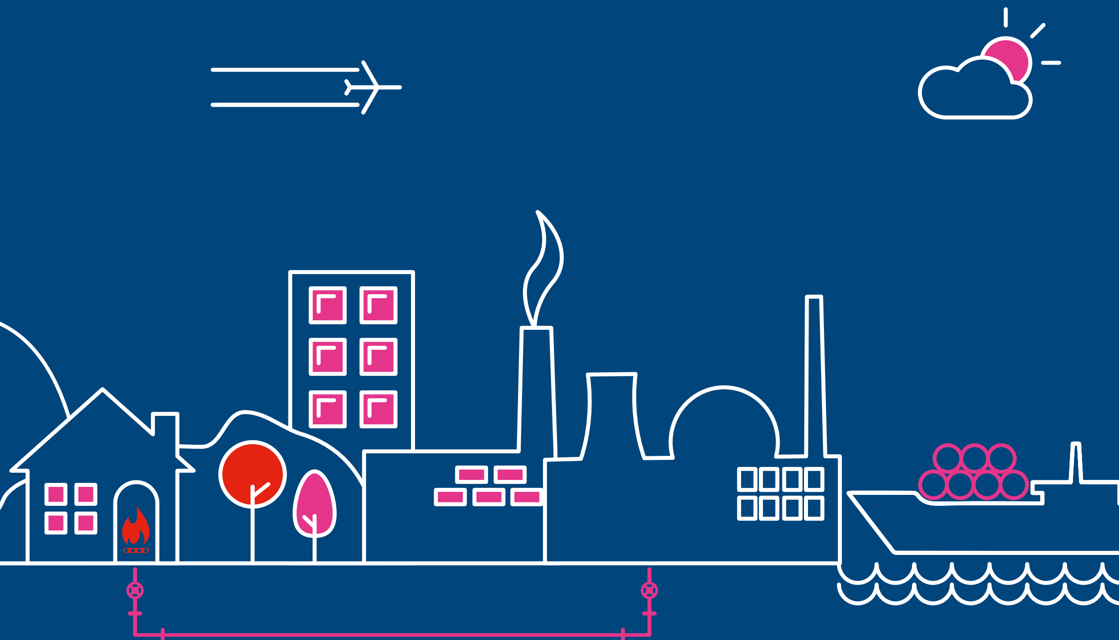
nationalgrid

Gas Ten Year Statement 2016

UK gas transmission



NOVEMBER 2016

How to use this interactive document

To help you find the information you need quickly and easily we have published the *GTYS* as an interactive document.

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

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

Previous view
Click on the icon to go to the previous page viewed.

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

Hyperlinks
Hyperlinks are highlighted in bold throughout the report. You can click on them to access further information.

We are in the midst of an energy revolution. The economic landscape, developments in technology and consumer behaviour are changing at an unprecedented rate, creating more opportunities than ever for our industry.

Our 2016 *Gas Ten Year Statement*, along with our other System Operator publications, aims to encourage and inform debate, leading to changes that ensure a secure, sustainable and affordable energy future.

GTYS 2016 continues to be an important part of how we engage with you to understand the drivers of change influencing your business, so that we can continue to develop the National Transmission System and market framework in line with those needs.

Although the key themes have remained unchanged over the past 12 months, their importance remain crucial to us, in particular how we respond to changing customer requirements, the impact of EU legislation on the market and infrastructure, and of course the effect of Great Britain's evolving and dynamic gas market on system operations and planning into the future.

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

Complementing 2016's *GTYS* and *FES* (*Future Energy Scenarios*) publications, National Grid will also be producing for the first time the *Gas Future Operability Planning (GFOP)* document. With the ambition to look out to 2050, *GFOP* will begin the first steps at articulating how changing customer requirements will affect the capability of the gas transmission system for both operations and its associated processes. Alongside *GTYS* we are keen to get your views on the inaugural *GFOP* publication, and engagement activities are being arranged to facilitate this.

I hope that you find both these documents, along with our other System Operator publications, useful as a catalyst for wider debate. For more information about all our publications, please see page 14.

Please share your views with us; you can find details of how to contact us on our website **http://www.nationalgrid.com/gtys**

Andy Malins
Head of Network Capability and Operations, Gas

Contents

Executive summary

Overview

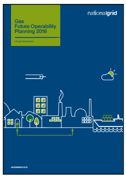
The 2016 *Gas Ten Year Statement (GTYS)* provides an update on the current and future challenges which impact the way we plan and operate the National Transmission System (NTS). It also outlines what we are doing to address these challenges in our roles as the System Operator (SO) and Transmission Owner (TO).

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

In partnership with the 2016 *GTYS*, National Grid will also be publishing the inaugural *Gas Future Operability Planning (GFOP)* document. This will describe how changing customer requirements may affect the future capability of NTS out to 2050, and the challenges these may pose to NTS operation and processes. The *GFOP* publication will enhance the way we respond to you and other market signals, leading to modifications in our decision making and operational processes to ensure we continue to maintain a resilient, safe and secure NTS.

Gas Ten Year Statement
November 2016

Future Energy Scenarios
July 2016

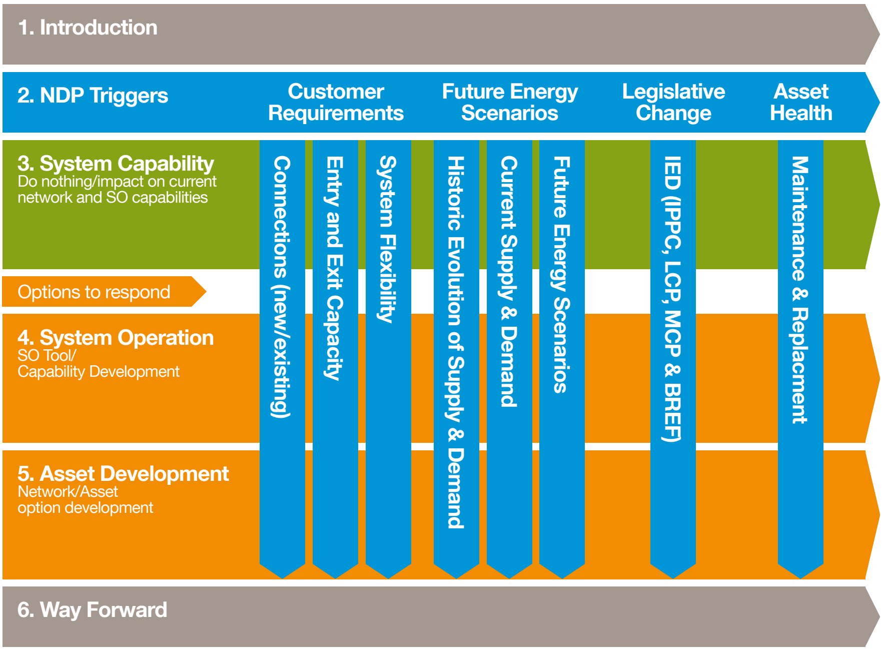


Gas Future Operability Planning
November 2016

Executive summary

Continuing with the revised format used for last year's document, *GTYS* 2016 is presented across the following sections (see Figure 0.1) with the aforementioned themes of customer requirements, future energy scenarios, legislative change, and asset health bridging the central three chapters of System Capability, System Operation and Asset Development.

Figure 0.1
2016 GTYS structure



Key messages

Changing energy landscape – over the past year the volume of renewable electricity sources has increased substantially (with solar and onshore wind contributing approximately 0.2GW of generation capacity in 2000, which increased to 17.8GW in 2015) representing 30% of installed capacity. In line with the November 2015 energy policy announcement from the government, higher levels of gas-fired generation are anticipated with enhanced importance on gas being used for both flexible electricity generation, as well as supporting renewable sources of electricity. Changes to gas demand, with customers using gas more flexibly, will create new operability challenges. These challenges will be discussed in more detail in our new *Gas Future Operability Planning* document which is also being published at the end of November 2016.

Impact of changing customer requirements – in February 2016 we initiated an innovation project (Project CLoCC; Customer Low Cost Connections) funded through the Ofgem Network Innovation Competition (NIC). Project CLoCC is aimed at achieving the key objectives of reducing connection costs to the NTS to less than £1 million, and the time it takes to do this to less than one year. Project CLoCC aims to provide greater choice for our customers to connect to the gas transmission network.

EU legislation in relation to asset operation on the NTS – in January 2013 the Industrial Emissions Directives (IED) came into force. This restricts the use of 16 of our 64 compressor units on the NTS. Combined with the Medium Combustion Plant (MCP) directive which will come into force by January 2018, this is anticipated to affect the availability of a further 26 units in our compressor fleet.

Following the result of the 2016 referendum National Grid notes that alongside other requirements, EU rules and regulations will continue to apply until the terms of the future UK relationship with the EU (including the Internal Energy Market) are defined.

Executive summary

Future *GTYS* editions and feedback

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

- Asset Health.
- Industrial Emissions Directive.
- Network Development Policy.

If you have any feedback to help us shape *GTYS* 2017, please contact us via the mailbox (**.Box.SystemOpertor.GTYS@nationalgrid.com**) and of course any other opportunities where we get to meet over the coming year.

Chapter one

Introduction

Welcome to our 2016 *Gas Ten Year Statement (GTYS)*. We write the *GTYS* to provide you with a better understanding of how we intend to plan and operate the National Transmission System (NTS) over the next ten years.

We update you on current and future challenges which impact the way we plan and operate the NTS. We also discuss what we're doing to address them as System Operator (SO) and Transmission Owner (TO). We are keen to engage with you to get your feedback on what we're doing and how we're doing it.

GTYS is published at the end of the annual planning cycle. We use *GTYS* to provide information on an annual basis to help you to identify connection and capacity opportunities on the NTS. We summarise key projects, changes to our internal processes that may impact you, and other key publications which provide further information on our System Operator activities.

1.1 What do we do?

Our role

We are the System Operator and Transmission Owner of the gas National Transmission System (NTS) in Great Britain. As System Operator 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 including balancing supply and demand, maintaining system pressures and ensuring gas quality standards are met. As Transmission Owner we must make sure all of our assets on the NTS are fit for purpose and safe to operate. We develop and implement effective maintenance plans and asset replacement schedules to keep the gas flowing.

Our network

The NTS plays a vital part in the secure transportation of gas and facilitation of the competitive gas market. We have a network of 7,600 km pipelines, presently operated at pressures of up to 94 bar, which transports gas from coastal terminals and storage facilities to exit offtake points from the system (Appendix 1). At the exit offtake points, gas is transferred to eight Distribution Networks (DNs) for onward transportation to domestic and industrial customers, or to directly connected customers including storage sites, power stations, large industrial consumers and interconnectors (pipelines to other countries).

Our regulatory framework

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

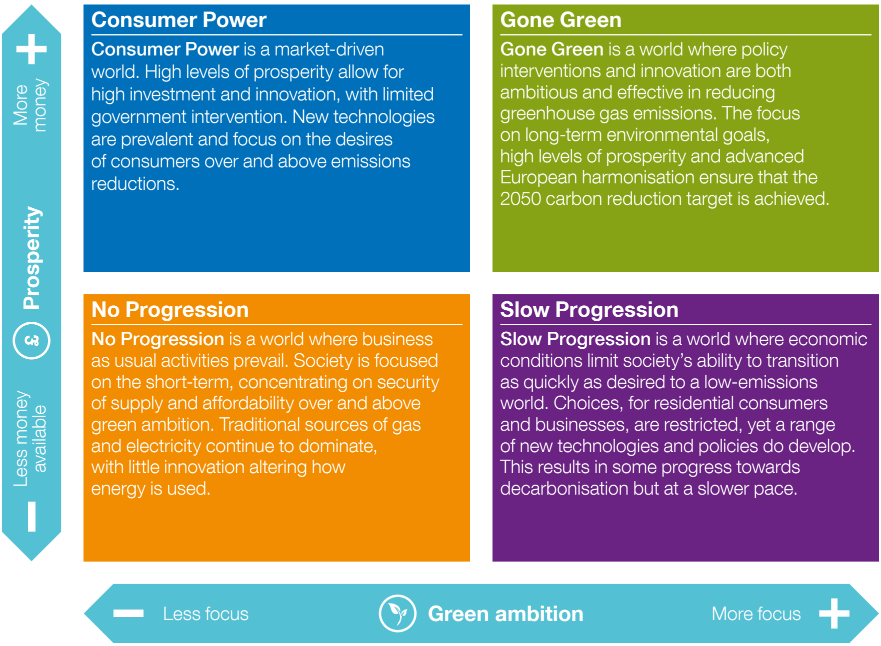
[1] http://www.talkingnetworkstx.com/general-performance.aspx

1.2
Future Energy Scenarios

We published our latest *Future Energy Scenarios (FES)* publication in July 2016[2]. We have created a credible range of scenarios, developed following industry feedback, which focus on the energy trilemma (sustainability, affordability and security of supply). The figure below (Figure 1.1) summarises the four 2016 scenarios.

Our 2016 *FES* publication gives details of annual and peak gas supply for each of our four scenarios. The *GTYS* expands on the *FES* by adding locational information and highlighting implications for the future planning and operation of the NTS.

Figure 1.1
Here are the political, economic, social, technological and environmental factors accounted for in our four 2016 Future Energy Scenarios



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

Introduction

1.3 Key themes

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

- Customer requirements.
- Legislative change.
- Asset health.

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

These themes are all considered against a backdrop of the *Future Energy Scenarios (FES)* and run through each chapter to show their impact on our day-to-day network operation and at each stage of our Network Development Process (NDP).

Customer requirements

Customer behaviour is continually changing. The NTS has to be able to respond in a more dynamic way. Often it's not a case of one customer changing how they use the system, it's the combined impact of multiple changing customer behaviours, occurring at the same time. This makes it ever more challenging to plan and operate the system.

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

This year we have also published a new ***Gas Future Operability*** (*GFOP*[3]) document to give greater focus to this important area. This is a first draft to demonstrate what this document could look like and cover. We will use this as a building block to develop a more collaborative publication going forward.

Legislative change

Legislative change has a big impact on how we plan and operate our network.

In previous versions of *GTYS* we have outlined the key elements of the Industrial Emissions Directive (IED) and how our network could be affected.

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

Asset health

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

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

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

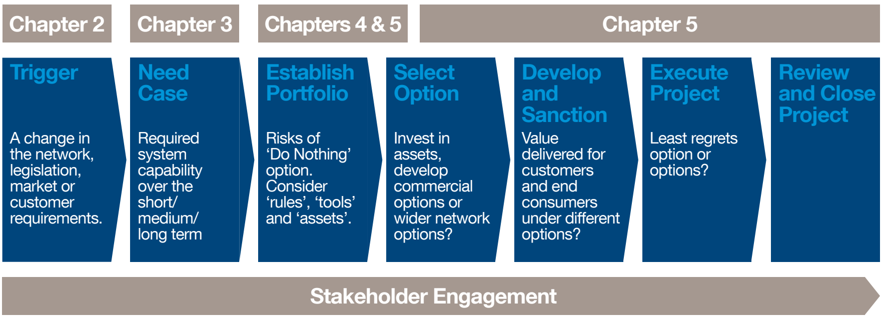
[3] www.nationalgrid.com/gfop

1.4
Network development process

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

The NDP defines the method for decision making, optioneering, development, sanction, delivery and closure for all our projects (Figure 1.2). The goal is to deliver projects that have the lowest whole-life cost, are fit for purpose and meet stakeholder and RIIO requirements.

