassco	Pipeline	St Fergus	13.5
Tampen	Gassco	Pipeline	St Fergus	9.9
Gjoa	Gassco	Pipeline	St Fergus	6.2
			Total	**146**

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

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

Appendix 8 – Import and storage infrastructure

8.2 Storage infrastructure

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

Table A8.3
Storage sites (Source: Ofgem GB Gas Storage Facilities report)

Site	Operator/Developer	Location	Space (bcm)	Approximate max delivery (mcm/d)
Aldbrough	SSE/Statoil	East Yorkshire	0.205	31
Hatfield Moor	Scottish Power	South Yorkshire	0.07	2
Holehouse Farm*	EDF Trading	Cheshire	–	–
Holford	Uniper	Cheshire	0.237	22
Hornsea	SSE	East Yorkshire	0.285	12
Humbly Grove	Humbly Grove Energy	Hampshire	0.243	7
Hill Top Farm	EDF Energy	Cheshire	0.059	13
Stublach	Storengy	Cheshire	0.4	30
		Total	1.499	117

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 2021/22 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.

* Holehouse Farm currently mothballed.

Appendix 8 – Import and storage infrastructure

8.2 Storage infrastructure

Table A8.4
Proposed storage projects* (Source: National Grid)

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	InfraStrata	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**	

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.

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

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