Figure 1.2
The network development process



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

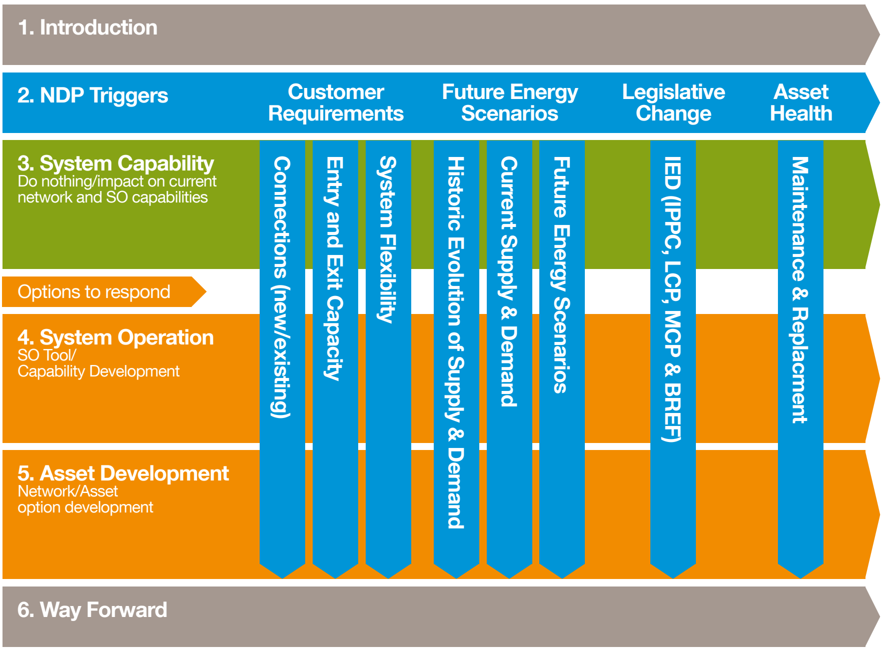
Introduction

1.5
GTYS chapter structure

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

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

Figure 1.3
2016 GTYS structure



Chapter 2. Network development inputs
There are many inputs that 'trigger' our NDP. For every trigger we assess the needs of our network to ensure it remains fit for purpose. We're in a period of great change, which may result in significant modifications to the way we currently plan and operate the NTS. We anticipate that we will have a wider range of triggers to our NDP in future.

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

Chapter 3. System capability
This section outlines the current system capability of the NTS. System capability defines the maximum and minimum ability of our current network infrastructure to transport gas safely and effectively. We explore the Need Case stage of our NDP. This is where we assess our system capability requirements.

We provide information about entry and exit capacity, pressures, and the impact of the IED.

Chapter 4. System operation
This chapter explores part of the 'Establish Portfolio' stage of the NDP. We develop a portfolio of non-asset and asset solutions to meet the Need Case requirements. In this chapter we detail the specific ongoing and planned developments to our System Operator capabilities (rules and tools).

These developments make sure that we can keep planning to operate a fit-for-purpose network safely and efficiently, to deliver value for our customers and stakeholders.

Chapter 5. Asset development
Here we consider the 'Establish Portfolio' stage with our asset solutions.

It sets out NTS reinforcement projects that have been sanctioned, projects under construction in 2016/17 and potential investment options for later years as a result of the IED. It also covers our asset health review. These are all assessed against the scenarios and sensitivities in our *FES* publication.

Chapter 6. Way forward
We're committed to meeting your needs and want you to help shape our *GTYS* and NDP. This chapter discusses our plans over the coming year and tells you how you can get involved.

530
Number of above-ground installations in the NTS network

Introduction

1.6
How does the *Gas Ten Year Statement* publication fit in?

National Grid has an important role to play in leading the energy debate across our industry and working with you to make sure that together we secure our shared energy future. As System Operator (SO), we are perfectly placed as an enabler, informer and facilitator. The SO publications that we produce every year are intended to be a catalyst for debate, decision making and change.

The starting point for our flagship publications is the ***Future Energy Scenarios (FES).*** The *FES* is published every year and involves input from stakeholders from across the energy industry.

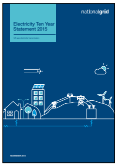
These scenarios are based on the energy trilemma (security of supply, sustainability and affordability) and provide supply and demand projections out to 2050. We use these scenarios to inform the energy industry about network analysis and the investment we are planning, which will benefit our customers.

For short-term challenges around gas and electricity transmission, we produce the ***Summer*** and ***Winter Outlook Reports*** every six months. We publish them ahead of each season to provide a view of gas and electricity supply and demand for the coming summer or winter. These publications are designed to support and inform your business planning activities and are complemented by *Summer* and *Winter Consultations* and reports.

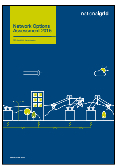
We build our long-term view of the gas and electricity transmission capability and operability in our *Future Energy Scenarios (FES), Ten Year Statements (ETYS* and *GTYS), Network Options Assessment (NOA), Gas Future Operability Planning (GFOP)* and *System Operability Framework (SOF)* publications. To help shape these publications, we seek your views and share information across the energy industry that can inform debate.

The *Gas Ten Year Statement (GTYS)* describes in detail what and where entry and exit capacity is available on the gas National Transmission System (NTS). The *GTYS* provides an update on projects we are currently working on. It also provides our view of the capability requirements and network development decisions that will be required for the NTS over the next ten years. If you are interested in finding out more about the longer-term view of gas capability and operability, please consider reading our *Future Energy Scenarios (FES)*, and *Gas Future Operability Planning (GFOP)* publications.

Our *Gas Future Operability Planning (GFOP)* publication describes how changing requirements affect the future capability of the NTS out to 2050. It also considers how these requirements may affect NTS operation and our processes. The *GFOP* may highlight a need to change the way we respond to you or other market signals. This, in turn, may lead us to modify our operational processes and decision making. This publication helps to make sure we continue to maintain a resilient, safe and secure NTS now and into the future. If you are interested in finding out more, please consider reading our *Future Energy Scenarios (FES)* and *Gas Ten Year Statement (GTYS)* publications.



The ***Electricity Ten Year Statement (ETYS)*** applies Future Energy Scenarios to network models and highlights the capacity shortfalls on the GB National Electricity Transmission System (NETS) over the next ten years. If you are interested in finding out about the network investment recommendations that we believe will meet these requirements across the GB electricity transmission network, please consider reading *Network Options Assessment (NOA)*. You can find out more about the longer-term view of electricity capability and operability by reading our *Future Energy Scenarios (FES)* and *System Operability Framework (SOF)* publications.



The ***Network Options Assessment (NOA)*** builds upon the future capacity requirements described in *ETYS* and presents the network investment recommendations that we believe will meet these requirements across the GB electricity transmission network. If you are interested in finding out more about electricity capability and operability, please consider reading our *Future Energy Scenarios (FES), Electricity Ten Year Statement (ETYS)* and *System Operability Framework (SOF)* publications.

The ***System Operability Framework (SOF)*** uses the Future Energy Scenarios to examine future requirements for the operability of GB electricity networks. It describes developments in operational needs and provides information that can help towards developing new technology, codes and solutions that improve system operability. If you are interested in finding out more, please consider reading our *Future Energy Scenarios (FES), Electricity Ten Year Statement (ETYS)* and *Network Options Assessment (NOA)* publications.

Introduction

1.7
How to use this document

We've colour coded each chapter, to help you find relevant content quickly and easily. And we've highlighted the main messages at the start of each section (see Figure 1.4). We'll use the same approach in our 2016 *Electricity Ten Year Statement*.

We'd love to hear your views on content and structure of the 2016 *GTYS*. If you'd like to get in touch, please email us at **.Box. SystemOperator.GTYS@nationalgrid.com**.

Figure 1.4
How to use this document

Chapter two

Network development inputs

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

Key insights

Customer requirements

- We are reviewing our connections processes to improve the customer experience and to help facilitate unconventional gas sources.
- In February 2016 we began a Network Innovation Competition (NIC) funded project, Project CLoCC, using innovative solutions to reduce the time and cost of connecting to the NTS.
- The Planning and Advanced Reservation of Capacity Agreement (PARCA) arrangements are in place. Customers can use them to reserve capacity before making final investment decisions in their projects.

Future Energy Scenarios

- Import dependency has grown considerably since the early 2000s and could reach 93% by 2040.
- Peak supply capacity is much higher than peak demand.
- Peak demand does not decline as sharply as annual demand. In scenarios with a lot of renewable generation gas-fired plant has lower utilisation but still provides back-up when wind generation is low.

Legislative change

- The Industrial Emissions Directive (IED) came into force in January 2013 combining the Integrated Pollution Prevention and Control Directive (IPPC) and Large Combustion Plant Directive (LCP).
- IPPC affects 8 of our 24 compressor sites.
- LCP affects 16 of our compressor units
- The draft Medium Combustion Plant Directive (MCP) affects 26 of our 64 compressor units.

Asset health

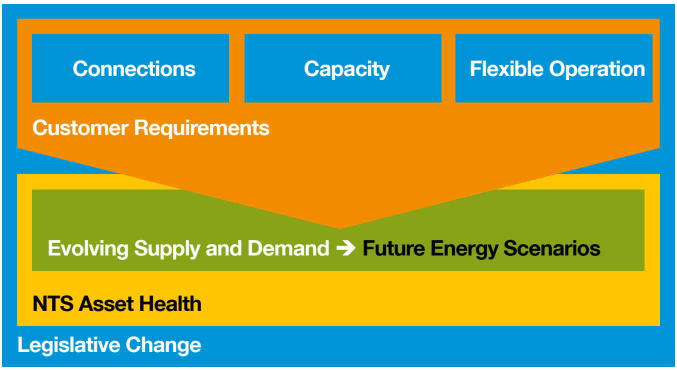
- In 2015/16 we have invested over £75 million on improvements to the health of over 2,000 assets on the NTS, equating to over 400 asset health changes.
- Approximately 3,500 Network Output Measures (NOMs) have been identified which will cover RIIO years four to six (2017–19).
- We will consider the removal of assets within the NDP to avoid unnecessary maintenance and reduce costs.

2.1
Introduction

As we outlined in Chapter 1, our NDP defines our decision-making, optioneering and project development processes for all projects. Certain triggers initiate the NDP. Over the last 12 to 24 months, three key triggers have emerged from our NDP work: customer requirements, legislative change, and asset health. The *FES* also influence the NDP.

These triggers are interlinked (see Figure 2.1) so a change in one trigger will affect another. We know that customers' gas requirements may change when new legislation is introduced. An example is emissions legislation, which has resulted in generators closing or reducing their use of coal plant and using more Combined Cycle Gas Turbine (CCGT) plant instead. This has changed the supply and demand patterns on the network, which feeds into our FES.

Figure 2.1
Key NDP triggers



Network development inputs

Customer requirements
We have updated our connections and capacity processes to meet our customers' changing needs and to more closely align with our customers' project development timelines. This chapter outlines our connections and capacity processes and tells you where to find more information.

Future Energy Scenarios
Our FES explore how the increasingly complex energy landscape is changing and what might happen. We use the FES as the basis of all of our system analysis as they provide a stakeholder-influenced view of the future of supply and demand patterns on the NTS. In this chapter we outline the evolution of supply and demand to show how our customers' needs might change under the four scenarios.

Legislative change
Recent legislative changes, such as the IED, will significantly affect how we plan and operate our network over the next ten years. Legislation is one of the main triggers for our NDP. We need to look at every compressor affected by new legislation and establish how critical each one is in maintaining our network capability. We must also be sure that we can meet future capability requirements.

Changes to the way that the European energy market is run might affect how we operate our network. The key legislative changes are outlined in this chapter.

Asset health
Many of our NTS assets are ageing and need maintaining or replacing. Our asset health campaign prioritises key assets on our network to establish if they need to be maintained or replaced.

Customer requirements

2.2
Customer requirements

This section outlines how our customers' requirements can trigger our NDP. We have provided information on customer connections, entry capacity and exit capacity.

Anyone wishing to connect to the NTS can arrange for a connection directly with us. In addition we can reserve capacity for you; however, you must be aware that a shipper must buy and hold your capacity.

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

2.2.1
Our connection and capacity application processes

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

Customer requirements

Table 2.1
Our connection and capacity application processes

	Our connection and capacity processes					
	Connections	**Entry and Exit Capacity**				
Our customers and their key service requirements	Appliction to offer (A2O) Includes physical pipeline connections to the NTS (if required) for new connections, modifications and diversions	Quarterly System Entry Capacity (QSEC – gas years y+2 to y+17) Auctions	Exit Application Windows (unsold within baseline capacity – gas years y+1 to y+3)	Exit Application Window (Enduring Annual – gas years y+4 to y+6 – Evergreen Rights) & (Adhoc – m+6 – Evergreen Rights) Enduring annual NTS exit Capacity	Flexible Capacity for flow changes	Entry/Exit Planning and Advanced Reservation of Capacity Agreement (PARCA – reserve unsold/ additional capacity & allocation)
Find more information in *GTYS* go to:	Chapter 2 – Section 2.2.2, Appendix 2	Chapter 2 – Section 2.2.3	Chapter 2 – Section 2.2.4, Appendix 2	Chapter 2 – Section 2.2.4, Appendix 2	Chapter 2 – Sections 2.2.3, 2.2.4, Appendix 2	Chapter 2 – Section 2.2.5, Appendix 2
Gas Shipper (signatory to the Uniform Network Code (UNC)) Capacity Rights to flow gas onto the system (short, medium long term)	✗	✓	✓	✓	✗	✓
Distribution Network (DN) (signatory to the UNC) Rights to offtake gas from the system	✓	✗	✓	✓	✓	✓
Customers New Site Developers (that are not signatory to the UNC) and or currently connected customers. Both new and currently connected customers have Capacity Rights to flow gas onto and offtake gas from the system.	✓	✗	✗	✗	✗	✓

If you need a new connection or a modification to an existing NTS connection, you will need to go through the application to offer (A2O) process (see section 2.2.2). You must be aware that our connection (A2O) and capacity processes (Planning and Advanced Reservation of Capacity Agreement – PARCA) are separate.

Our customers have the flexibility to initiate these two processes at their discretion; however, the two processes can become dependent on each other. The new 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, it can take up to 12 months to progress and sign an FCO. This means that the A2O process (if required) needs to be initiated at least 12 months before the capacity allocation date defined in the PARCA contract (see section 2.2.5 and Appendix 2 for more detail).

The connection and capacity processes initiated by our customers trigger our NDP. We need to assess what impact a connection (new or modified) or a capacity change (supply or demand increase/decrease) will have on our current network capability and our operational strategies. 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 new PARCA process as we can now align any works we need to complete with our customers' projects.

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

2.2.2
Connecting to our network

We offer four types of connection to the NTS as well as modifications to existing NTS connections[1].

To connect your facility to the NTS you will need to initiate the A2O process. You can either have other parties build the facility's connection or have the connection adopted by the host gas transporter (depending upon their circumstances).

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

Table 2.2 summarises the four different NTS gas connections that are currently available.

[1] http://www2.nationalgrid.com/uk/services/gas-transmission-connections/connect/

Customer requirements

Table 2.2
NTS gas connections

NTS Gas Connections Categories	
Entry Connections	Connections to delivery facilities processing gas from gas producing fields or Liquefied Natural Gas (LNG) vaporisation (importer) facilities, for the purpose of delivering gas into the NTS.
Exit Connections	These connections allow gas to be supplied from the NTS to the premises (a supply point), to a distribution network (DN) or to connected systems at connected system exit points (CSEPs). There are several types of connected system including: – A pipeline system operated by another gas transporter – A pipeline operated by a party that is not a gas transporter, for transporting gas to premises consuming more than 2,196MWh per annum.
Storage Connections	Connections to storage facilities, for supplying gas from the NTS and delivering it back later.
International Interconnector Connections	These are connections to pipelines that connect Great Britain to other countries. They can be for supply of gas from and/or delivery of gas to the NTS.

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

Customer Connections – Application to Offer (A2O)

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

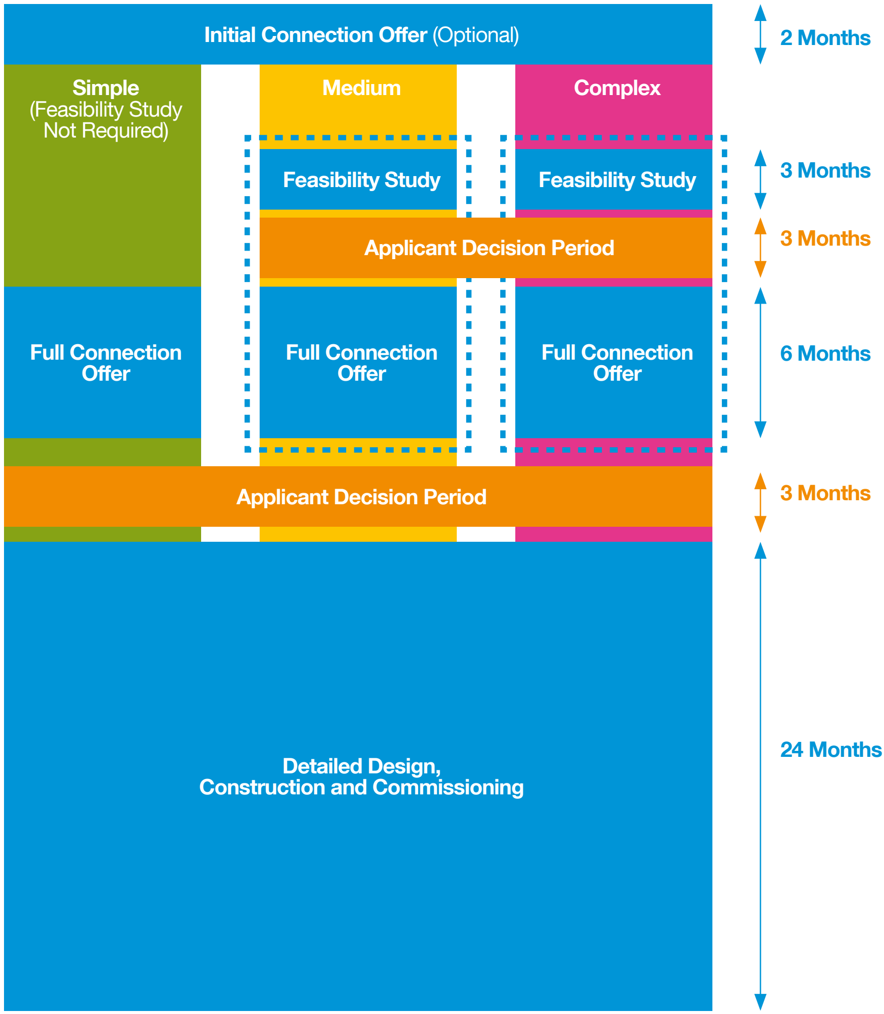
The UNC provides:
- a formal connection application template for customers to complete
- definition of the content of an initial connection offer
- definition of the content of a full connection offer
- how to request a modification to a full connection offer
- timescales for National Grid to produce a connection offer:
  – initial connection offer – up to two months
  – full connection offer – up to six months (simple) or nine months (medium/complex)
- timescales for customers to accept initial/full connection offer (up to three months)
- application fees for an initial connection offer (fixed) and full connection offer (variable and reconciled)
- a requirement for National Grid to review the application fees on an annual basis.

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

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

[2] http://www.gasgovernance.co.uk/UNC
[3] http://www2.nationalgrid.com/UK/Services/Gas-transmission-connections/Connect/Application-to-offer/

Figure 2.2
Application to Offer (A2O) Process



Chapter two

Customer requirements

Connection application charges

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

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

Connecting pipelines

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

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

Connection pressures

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

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

These pressures will be stated in the Network Entry Agreement (NEA) or Network Exit Agreements (NExA) 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 UNC Section J 2.2.

General connection pressure information

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

[4] http://www2.nationalgrid.com/UK/Services/Gas-transmission-connections/Connect/Application-to-offer/

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

Ramp rates and notice periods

Directly connected offtakes have restrictions in terms of ramp rates and notice periods written into NExAs. A ramp rate (the rate at which the offtake of gas can be increased at the offtake) of 50MW/minute can be offered for a simple connection. Higher ramp rates can be agreed subject to completion of a ramp rate study. Notice periods are typically defined as the number of hours' notice for increases of upto 25%, up to 50% and greater than 50% of maximum offtake rate. These notice periods are required to ensure that pressures can be maintained at times of system stress including high demand. Notice periods will only be enforced in these circumstances when system flexibility is limited. More detail regarding access to system flexibility can be found on our website in the Short Term Access to System Flexibility Methodology Statement[6].

Evolving our connections process

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

We have begun to see new types of connection request, for example shale and biomethane entry connections and natural gas-powered vehicle refuelling stations exit connections. The system requirements for these connections are fundamentally different to more traditional project connections.

Many of you have told us that the existing connection regime does not meet your project's requirements, and if our present NTS connection service continues as it is, the majority of new and unconventional gas projects could be forced to seek connections to distribution networks, or try to find other ways of using the gas they produce.

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

Spotlight: Opening up the Network

Through Project CLoCC (Customer LOw Cost Connections), we are helping customers by minimising the time and cost to connect to the gas National Transmission System (NTS).

Having listened to our customers, we've launched an initiative that is all about addressing the main obstacles that hold entry and exit customers back from getting connected – the current cost (up to £2 million) and duration (up to three years). The goal of Project CLoCC is to halve the cost of a connection to less than £1 million, while reducing the time it takes from initial enquiry to being connected to less than one year.

We're fundamentally challenging every aspect of the connection process, so that we can make life easier for customers and offer more choice – an NTS that can support both large and small connections.

Project CLoCC is looking at three main areas:

- **Optimised commercial process** designed to meet the requirement of non-traditional customers.
- **Innovative Physical Connection Solutions** tailored to the needs of unconventional gas connections at high pressure.
- **A Web-based Connections Platform** designed to improve the customer experience, this innovative tool will use geographical data and customer information so customers can compare and assess suitable options for an NTS connection.

By considering the three areas above in unison, we believe this project, which was awarded funding through Ofgem's gas Network Innovation Competition, will provide a truly innovative service, supporting the development of all future gas connections.

You can find out more at **www.ProjectCLoCC.com**

[6] http://www2.nationalgrid.com/uk/industry-information/gas-transmission-system-operations/capacity/constraint-management/

Customer requirements

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

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

The PARCA process (see section 2.2.5) was designed to encourage developers to approach us at the initial stages of their project. This new process allows alignment between both the developer's project timeline and any reinforcement works required on the NTS to accept or deliver capacity.

2.2.3 NTS entry capacity

Entry capacity gives shippers the right to flow gas onto the NTS. Only licensed shippers can apply for and obtain entry capacity. A licensed shipper is considered a 'User' of the NTS under the terms of the UNC.

NTS entry capacity types
We can make firm and interruptible NTS entry capacity available to the market at each Aggregated System Entry Point (ASEP)[7]. The volume of firm capacity made available at each ASEP consists of the following:

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

Interruptible NTS entry capacity can be made available to the market at ASEPs where it can be demonstrated that firm NTS entry capacity is not being used. The volume of Interruptible NTS entry capacity available at an ASEP consists of two parts:

- **Use it or Lose it (UIOLI)** – any NTS entry firm capacity that has been unused for a number of days can be resold to the market as interruptible NTS entry capacity.
- **Discretionary** – we can make additional interruptible NTS entry capacity available to the market at our discretion.

If there is physical congestion on the network, then we may limit interruptible NTS entry capacity rights, without any compensation for the Users affected.

[7] http://www2.nationalgrid.com/UK/Industry-information/Gas-transmission-system-operations/Capacity/Entry-capacity/

NTS entry capacity auctions

To obtain entry capacity a shipper can bid for capacity on the Gemini system through a series of auctions[8]. For long-term capacity shippers can bid in three auctions:

- Quarterly System Entry Capacity (QSEC).
- Annual Monthly System Entry Capacity (AMSEC).
- Rolling Monthly Trade & Transfer (RMTnTSEC).

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

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

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

2016 incremental obligated capacity

In order for incremental obligated entry capacity to be released, and therefore the obligated entry capacity level to be increased, enough bids for entry capacity must be received during the QSEC auctions to pass an economic test. If this capacity can be made available via capacity substitution[9] then it will be increased.

This involves moving unused capacity from one or more system points to a point where there is excess demand. If incremental capacity requires reinforcement works it can only be triggered when the customer enters into a PARCA (see section 2.2.5).

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

The QSEC auctions opened on Monday 7 March 2016 and closed on Tuesday 8 March 2016. No bids were received for incremental entry capacity.

Bids received at all ASEPs were satisfied from current unsold obligated levels for future quarters and no incremental obligated entry capacity was released.

[8] http://www2.nationalgrid.com/uk/industry-information/gas-transmission-system-operations/capacity/entry-capacity/

[9] http://www2.nationalgrid.com/UK/Industry-information/Gas-capacity-methodologies/Entry-Capacity-Substitution-Methodology-Statement/

Customer requirements

2.2.4 NTS exit capacity

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

NTS exit capacity types

We make 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 Capacity (obligated)** – as defined by our Gas Transporter Licence.
- **Incremental Capacity (obligated)** – firm capacity made available over and above baseline, in response to market demand and supported by User commitment. This increase in capacity is permanent.
- **Incremental Capacity (non-obligated)** – at our discretion, we can release additional firm capacity at an offtake point over and above obligated levels.

Off Peak capacity is made available to the market at offtake points where it can be demonstrated that firm capacity is not being used. The volume of Off Peak capacity available at an offtake consists of three parts:

- **Use it or Lose it (UIOLI)** – any firm capacity that has been unused over recent days, can be resold to the market as interruptible capacity.
- **Unused Maximum NTS Exit Point Offtake Rate (MNEPOR)** – during D-1 at 1:30pm the NTS Demand Forecast is published. Where this demand forecast is less than 80% of the annual peak 1-in-20 demand forecast, we are obligated to release any remaining capacity up to the MNEPOR level as Off Peak capacity.
- **Discretionary** – we can make additional Off Peak capacity available to the market at our discretion.

If there are low pressures on the network, then we may curtail Off Peak capacity rights, without any compensation for the Users affected.

For our DNO Users we also make NTS exit (flexibility) capacity available. This allows the DNO to vary the offtake of a quantity of gas from the NTS away from a steady rate over the course of a gas day. This allows the DNO to meet their 1-in-20 NTS Security Standard as well as to meet their diurnal storage requirements.

NTS exit capacity application windows
To obtain exit capacity a shipper can apply for capacity through four exit capacity application windows:

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

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

Enduring Annual Exit (Flat) Capacity Decrease (EAFLEC) – This application window allows a User to decrease their enduring capacity holdings from Year Y+1 (October following the July window). Further decreases and increases can be requested in subsequent application windows. The application period for this auction is 1 to 15 July 2016.

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

DNOs apply for NTS exit (flexibility) capacity during the 1 to 31 July enduring annual exit (flat) capacity application window.

All capacity requests are subject to network analysis to assess the impact on system capability. Where the capacity requested can be accommodated through substitution the capacity request is accepted. Capacity substitution involves moving unused capacity from one or more offtakes to a point where there is excess demand. If incremental capacity cannot be met via substitution the customer will need to enter into a PARCA as reinforcement works may be required to meet the capacity request (see section 2.2.5).

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

Customer requirements

2.2.5
The PARCA framework

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

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

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

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

The PARCA framework provides a number of benefits for PARCA customers, other NTS customers/Users and us.

Benefits for PARCA Customers
It is designed to help customers to reserve NTS entry and/or exit capacity early on in their project development without full financial commitment to formally booking capacity.
Reserved NTS Capacity will be exclusive to the PARCA applicant (or their nominated NTS user) and will not available to other NTS users.
It provides the customer with greater certainty around when capacity can be made available should their project progress to completion.
It aligns the customers and our project timelines; this is particularly important where reinforcement is required, so the projects can progress together.
The customer can align the NTS capacity and connection processes for their project.
The process is flexible, with logical ‘drop-out points’ before capacity allocation. Capacity allocation would be closer to the customer’s first gas day than under previous arrangements. As a result, the customer would be able to take advantage of these ‘drop-out points’, should their project become uncertain.
They are available to both UNC parties and project developers and therefore available to a wider range of customers compared to the existing annual NTS capacity auction and application processes.

Benefits for other NTS Customers and Users
Throughout the lifecycle of a PARCA, we will publish more information externally (compared to the existing auction/application mechanisms) increasing transparency for other NTS users.
The PARCA entry capacity process includes an ad hoc QSEC auction mechanism to allow other NTS users to compete for unsold QSEC before it is reserved.
The PARCA process includes a PARCA application window during which other NTS users can approach us to sign a PARCA. This provides a prompt for those customers considering entering into a PARCA. It would allow multiple PARCAs to be considered together. This way, we will make best use of unsold levels of NTS capacity and existing system capability when determining how to meet our customers' requirements. This will enable the most economic and efficient investment decisions to be made.
Throughout the lifecycle of a PARCA, each customer must provide us with regular project progress updates. If a customer fails to provide the required information in the appropriate timescales, their PARCA may be cancelled and any reserved NTS capacity would either be used for another live PARCA or returned to the market. This will ensure that NTS capacity is not unnecessarily withheld from other NTS users.
A PARCA customer will be required to provide financial security to reserve NTS capacity. If the customer cancels their PARCA, a termination amount will be taken from the security provided. This would be credited to other NTS users through the existing charging mechanisms.
The timescales for the release of incremental NTS capacity to the PARCA applicant will be aligned to our timescales for providing increased system capability. This will take into account the Planning Act requirements for a reinforcement project. As a result, the risk of constraint management actions taking place and any costs potentially being shared with end consumers will be reduced.
They are available to both UNC parties and project developers and therefore available to a wider range of customers compared to the existing annual NTS capacity auction and application processes.

Benefits for Us
Throughout the lifecycle of a PARCA, the customer will be required to provide regular project progress updates. We would not begin construction on any investment projects until the customer has received full planning permission for their project. This will allow our case for any required investment to be clearly linked to our customer requirements.

Customer requirements

2.2.6
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 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 (Figure 2.3). This phased structure gives the customer natural decision points where they can choose whether to proceed to the next phase of activities.

Figure 2.3
PARCA framework phases

More information on the PARCA process is provided in Appendix 2 and on our website[10].

[10] http://www2.nationalgrid.com/UK/Services/Gas-transmission-connections/PARCA-Framework/

Customer requirements

2.2.7
Gas Future Operability Planning document

In previous years, we have considered the impact of changes in your requirements as part of the *GTYS*. This year we have developed a separate *Gas Future Operability Planning (GFOP)* document to provide a clearer focus to this increasingly important area.

The *GFOP* document outlines how your changing requirements may impact the future capability of the NTS out to 2050 and what challenges these may pose to NTS operation and our processes. The *GFOP* may trigger a change in the way we respond to you and other market signals leading to modifications in our decision making and operational processes to ensure we continue to maintain a resilient, safe and secure NTS now and into the future.

The 2016 *GFOP* is a first draft of this document for your review and comment. Our aim is for future editions to be more collaborative so all interested parties can highlight changes which will require us to quantify the effect on the future NTS capability and operability. We are keen to hear your views so this document can evolve and focus on what you believe are the most important elements of the future energy landscape. You can let us know what you think by emailing us at **.box.GFOP@nationalgrid.com**.

The market does not currently have a clear vehicle in which all participants can discuss and quantify future gas transmission network needs, future operational challenges and uncertainties. The *GFOP* will fill that gap and complement the *GTYS* and our other Future of Energy suite of documents (Figure 2.4). We need to work with all interested parties to make sure that the right commercial options (rules), operational arrangements (tools) and physical investments (assets) are considered across the NTS. Any resulting impacts and changes will be documented in the *GTYS*.

Figure 2.4
The role of the Gas Future Operability Planning document

Scenarios
We use our Future Energy Scenarios as the starting point for all our future network planning.

Assumptions
We need to make assumptions about the more uncertain elements of the future and which areas to focus on first e.g. areas of greatest uncertainty or impact on the future of gas, our network and customers.

Analysis
We then complete our network analysis based on the scenarios and assumptions we have made.

Network Impact
We then assess the impact and document what this could mean for our network and our customers. What problems we may encounter and what possible solutions there may be. Anything we decide to take further action on will be detailed in the GTYS.

Actions
What action we need to take now in our investments or processes etc.

The *GFOP* will allow you to:
- tell us what you think might happen
- tell us how your use of the NTS might change
- challenge our assumptions
- provide evidence for other areas we should look at
- explore options/opportunities for collaborative working.

The *GFOP* will then help us to:
- understand the impact
- identify and quantify operability risk
- quantify capability requirements
- discuss potential options (rules, tools and assets)
- provide a starting point for innovation and collaboration.

The *GFOP* will allow us to more clearly articulate:
- what operability issues we have identified
- their extent – localised or national
- when they are likely to occur
- what capability is required
- what potential options we are aware of
- what the consequences could be on our service.

In *GTYS* we will outline:
- how we are responding to these impacts
- what options we are taking forward
- what changes we are making to our decision-making processes
- what changes we are making to our operational processes and what the consequences could be on our service.

Future energy scenarios

2.3
Future energy scenarios

This section describes the evolution of demand and supply, and how our customers' requirements of the NTS have changed since 2005. It establishes our view of how demand and supply could continue to evolve over the next ten years.

Every year we produce a set of credible future energy scenarios with the involvement of stakeholders from across the energy industry. Most feedback we received on our 2015 scenarios was highly positive. Overwhelmingly, our stakeholders told us that they want to see consistency year on year. This reaffirmed our approach to the 2016 *Future Energy Scenarios* and there are no big changes this year.

In Chapter 1 (Figure 1.1), we showed the political, economic, social and technological factors accounted for in our four 2016 Future Energy Scenarios. You can find out more information about each of the scenarios in our *Future Energy Scenarios 2016 (FES)* publication[11].

2.3.1
Evolution of gas demand

The following section explains how gas demand has changed over the last decade and how it might look in future. The changes we have seen in our customers' use of the NTS have led to increasingly variable levels of national and zonal NTS demand, both on a day-to-day and within-day basis. This presents a number of challenges for us as the System Operator. In Chapters 3 and 4 we outline how we are developing our planning and operational strategies to adapt to these new challenges.

Changing GB gas demand

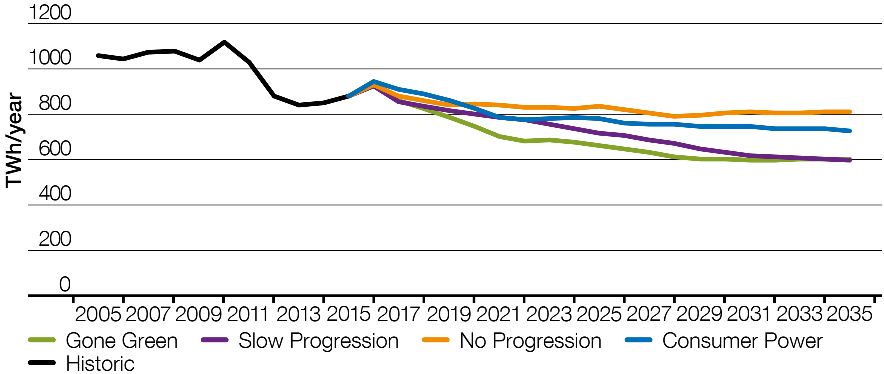
Between 2005 and 2010, gas demand was relatively stable at around 1,080 TWh/year. During this period, declining demand in manufacturing was counteracted by an increase in demand for gas-fired power generation. In 2010, gas demand fell sharply as lower coal prices meant that coal was favoured over gas for power generation. Gas remained marginal within the UK power generation sector until 2015 when a rise in the price of coal led to gas returning as the preferred thermal generation fuel. This led to a sharp increase in the usage of gas.

Residential gas demand hit a peak of 400 TWh/year in 2004 and has fallen steadily at an average of 2% per year. Since 2004, Government incentives and heightened consumer awareness have led to homeowners improving levels of insulation and replacing old gas boilers with new, more efficient, A-rated boilers.

[11] http://www2.nationalgrid.com/uk/services/gas-transmission-connections/connect/

In our *FES*, all the scenarios show increases in demand as favourable gas prices indicate a greater use of gas for power generation in the coming years. This is anticipated to stabilise over the longer period heading out beyond 2018. The **Slow Progression** and **Gone Green** scenarios show a notable decline in gas demand in the UK in the long term as more household efficiency improvements are made and alternative heating appliances are installed. **Consumer Power** and **No Progression** show a slower decrease as a result of lower energy efficiency uptake, combined with growth in the distributed gas combined heat and power (CHP) sectors (Figure 2.5).

Figure 2.5
Total gas demand under our four scenarios



Chapter two

Future energy scenarios

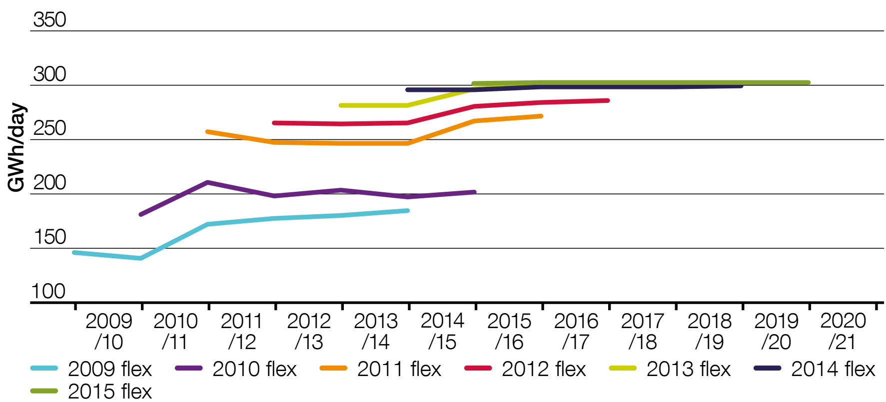
Distribution Network (DN) flexibility requirements

The changing nature of gas demand in the UK over the last five to ten years, combined with our stakeholder engagement feedback, gives us an indication of how our customers may want to use the NTS in the future.

As levels of residential demand steadily declined, Distribution Network Operators (DNO) have reduced the level of embedded storage in their networks through their gas-holder closure programme. As a result, they now increasingly rely on the use of NTS linepack to meet their required daily storage levels (see Chapter 3). DNOs signal their requirements for using NTS linepack by booking NTS exit (flexibility) capacity levels.

We have seen a steady increase in recent years in the flex capacity being requested (see Figure 2.6). However, due to the increase in risk to the operation of the NTS we cannot always accept the flex capacity requested.

Figure 2.6
NTS exit (flexibility) capacity bookings by DNOs

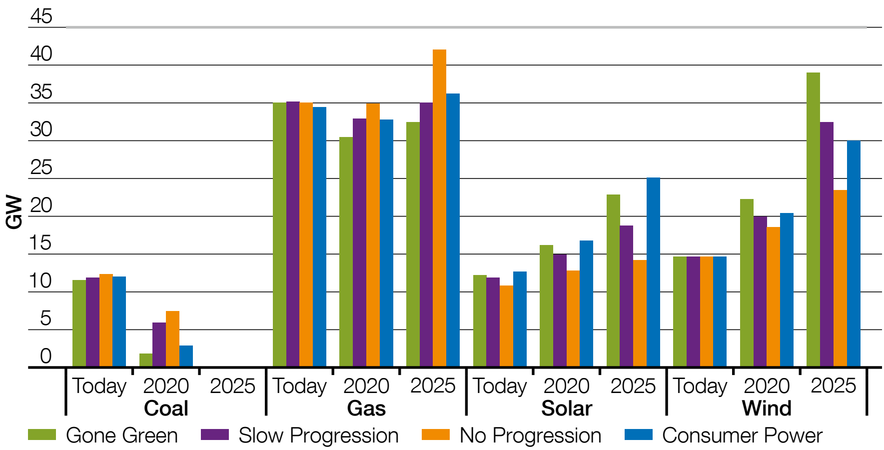


The role of CCGTs

In the last year we have seen an increase in annual gas demand for Combined Cycle Gas Turbines (CCGTs). The cost of gas relative to coal has fallen significantly, making gas the more favourable fuel for electricity generation. Furthermore, as a result of EU environmental directives, coal power stations are being retired with the last site expected to close in 2025. Predicting gas demand based on the price differential between coal and gas is therefore no longer a suitable technique.

We are seeing increasing levels of solar and wind capacity connecting to onshore and offshore electricity grids (see Figure 2.7). This means that gas-fired generation is likely to decline from its present high. It will become a more marginal fuel (i.e. operating with low load factors) up to 2020 and beyond. The behaviour of CCGTs is expected to become more unpredictable as their requirement to generate will correlate with renewable generation output (e.g. wind, solar etc) and the interaction with other balancing tools.

Figure 2.7
Forecast levels of coal, wind and solar capacity



CCGTs play an important role in balancing the electricity system alongside other balancing tools (interconnection, storage, other generation and demand-side response) that are available to the electricity System Operator. This means that CCGTs do not carry the entire balancing burden, so volatility in renewable generation does not always result in volatility in CCGT gas demand.

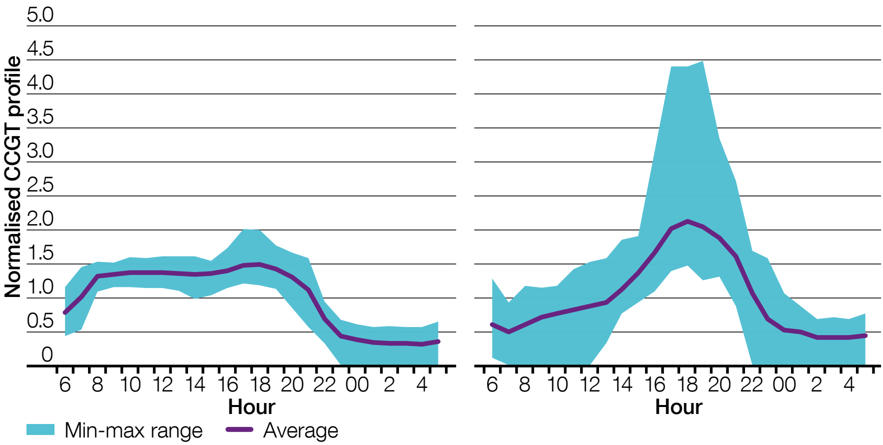
As both the electricity System Operator and individual suppliers have a range of balancing tools available, it is difficult to predict when CCGTs will be used. They tend to be used in combination with the other options to maintain a system balance. This all adds to the challenge of forecasting CCGT demand.

Future energy scenarios

Figure 2.8 shows two very different historical within-day profiles of CCGTs. In both cases the average profile is shown, overlaid on the typical range.

On the left, CCGT generation occurs throughout the day peaking at 6:00pm in winter periods. On the right however, we observe a CCGT profile that responds only over the 'tea-time' peak, generating little electricity, if at all, during the rest of the day.

Figure 2.8
Two very different CCGT profiles (normalised)



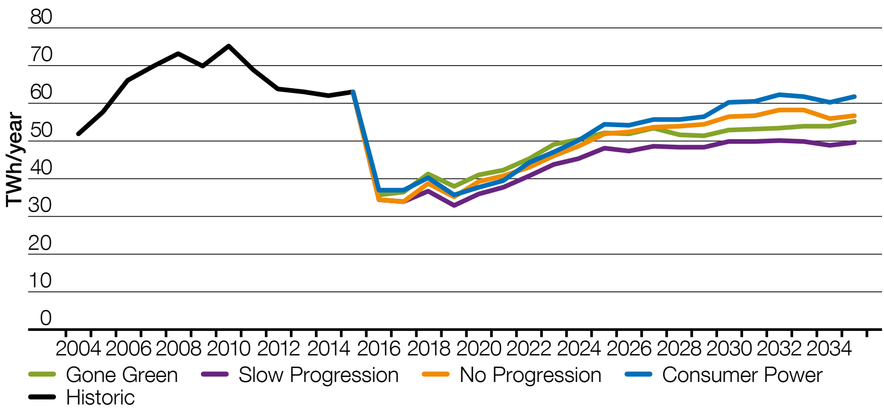
Exports

Exports account for around a sixth of total gas demand. We currently have two export interconnectors in the UK, one to Ireland and one to Continental Europe. In 2016, the Corrib gas field started injecting into the Irish system, resulting in lower levels of exports to Ireland.

We expect that while Corrib is running there will be a reduction in exports from Great Britain (GB). However, it is anticipated that the gas field production will be relatively short lived, with rates reducing over time and the reliance on GB exports gradually returning (Figure 2.9).

Exports to Europe via the Interconnector UK (IUK) are highly sensitive to both the overall UK supply/demand balance and continental gas markets. The import and export levels flowing through IUK are subject to uncertainty.

Figure 2.9
Gas demand from the NTS to Ireland



Future energy scenarios

Peak daily demand

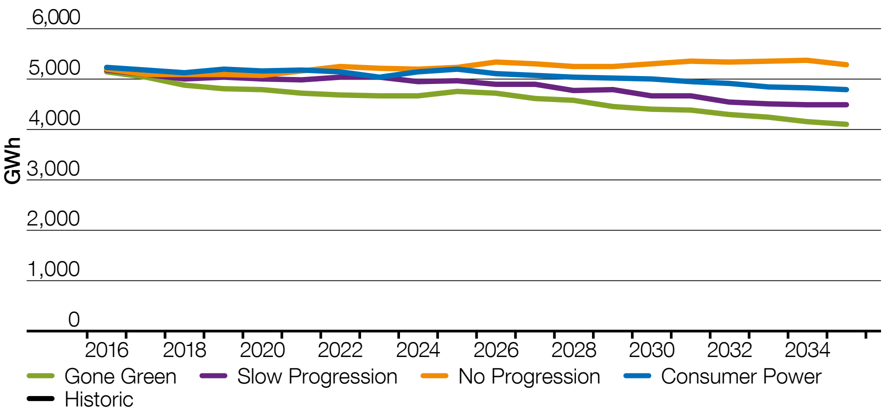
Peak demand is based on the historical relationship between daily demand and weather. This relationship is combined with the expected amount of gas-fired power generation on a peak day. Figure 2.10 shows our peak demand scenarios, which are aligned to our annual demand scenarios.

The short-term increase in annual gas demands does not reflect in a similar manner in peak demand. This is due to peak conditions meaning that most gas-fired power stations will be running on a peak day regardless of how they run throughout the rest of the year. Our analysis assumes a low wind load factor of 7% with gas prices more favourable to coal. In the longer term, peaks follow similar, albeit less pronounced, trends to annual scenarios as residential peak demands scale with annuals.

Peak within-day demand

Through our FES work we do not produce within-day peak demand data. However, our scenarios are used to assess changes to within-day profiling, which is explained in more detail in Chapter 3.

Figure 2.10
1-in-20 diversified peak gas demand



2.3.2
Evolution of gas supply

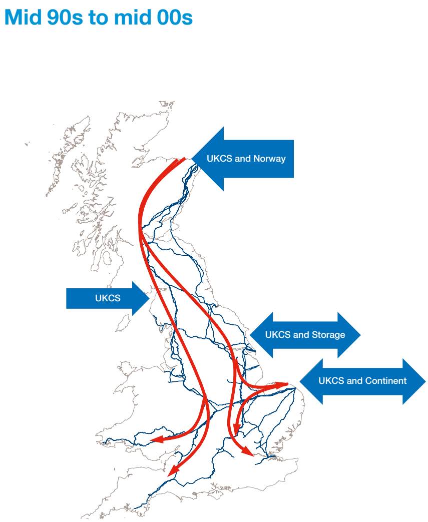
The following section explains how gas supply has changed over the last decade and how it could look going forward. Gas supply sources have become increasingly variable which presents a number of challenges for us as the System Operator (see Chapters 3 and 4).

Changing GB gas supply

Our 2016 *FES* publication gives details of annual and peak gas supply for each of our four scenarios. The 2016 *GTYS* expands on the *FES* by adding locational information and highlighting implications for the future planning and operation of the NTS. In recent years we have shown how supply patterns on the NTS are changing and how they are expected to become more uncertain in the future.

Figure 2.11 shows some of the changes we have seen from the mid-1990s to today. From the mid-1990s to 2000s, supply patterns were dominated by the UK Continental Shelf (UKCS). Gas mainly entered the system at terminals on the east coast and travelled in a north to south pattern.

Figure 2.11
Changing flow patterns on the NTS



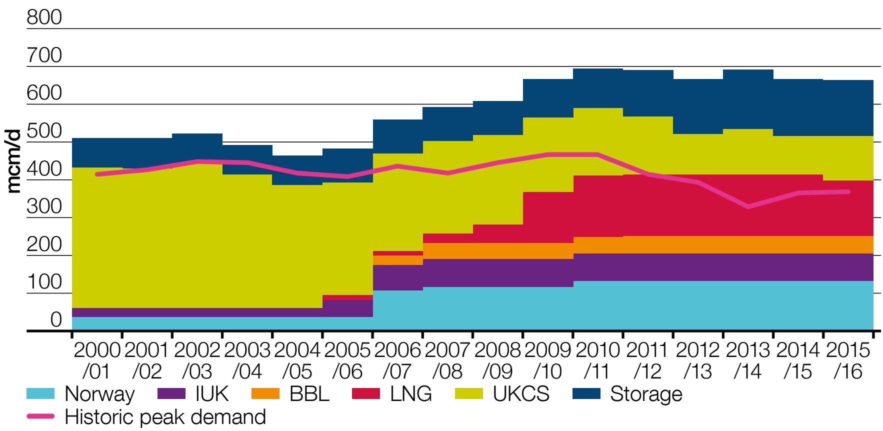
Future energy scenarios

From the mid-2000s onwards, as the UKCS declined, new imports were connected:

- Norwegian gas at Easington.
- Continental gas (BBL) at Bacton.
- LNG at Grain and Milford Haven.

In addition, a number of new medium-range storage sites were added. At the same time as the range of supplies has increased, demand has decreased, giving a larger surplus of capacity over peak demand, as shown in Figure 2.12.

Figure 2.12
Historic gas supply capacity and peak demand

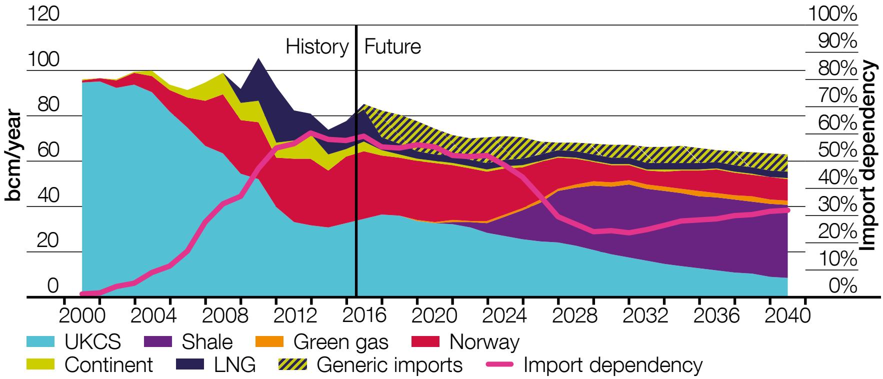


As a result of these changes, the credible range of supply patterns needed to meet demand has increased considerably. This affects future system planning as we have to develop a sufficiently adaptable system to be able to deal with multiple supply pattern possibilities. For example, high flows from Milford Haven support high exit capability in South Wales, but if Milford Haven flows are lower, exit capability is limited. We have to plan for this uncertainty when making exit capacity available. These issues and the implications for planning and operating our network are discussed in more detail in Chapters 3 and 4.

Annual and peak gas supply

Figures 2.13 and 2.14 show annual gas supplies in two of our scenarios: **Consumer Power** and **Slow Progression**. These represent extreme cases for different elements of the total supply.

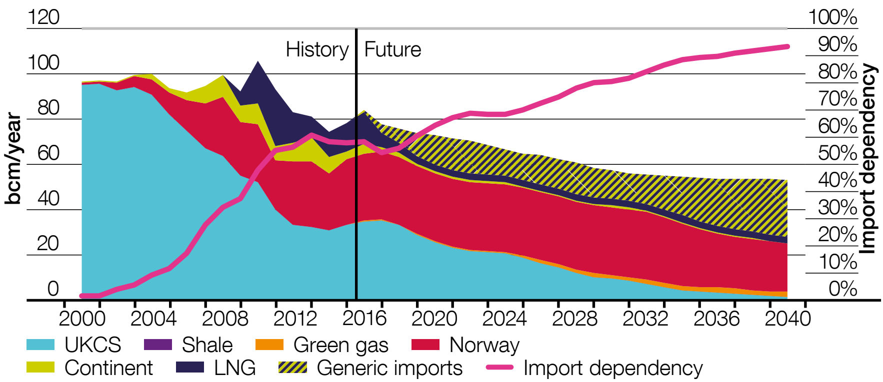
Figure 2.13
*Annual gas supply for **Consumer Power***



Chapter two

Future energy scenarios

Figure 2.14
*Annual gas supply for **Slow Progression***



In **Consumer Power**, supplies from the UK (including UKCS and shale gas) are higher than in any of the other scenarios. This leaves less room for imports.

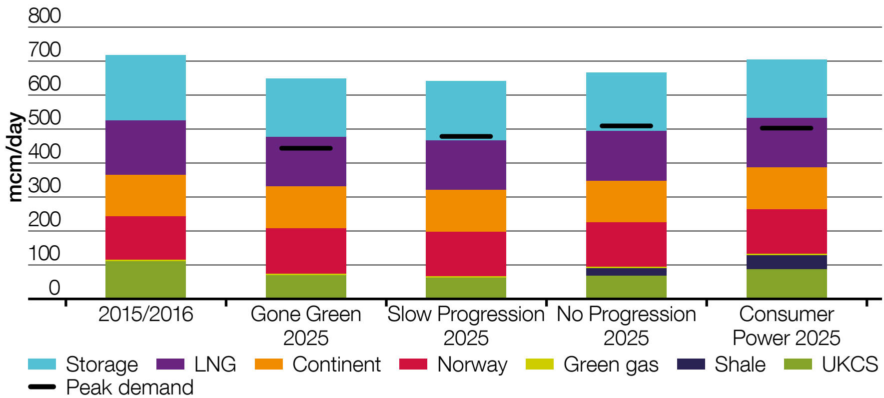
In **Slow Progression**, UKCS production is low and there is no shale gas, leading to much higher levels of imported gas.

In all scenarios the declining UKCS production means that flows through some sub terminals will fall to zero before 2040. Detailed terminal flow projections are shown in Appendix 5 (Gas Demand and Supply Volume Scenarios).

The 'generic import' hatched area represents imported gas that could be any mixture of LNG and continental gas. The figures give some indication of the challenges we face with planning and operating the NTS. For example, in **Slow Progression**, the range of LNG flows in 2025 is from 3 bcm up to 15 bcm, dependent on the balance between LNG and continental gas in the Generic Import.

In our 2016 scenarios, the current level of physical supply capability is more than enough to satisfy peak gas demand in all our scenarios. Figure 2.15 shows the current peak supply capability along with the peak supply capability at 2025 in the four scenarios and the peak demands in each. The chart shows that in all years the peak demand can be met by the existing supply infrastructure.

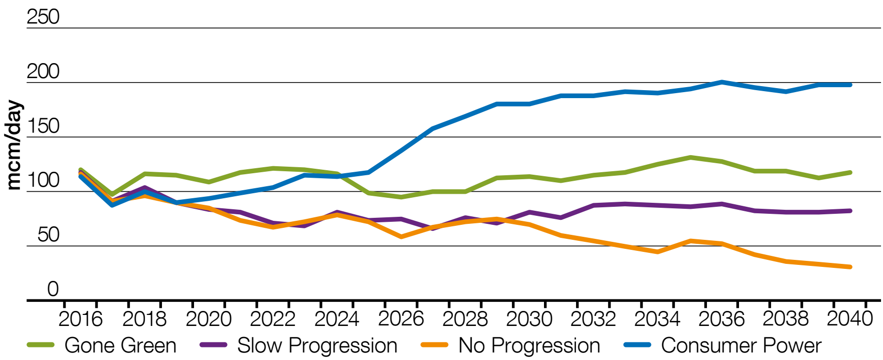
Figure 2.15
Peak supply capacity and demand



To ensure there is sufficient peak supply to meet demand we carry out the N-1 test, as implemented by the European Commission. This assesses whether there is sufficient supply to meet demand when the largest single piece of infrastructure is removed. For all scenarios this represents losing supply from both LNG terminals at Milford Haven, a loss of 86 mcm per day. At the start of the scenarios this results in a margin of approximately 115 mcm per day. Figure 2.16 highlights the margin by which supply exceeds demand, with the N-1 condition applied, and shows that all of our scenarios pass this test.

Future energy scenarios

Figure 2.16
Peak day N-1 margins



Supply Infrastructure

The peak day N-1 chart, Figure 2.16, shows that there is no requirement for new supply infrastructure solely to meet peak demand. However, there may be commercial reasons for new developments. For example, there may be a case for operators to develop storage to make best use of shale gas, which is expected to produce at a constant rate through the year, or to support an electricity generation market increasingly dominated by intermittent low carbon generation. Similarly, in a scenario with high LNG import, developers may wish to open new capacity to take a share of the market.

In order to examine the implications of our gas supply scenarios on the NTS, we show annual and peak flows split by supply terminal. To capture the full range of supply possibilities there are two cases for each scenario: one where the generic import is all LNG, and one where the generic import is all continental gas. Charts showing the flows by terminal are provided in Appendix 5.

Storage

Many new storage sites have been proposed over the last ten years and there are currently plans for nearly 9 bcm of space, both for medium-range fast-cycle facilities and for long-range seasonal storage. Details of existing and proposed storage sites are provided in Appendix 5.

In March 2015, Centrica Storage Limited announced a reduction to the capacity of the Rough long-range storage site for up to six months as a precautionary measure while investigative work was undertaken. In June 2016, an additional issue was discovered. As a result, all injections and withdrawals were suspended for an initial period of at least 42 days. Following a period of further investigation, Centrica Storage Limited now aim to make 20 (from a total of 29) wells available for withdrawal by the second half of November 2016[12]. In a further development, Centrica Storage Limited decided that part of the facility would not be returned to service following the testing. They have stated that this should have a minimal impact on the performance of the site as a whole[13]. The analysis for this year's *GTYS* was mostly carried out before the withdrawal from service in June 2016. Based on the best information available to us at the time, we assumed that Rough would be in service throughout the duration of the analysis. In Appendix 5 we show details for space and deliverability at Rough, but we note that these should be regarded as provisional until the site is returned to service and all testing has been completed. This is expected by March 2017.

Imports

The UK has a diverse set of import options with pipelines from Norway, the Netherlands and Belgium, and from other international sources in the form of LNG. There are currently no plans for increased pipeline interconnection. Details of existing and proposed LNG sites and existing interconnectors are given in Appendix 5.

[12] http://www.centrica-sl.co.uk/regulation/remit/2015-33

[13] http://www.centrica-sl.co.uk/regulation/remit/2015-67

Legislative change

2.4
Legislative change

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

2.4.1
Emissions directives

The European Union (EU) has agreed targets and directives that determine how we should control emissions from all industrial activity. The Industrial Emissions Directive[14] (IED) is the biggest change to environmental legislation in over a decade, with implications for everyone who relies on the NTS.

The IED came into force on 6 January 2013, and is applicable to industrial emissions for units with a thermal input 50MW and above. It brought together a number of existing pieces of European emissions legislation. Two elements of IED, the Integrated Pollution Prevention and Control (IPPC) Directive and the Large Combustion Plant (LCP) Directive, heavily impact our current compressor fleet. Figure 2.17 on the next page summarises the key features of emissions legislation.

The IED impacts the energy industry as a whole. Our customers, energy generators in particular, have to either close or significantly reduce their coal plant usage to comply with the emissions legislation. This means that our customers are using other sources, such as CCGT's plant, to generate electricity instead.

These emission legislation changes impact on how our customers use the NTS and we have to be able to provide an adaptable system to accommodate these changing requirements (see Chapter 3).

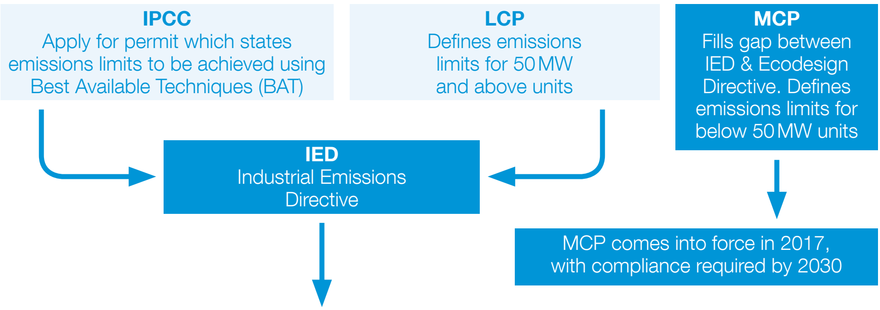
The IPPC impacts 23 of our 24 NTS compressor sites. The LCP directive impacts 16 of our 64 gas turbine driven compressor units. Details of what we are doing to adapt our sites to comply with this legislation are outlined in Chapter 5.

The IED legislation forms the new mandatory minimum emission standards that all European countries must comply with by 2023.

For units with a thermal input from 1MW to below 50MW, the Medium Combustion Plant (MCP) Directive will apply. This is currently draft legislation, which needs to be "in force" by 1 January 2018 and is expected to be transposed into UK legislation by 19 December 2017. Based on the current draft legislation we anticipate this will impact a further 26 of our compressor units.

[14] A copy of the Industrial Emissions Directive can be found here: http://ec.europa.eu/environment/industry/stationary/ied/legislation.htm

Figure 2.17
IED and MCP emissions legislation key features



IED and MCP Key Features					
MCP Below 50 MW	Installations must be operated with a permit	Permits specify the emission limit values (ELVs) to be complied with which are based on BAT	BREF documents draw conclusions on what the BAT is for each sector affected by IED	BREF document for combustion plant due to be finalised in 2017	
IED 50 MW & above	Set new ELV for carbon monoxide 100 mg/Nm³ for new and existing plant Set new ELV for nitrogen oxide 50 mg/Nm³ new plant; 75 mg/Nm³ for existing plant	All our gas-driven compressors that produce emissions above the threshold set by the IED must be compliant with new limits by 31 December 2023	Compressors not meeting new ELVs had to stop operating by 31 December 2015 unless a Limited Lifetime Derogation applied for or the unit entered into emergency use	Through Limited Lifetime Derogation the operator declares not to operate plant for more than 17,500 hours until 31/12/2023	Can use affected compressors that do not comply with ELVs for ‘emergency use’ for less than 500 hours per year

The following sections summarise the main elements of IED and MCP that impact upon our compressor fleet. More detail about what we are doing to comply with these legislative changes, along with maps highlighting which compressor sites are affected, are provided in Chapters 3 and 5.

Legislative change

Integrated Pollution Prevention and Control (IPPC) Directive

The IPPC[15], implemented in 2008, states that any installation with a high pollution potential (oxides of nitrogen (NOx) and carbon monoxide (CO)) must have a permit to operate.

To obtain a permit we must demonstrate that Best Available Techniques (BAT, see below for more information) have been used to assess all potential options to prevent emitting these pollutants. The BAT assessments provide a balance between costs and the environmental benefits of the options considered.

We have to ensure that all of our compressor installations covered by the regime have a permit. These permits will specify the maximum Emission Limit Values (ELVs) to the air for each unit.

We are currently working on three compressor sites in order to ensure compliance with the IPPC directive. Further information on these works can be found in Chapter 5.

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

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

BAT Reference (BREF)

BREF[16] documents have been adopted under both the IPPC directive and IED. The BREF documents outline:

- techniques and processes currently used in each sector
- current emission levels
- techniques to consider in determining the BAT
- emerging techniques to comply with the legislation.

The BAT conclusions drawn from the BREF documents will outline the permit conditions for each non-compliant unit.

The BREF document for large combustion plants is in draft form (June 2013) and it is anticipated that this will be finalised in 2017. From the date of finalisation we will have four years to implement the conclusions.

[15] A copy of the IPPC directive can be found here: http://eur-lex.europa.eu/legal-content/EN/TXT/?uri=URISERV:l28045

[16] BREF documents can be found here: http://eippcb.jrc.ec.europa.eu/reference/

Large Combustion Plant (LCP) Directive

The LCP directive[17], implemented in 2001, applies to all combustion plant with a thermal input of 50MW or more. All of our compressor units that fall within the LCP directive must meet the ELVs defined in the directive. The ELVs are legally enforceable limits of emissions to air for each LCP unit. ELVs set out in the directive can be met in one of two ways:

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

Limited Lifetime Derogation

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

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

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

Emergency use provision

The IED includes the possibility of using plant for emergency use:

> *"Gas turbines and gas engines that operate less than 500 operating hours per year are not covered by the emission limit values set out in this point. The operator of such plant shall record the used operating hours."*

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

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

[17] A copy of the LCP directive can be found here: http://eur-lex.europa.eu/legal-content/EN/TXT/?uri=URISERV:l28028

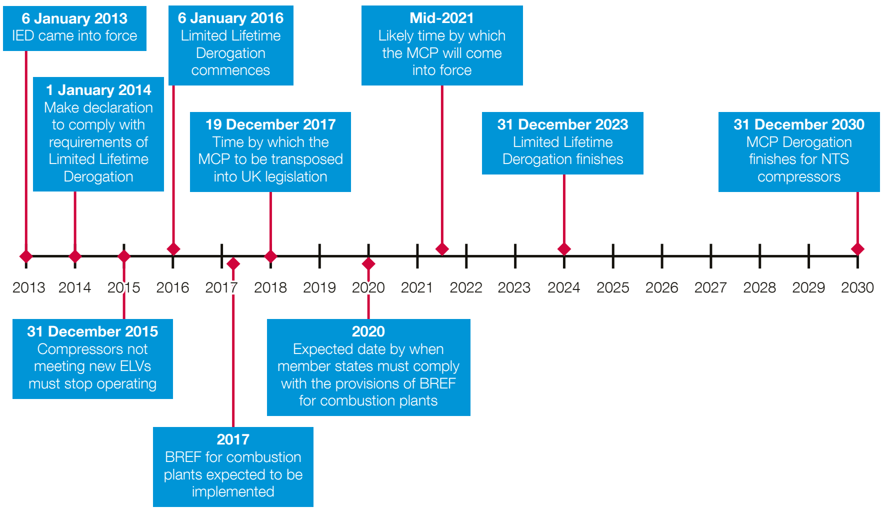
Legislative change

Medium Combustion Plant (MCP) Directive

The Medium Combustion Plant (MCP) Directive will be transposed into UK legislation by 19 December 2017. During 2015 the MCP Directive was finalised at a European level. The time derogation for gas-driven compressors was originally 2025. National Grid has secured a longer derogation for gas compressors that are required to ensure the safety and security of an NTS, which now have a further five years (to 2030) to comply with the requirements.

The MCP Directive applies to smaller gas compressors and will affect a further 26 of the NTS compressor units. Other combustion plants, such as pre-heat systems, are also captured as part of this Directive. During 2016/17 we will undertake an audit of this plant type and develop mitigation plans.

Figure 2.18
Legislation timelines



2.4.2
Other legislation

Following the UK's referendum result on EU membership in June 2016, National Grid notes that EU rules and regulations will continue to apply in the UK until such time as the UK's membership of the EU is withdrawn. National Grid will continue to take forward implementation of EU requirements whilst the terms of the future UK relationship with the EU, including the Internal Energy Market, are defined.

European Union Third Package

One of the most important pieces of European gas and electricity markets legislation is referred to as the Third Package. This was transposed into law in Great Britain (GB) by regulations that came into force in 2011.

The Third Package creates a framework to promote cross-border trade and requires a number of legally binding Guidelines and Network Codes to be established and implemented with the aim of: promoting liquidity; improving integration between Member States' gas markets; and promoting the efficient use of interconnectors to ensure that gas flows according to price signals, i.e. to where it is valued most.

These EU legislative requirements take priority over GB domestic legislation and associated regulations and codes, including the Uniform Network Code (UNC). We, as the Transmission System Operator, have raised a series of EU related UNC Modifications to comply with the legislation.

The focus to date has been on:

(a) Commission Decision on amending Annex I to Regulation (EC) No 715/2009 on conditions for access to the natural gas transmission networks [2012/490/EU, 24/08/2012]; (Congestion Management Procedures (CMP)).

This specifies rules to ensure booked capacity at Interconnection Points is used efficiently to address issues of contractual congestion in transmission pipelines.

(b) Commission Regulation (EU) No 984/2013 of 14 October 2013 establishing a Network Code on Capacity Allocation Mechanisms in Gas Transmission Systems and Supplementing Regulation (EC) No 715/2009; and (CAM).

This seeks to create more efficient allocation of capacity at the Interconnection Points between adjacent Transmission System Operators. CAM introduced the revised 05:00-05:00 Gas Day arrangements at Interconnection Points.

(c) Commission Regulation (EU) No 312/2014 of 26 March 2014 establishing a Network Code on Gas Balancing of Transmission Networks; (BAL).

This includes network-related rules on nominations procedures at Interconnection Points, rules for imbalance charges and rules for operational balancing between Transmission System Operators. This also reflects the new Gas Day arrangements that are applicable across the GB balancing zone via this code. It applied in Great Britain from 1 October 2015.

Legislative change

(d) Commission Regulation (EU) No. 703/2015 of 30 April 2015 establishing a Network Code on Interoperability and Data Exchange Rules.

This obliges Transmission System Operators to implement harmonised operational and technical arrangements in order to remove perceived barriers to cross-border gas flows and thus facilitate EU market integration. Implemented 1 May 2016.

An EU-wide Network Code on Harmonised Transmission Tariff Structures for Gas (TAR) and an amendment proposal to the Network Code on Capacity Allocations Mechanisms (CAM) on Incremental Capacity are currently going through the EU regulatory process with agreement expected to be reached in 2017.

Further legislative elements of the EU third package concern energy market integrity and transparency. This was taken forward by Regulation (EU) 1227/2011 and Regulation (EU) 1348/2014 (commonly known as REMIT and the REMIT Implementing Regulation respectively).

For more information on our activity to date and our future activity to comply with third package EU legislation see Appendix 6.

Ofgem Significant Code Review

In January 2011, Ofgem began its Significant Code Review (SCR) into gas security of supply to address its concerns with the gas emergency arrangements. The aim of the review was to reduce the likelihood, severity and duration of a gas supply emergency by ensuring that the market rules provide appropriate incentives to gas shippers to balance supply and demand.

In September 2014 Ofgem issued its conclusions[19] which included a reformed cash-out arrangement (the unit price at which differences in each gas shipper's supply and demand are settled) in an emergency. The reformed cash-out arrangement incentivises gas shippers to deliver supply security as price signals incorporate the costs of involuntary consumer interruptions into cash-out. These changes took effect from 1 October 2015.

Following a successful trial in summer 2015, the gas demand-side response mechanism went live on 1 October this year. This new mechanism will act as a route to market for large gas consumers, allowing them to bid to reduce the amount of gas they use during times of system stress in exchange for a payment.

[19] https://www.ofgem.gov.uk/publications-and-updates/gas-security-supply-significant-code-review-conclusions

Asset health

2.5
Asset health

Asset health is a becoming a more frequent trigger to our Network Development Process (NDP). This section explores asset maintenance and our asset health programme, from identification of an issue, through to resolution. The NTS comprises 7,600 km of pipeline, 24 compressor sites with 75 compressor units, 20 control valves and 530 above-ground installations (AGIs). Of these assets approximately 70% of pipeline and 77% of our other assets will be over 35 years old at the end of RIIO-T1.

We have developed our asset maintenance and asset health programmes in order to maintain the health of the NTS to appropriate levels. Our asset maintenance programme focuses on delivering routine maintenance and monitoring the health of our assets versus our expected asset life cycles; the asset health programme addresses assets that are either end of life or have failed, typically through more invasive works such as replacement or refurbishment. These programmes ensure that we can consistently deliver a safe and reliable system to meet our customers' and stakeholders' needs. The RIIO price control arrangements have changed how we report on the health of the NTS. RIIO has introduced Network Output Measures (NOMs) as a proxy for measuring the health and thus level of risk on the network. We must meet specific targets that are related to the condition of the NTS. This change means that asset health is a key RIIO measure in terms of allowances and output. The targets we have been set cover an eight-year period from 2013 to 2021.

In aggregate we have plans to deliver a residual risk through investment that meets the RIIO target. However, the licence breaks the NTS into five primary categories and through examination of the risks we now believe that it is in the interests of consumers to meet only three of the five category targets.

As the NTS is ageing and we have an increasing number of assets reaching the end of their design life, we have implemented a five-year programme of works to resolve current asset issues as efficiently as possible while minimising disruption to our customers. This is our Asset Health Campaign, outlined in further detail later in this chapter.

Asset health

2.5.1
Asset maintenance

We manage the assets that make up the NTS against 47 asset categories. Our asset maintenance strategy takes into account the likely failure modes of the asset families and the consequences should we lose functionality. This consideration leads to decisions on the type of intervention and triggers for the maintenance activity.

By understanding what our assets are doing and the condition we expect them to be in throughout their lifecycle, we can plan, monitor and react to their maintenance requirements. Examples of application of the strategy are:

- **Pipelines** – Risk-based inspection.
- **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.
- **Compressors** – Condition monitoring, functional checks, scheduled inspections, and usage-based inspections.
- **Valves** – Criticality-based intervals.
- **Above Ground Installations (AGIs)** – Functional checks.

We have processes in place to collate asset health issues whether identified through maintenance or identified through performance indicators or observations.

Some of the issues identified can be resolved by the maintenance teams while others are more complex to resolve and are handled through our network development process. We carefully consider what priority is given to the resolution of the issues.

This prioritisation process is represented in our regulatory reporting using a risk matrix (Figure 2.19). The health of the asset represents the likelihood of loss of function, while criticality represents the impact of that loss.

Figure 2.19
Asset replacement priority matrix

Asset Health Scores	
AH1	New or as new
AH2	Good or serviceable condition
AH3	Deterioration, requires assessment or monitoring
AH4	Material deterioration, intervention requires consideration
AH5	End of serviceable life, intervention required

Criticality	
C1	Very High
C2	High
C3	Medium
C4	Low

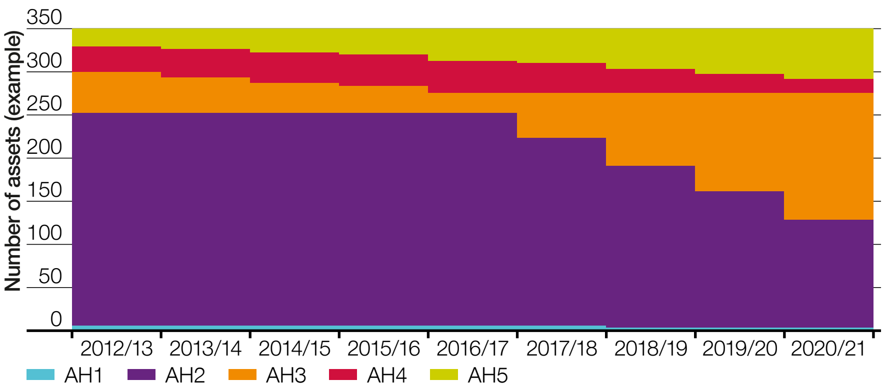
Replacement Priority Matrix

	AH1	AH2	AH3	AH4	AH5
C1	RP4	RP3	RP2	RP1	RP1
C2	RP4	RP3	RP2	RP1	RP1
C3	RP4	RP3	RP2	RP2	RP1
C4	RP4	RP3	RP2	RP2	RP1

We currently use models to predict how the health of asset categories will change over their lifetime. Across a portfolio of assets with different installation dates, we are able to forecast the future investment workload for replacement of assets, as illustrated in Figure 2.20. We supplement the forecast workload with actual asset health information collected through our asset management processes.

During 2015/16 we have invested £75 million on improvements to the health of over 2,000 NTS assets. Within the NOM methodology this is associated with over 400 asset health changes.

Figure 2.20
Asset ageing model – showing an example asset condition decline over time



Asset health

2.5.2
The asset health campaign

Over the past year we have been building a catalogue of known asset condition issues which will be addressed by the campaign within the next five years. The planning stages of this five-year campaign have identified which assets should be addressed first, with works starting in RIIO Year 4 (2016/17) and concluding in RIIO Year 8 (2020/21).

During 2015/16 we have been improving our asset management capabilities and, through this, we have identified additional investments that will be required to manage the NTS asset health risk to an acceptable level.

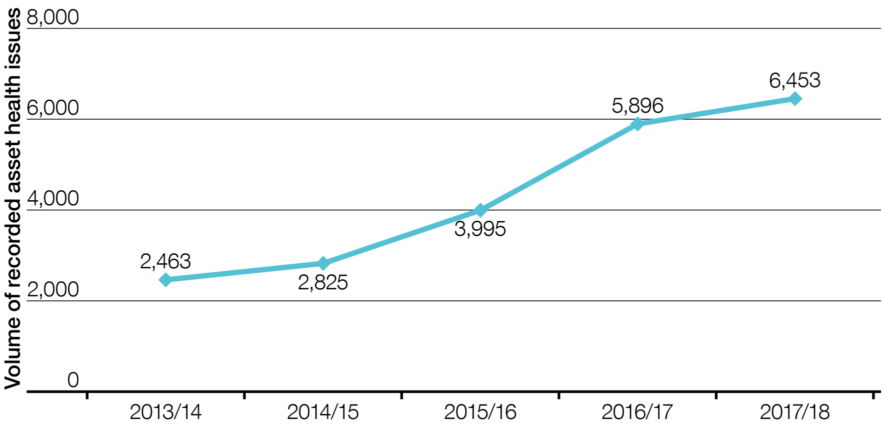
The revised approach is expected to be scaleable for the higher volumes of asset health investment that we anticipate will be required. The figure below (Figure 2.21) illustrates the increase in volume of asset health issues that have been collected into our register through more rigorous application of our collation process.

Minor asset issues can be resolved outside of our NDP, however, where multiple options are being considered to resolve the asset issue our NDP may be used to critically assess the options.

Campaign delivery
We have examined the most appropriate approach to complete all of the investments required to manage the asset health risk, taking into account efficient spend and minimising disruption to gas consumers.

Our revised campaign approach retains elements of geographic coordination but now bundles investment by work type to maximise the opportunity for cost saving.

Figure 2.21
Volume of recorded asset health issues



Asset health and NDP

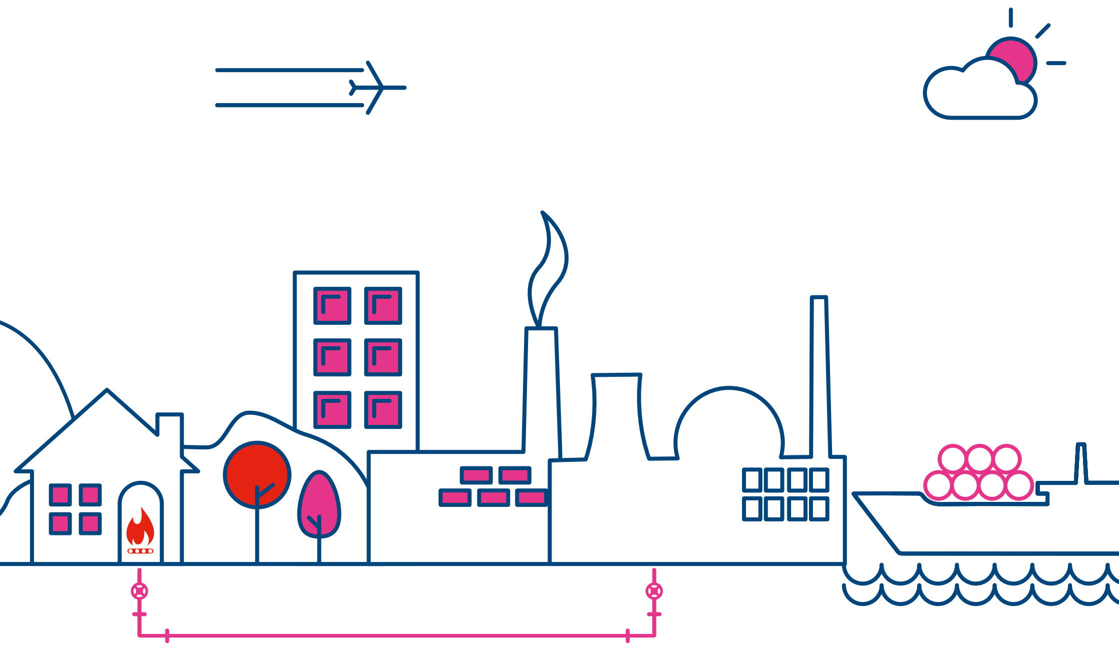
By using our NDP to resolve an asset health issue we are able to reach the most efficient and effective solution. We start with a stakeholder engagement workshop to establish a range of options which could address the asset need. We then explore the advantages and disadvantages of the options and align them to the Whole Life Prioritisation Matrix (WLP) (Appendix 1). This process narrows down the range of options for more detailed assessment. The WLP is explained further in Chapter 3.

The Establish Portfolio stage of the NDP, as described in Chapter 5, explores the asset investment options we consider to resolve asset health issues. When looking at asset investment options we not only look at the impact on NTS capability and operation, we also look at the impact on other projects and governance obligations such as to the Health and Safety Executive (HSE) and the Department for Business, Energy and Industrial Strategy (BEIS).

We expect each of the asset health deliveries throughout the campaign (see Figure 2.21) to follow our NDP. Depending on the asset type and location it may be assessed individually or collectively.

Asset health campaign challenges

The network section approach to asset health works can result in system access challenges, as some assets will need to be taken offline to complete the required work. In order to manage this temporary impact on our network, the programme of works will be designed to minimise disruption and will not affect our ability to provide a safe and reliable network.



Chapter three

System capability

This section outlines the current system capability of the National Transmission System (NTS). Information is provided for entry and exit capacity and the impact of the Industrial Emissions Directive (IED). This chapter also explores the Need Case stage of the Network Development Process (NDP), which we use to establish NTS capability requirements.

We update you on current and future challenges which impact the way we plan and operate the NTS. We also discuss what we're doing to address them as System Operator (SO) and Transmission Owner (TO). We are keen to engage with you to get your feedback on what we're doing and how we're doing it.

GTYS is published at the end of the annual planning cycle. We use *GTYS* to provide information on an annual basis to help you to identify connection and capacity opportunities on the NTS. We summarise key projects, changes to our internal processes that may impact you, and other key publications which provide further information on our System Operator activities.

Key insights

We use our NDP to assess system capability requirements.

- The first round of Electricity Market Reform (EMR) auctions has mainly resulted in capacity contracts for existing power stations with some new build. Although the initial developer activity before EMR has not resulted in any new NTS projects, we are still discussing future connections which may lead to future NTS projects.
- The impact of legislative change – particularly the IED – continues to challenge how we develop our network and improve our investment approach.
- We continue to provide information about lead times and capacity across different geographical areas and we aim to make our *GTYS* and our other publications more relevant to your needs.
- Overall distribution network (DN) flat capacity requests are falling but the flex requests, particularly in the South West region, are increasing.

Introduction

3.1
Introduction

System capability and the development of the NTS is managed through the Network Development Process (NDP) which we introduced in Chapter 1. Following on, Chapter 2 explored some of the triggers for this process including: customer requirements, changing market conditions as described in our *Future Energy Scenarios (FES)*, changes in legislation such as the IED and asset health requirements.

This chapter describes what happens once we receive a 'trigger' and we enter the Need Case stage of the NDP. This is where we analyse the NTS's capability requirements.

Included within this chapter are:
- customer entry and exit capacity processes
- capability requirements triggered by the IED.

Understanding our system capability allows us to determine where rules, tools or asset solutions need to be found to meet our customer requirements. Chapter 4 will discuss where, as System Operator, we can better use rules and tools to make more efficient use of the system. Chapter 5 will discuss how the asset solutions are developed.

NDP – Defining the Need Case

3.2
NDP – defining the Need Case

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

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

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

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

We initially look at the 'Do Nothing' option. This is the minimum action we could take. This may mean no investment or the minimum investment on a like-for-like basis to ensure safety and licence requirements are met. We then assess other high-level options; these could be rules, tools or assets, against a 'Whole Life Prioritisation Scorecard' as shown in Appendix 7. This ranks the options against multiple categories such as time to deliver, ability to meet the need, and support from the industry. We filter the options to provide a cost envelope under which the development of detailed options can be assessed.

Customer capacity – exit

3.3
Customer capacity – exit

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

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

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

Figure 3.1
Capacity leadtimes

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

If we identify reinforcement works or increased operational risk, we investigate substituting unsold capacity. Capacity substitution involves moving our obligation to make capacity available from one system point to another. This is intended to avoid the unnecessary construction of new assets. (Further information on substitution is available in the Transmission Planning Code (TPC)[1] and via the methodology statements[2].)

If substitution is not possible, we will consider whether a Need Case has been triggered and hence reinforcement works and contractual solutions will be investigated. Works on our existing sites, such as modification of compressors and above-ground installations (AGIs) may not require planning permission, so may have shorter lead times. Significant new pipelines require a Development Consent Order (DCO), as a consequence of The Planning Act (2008). This can result in capacity lead times of 72 to 96 months. Construction of new compressor stations may also require DCOs if a new high-voltage electricity connection is needed and, subject to local planning requirements, may require similar timescales to pipeline projects.

[1] http://www2.nationalgrid.com/UK/Industry-information/Developing-our-network/Gas-Transportation-Transmission-Planning-Code/
[2] http://www2.nationalgrid.com/uk/industry-information/gas-capacity-methodologies/

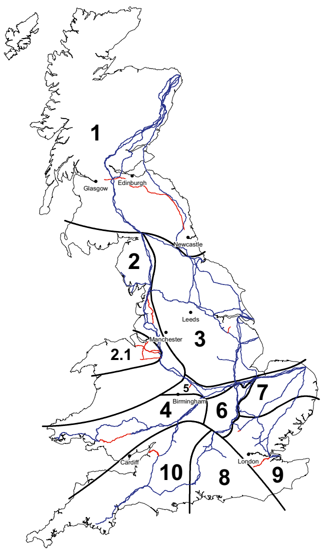
Customer capacity – exit

3.3.1
NTS exit capacity map

NTS exit capacity map divides the NTS into zones based on key compressor stations, and multi-junctions (see Figure 3.2). Within these zones, any new connection and/ or capacity request is likely to either be met through substitution within the zone or by a similar reinforcement project. It is likely that substitution within a zone will be close to a 1 to 1 basis. These zones are purely for information and were created for the *GTYS*. All our substitution analysis is carried out to the substitution methodology statement rules and, while it is very likely that capacity will be substituted from within a zone, it is not guaranteed.

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

Figure 3.2
NTS exit capacity map



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

3.3.2
Available (unsold) NTS exit (flat) capacity

Table 3.1 includes the quantities of unsold NTS exit (flat) capacity in each zone that could be used to make capacity available at other sites through exit capacity substitution. The table also shows how unsold capacity has changed since the publication of the 2015 *GTYS*.

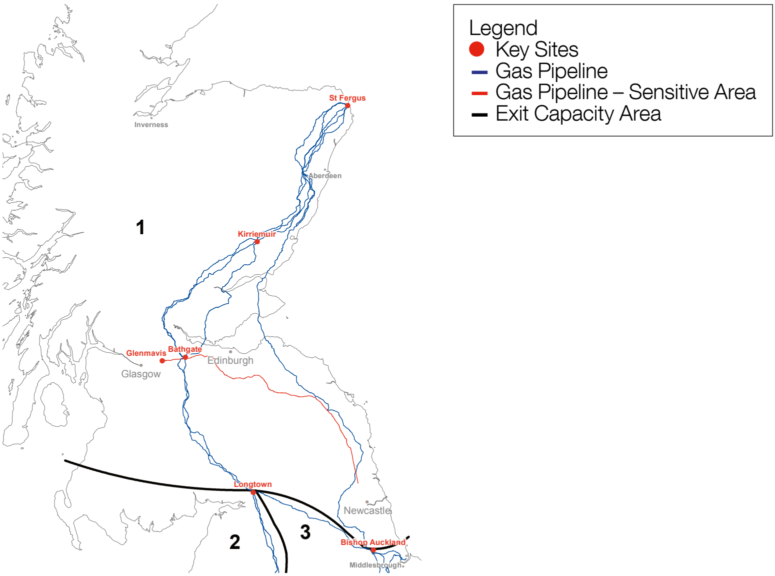
Table 3.1
Quantities of unsold NTS exit (flat) capacity

Region Number	Region	Obligated	Unsold		
		(GWh/d)	(GWh/d)	% of unsold capacity	% change from 2015 *GTYS*
1	Scotland & the North	718	138	19%	+4%
2	North West & West Midlands (North)	1,110	392	35%	+4%
2.1	North Wales & Cheshire	315	199	63%	0%
3	North East, Yorkshire & Lincolnshire	1,570	595	38%	+1%
4	South Wales & West Midlands (South)	569	48	8%	0%
5	Central & East Midlands	281	134	48%	+7%
6	Peterborough to Aylesbury	126	29	23%	0%
7	Norfolk	368	124	34%	+1%
8	Southern	526	227	43%	+4%
9	London, Suffolk & the South East	1,504	475	32%	+4%
10	South West	461	72	16%	+1%

Customer capacity – exit

Region 1 – Scotland and the North

Figure 3.3
Region 1 – Scotland and the North



NTS Location:
North of Long Town and Bishop Auckland

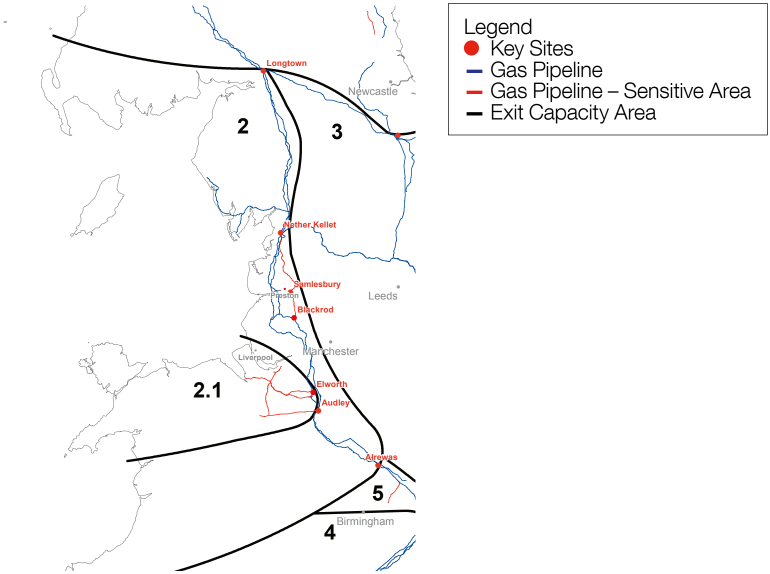
NTS/DN exit zones:
SC1, 2, 3, 4, NO1, 2

This region is sensitive to St Fergus flows.

High St Fergus flows mean exit capacity will be available. As St Fergus flows reduce, exit capacity will be constrained. There is only a small quantity of substitutable capacity in the area, but compressor flow modifications, including reverse flow capability, can be delivered to provide significant quantities of capacity without requiring Planning Act timescales. Capacity may be more limited in the sensitive area (feeder 10 Glenmavis to Saltwick) due to smaller diameter pipelines.

Region 2 – North West and West Midlands (North)

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



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

NTS/DN exit zones:
NW1, WM1

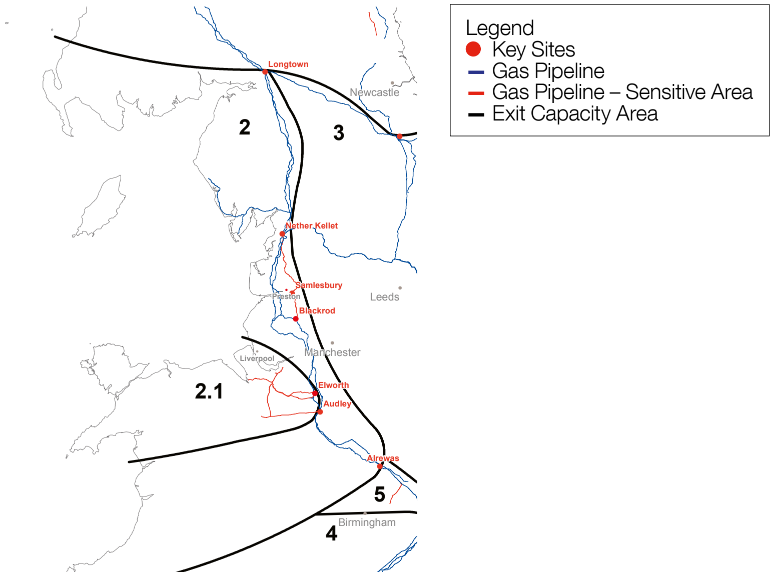
The region is highly sensitive to national supply patterns and use of storage; this area was historically supplied with gas from the north but increasingly receives gas from the south and from the east across the Pennines.

The amount of unsold capacity in the region indicates that capacity could be made available by exit capacity substitution. A capacity request in zone 2 is likely to be met through substitution from zone 2, including zone 2.1, and then from the downstream zones, in this case zone 5. Capacity is likely to be available on the main feeder sections between Carnforth and Alrewas. Potential non-Planning Act reinforcements could release capacity, but then significant pipeline reinforcement would be required, particularly in the sensitive region around Samlesbury and Blackrod (North Lancashire and Greater Manchester).

Customer capacity – exit

Region 2.1 – North Wales and Cheshire

Figure 3.5
Region 2.1 – North Wales and Cheshire



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

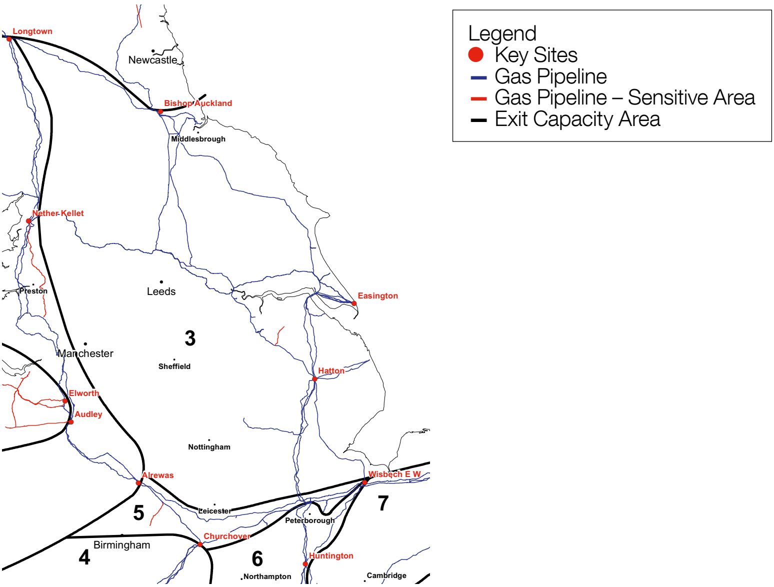
NTS/DN exit zones:
NW2, WA1

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

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

Region 3 – North East, Yorkshire and Lincolnshire

Figure 3.6
Region 3 – North East, Yorkshire and Lincolnshire



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

NTS/DN exit zones:
NE1, 2, 3, EM1, 2

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

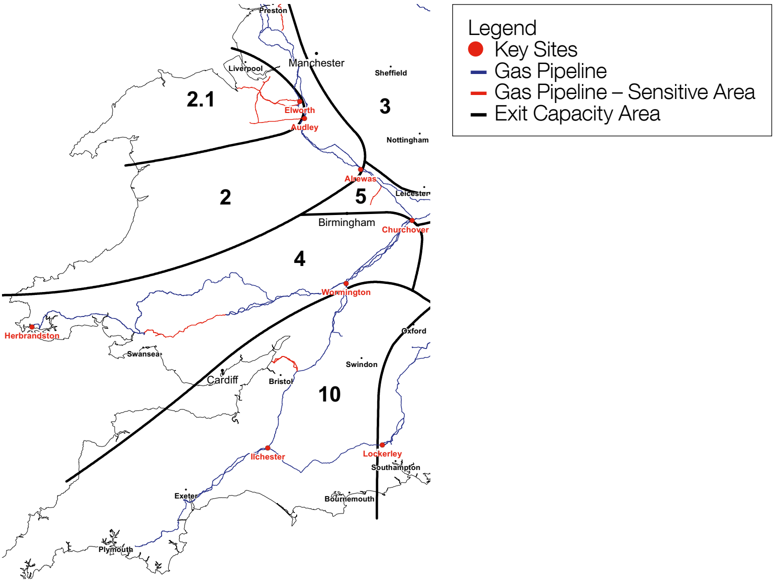
The amount of unsold capacity in the region indicates that capacity could be made available through exit capacity substitution. Further capacity should be available without needing reinforcement, assuming stable north-east supplies; however, this may be limited on smaller diameter spurs, including Brigg (shown as a sensitive pipe).

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

Customer capacity – exit

Region 4 – South Wales and West Midlands South

Figure 3.7
Region 4 – South Wales and West Midlands South



NTS Location:
West of Churchover

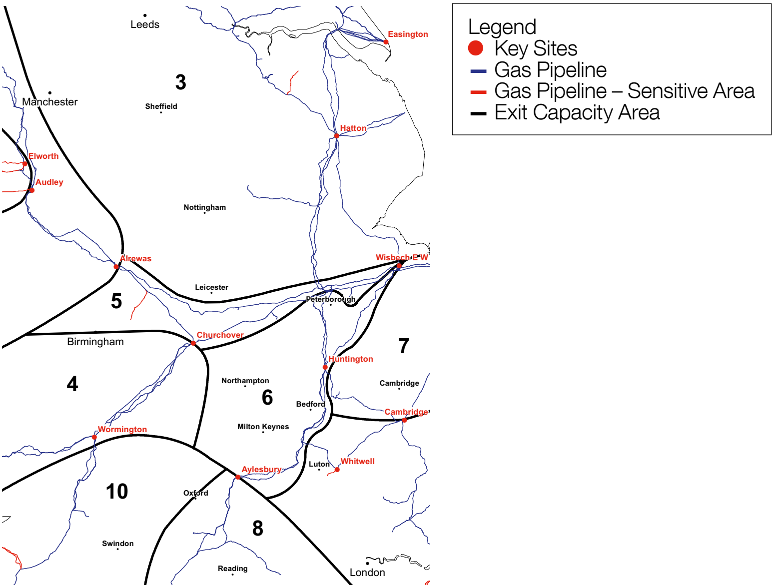
NTS/DN exit zones:
WM3, SW1, WA2

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

The quantity of unsold capacity within the region indicates a limited quantity of capacity could be substituted. Potential non-Planning Act reinforcements could release small quantities of capacity, but significant pipeline reinforcement would be required, since the area south of Cilfrew is a sensitive area (shown in red) due to the different pressure ratings.

Region 5 – Central and East Midlands

Figure 3.8
Region 5 – Central and East Midlands



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

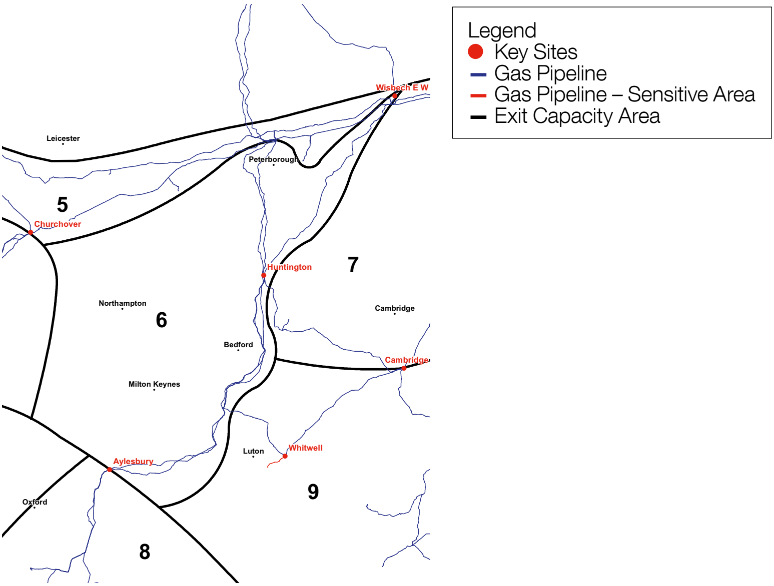
NTS/DN exit zones:
EM3, 4, WM2

The unsold capacity here indicates a limited scope for substitution. Potential non-Planning Act reinforcements could be carried out to release a small amount of capacity, but significant pipeline reinforcement would be required, in particular for the sensitive area Austrey to Shustoke (shown in red).

Customer capacity – exit

Region 6 – Peterborough to Aylesbury

Figure 3.9
Region 6 – Peterborough to Aylesbury



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

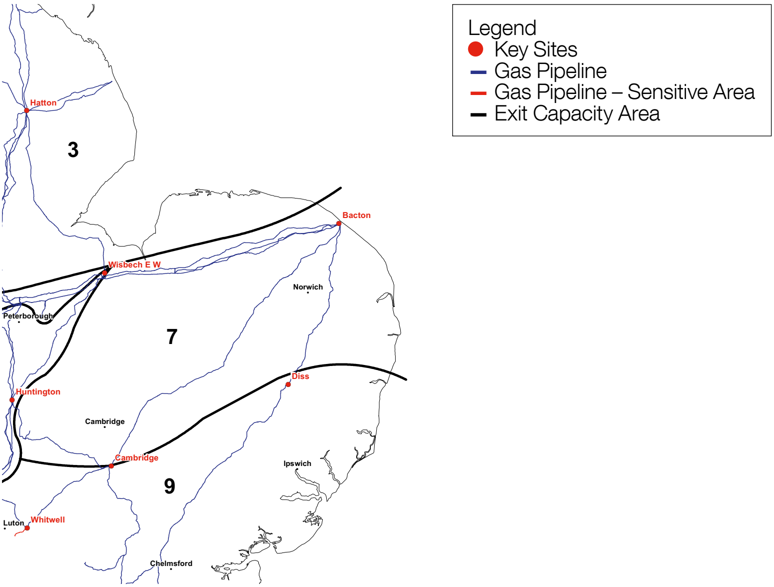
NTS/DN exit zones:
EA6, 7

Capacity availability is sensitive to demand increases downstream in region 10, the South West.

The quantity of unsold capacity indicates limited scope for exit capacity substitution from the single offtake in the region, but there may be scope for substitution from the southern region downstream of Aylesbury. Potential non-Planning Act reinforcements could be carried out to release capacity.

Region 7 – Norfolk

Figure 3.10
Region 7 – Norfolk



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

NTS/DN exit zones:
EA1, 2, 3

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

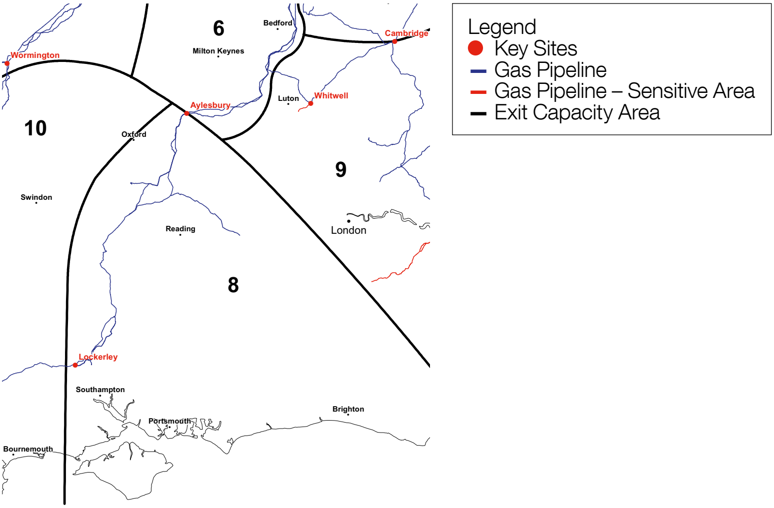
Unsold capacity here indicates a good probability that capacity could be substituted. Additional capacity could be made available without reinforcement works, assuming stable Bacton supplies.

Chapter three

Customer capacity – exit

Region 8 – Southern

Figure 3.11
Region 8 – Southern



NTS Location:
South of Aylesbury and north of Lockerley

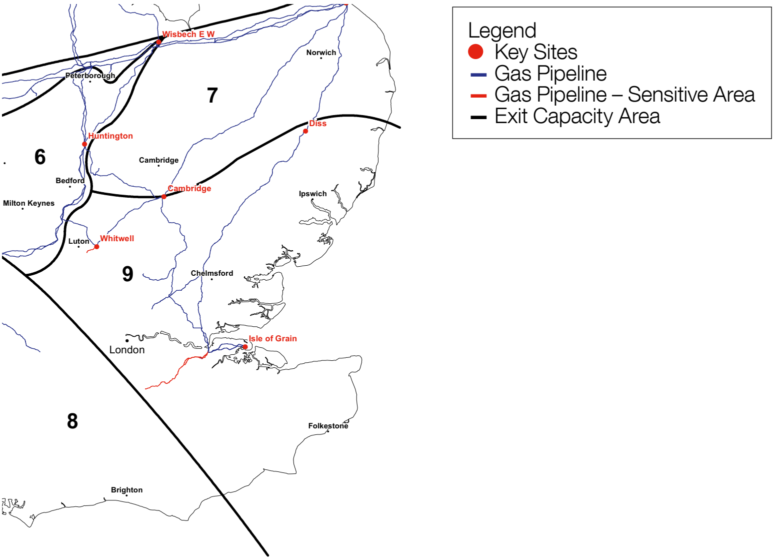
NTS/DN exit zones:
SO1, 2

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.

Region 9 – London, Suffolk and the South East

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



NTS Location:
South Diss, Cambridge, east of Whitwell

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

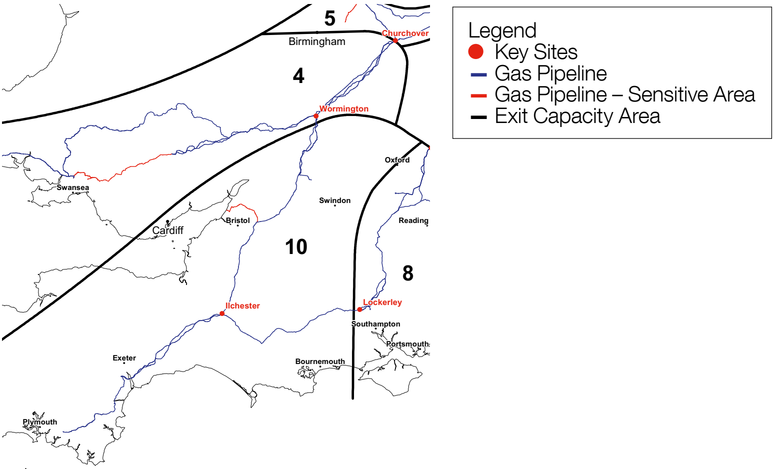
The region is sensitive to Isle of Grain flows, with low flows limiting capacity. Capacity may be more limited in the sensitive areas at the extremities of the system shown in red (Tatsfield, Peters Green). The significant number of power stations in the region may impact on future ramp rate agreements (the rate at which flows can increase at an offtake, as set out in the Network Exit Agreement – NExA).

Unsold capacity indicates a good chance that capacity could be made available via exit capacity substitution, however, exchange rates may vary between locations. Potential non-Planning Act reinforcements could be carried out to release small quantities of additional capacity but significant pipeline reinforcement would be needed.

Customer capacity – exit

Region 10 – South West

Figure 3.13
Region 10 – South West



NTS Location:
South of Wormington and Lockerley

NTS/DN exit zones:
SW2, 3

The quantity of unsold capacity in this region indicates limited scope for capacity being made available through exit capacity substitution. Exchange rates may be high due to small diameter pipelines. Potential non-Planning Act reinforcements could release small quantities of additional capacity, but significant pipeline reinforcement would be needed, resulting in long (Planning Act) timescales, particularly in the sensitive area shown in red (west of Pucklechurch on the feeder 14 spur) due to small diameter pipelines. There is some sensitivity to low Milford Haven flows.

3.3.3
Directly Connected exit points

The following table shows which region the current Directly Connected (DC) offtakes fall within. There are no such offtakes in region 6.

Table 3.2
Direct Connect offtakes by region

Region	Offtake	Region	Offtake	Region	Offtake
1	Blackness (BP Grangemouth)	3	Garton Max Refill (Aldbrough)	4	Tonna (Baglan Bay)
	Cockenzie Power Station		Bishop Auckland (test facility)		Dynevor Max Refill
	Glenmavis Max Refill		Teesside (BASF, aka BASF Teesside)		Pembroke Power Station
	Gowkhall (Longannet)		Hatfield Moor Max Refill		Upper Neeston (Milford Haven Refinery)
	St. Fergus (Peterhead)		Teesside Hydrogen	5	Caldecott (Corby Power Station)
	St. Fergus (Shell Blackstart)		Saltend BPHP (BP Saltend HP)		Drakelow Power Station
2	Barrow (Bains)		Blyborough (Brigg)		Peterborough (Peterborough Power Station)
	Barrow (Black Start)		Brine Field (Teesside) Power Station	7	Bacton (Baird)
	Barrow (Gateway)		Blyborough (Cottam)		Deborah Storage (Bacton)
			Enron Billingham		Saddle Bow (Kings Lynn)
	Carrington (Partington) Power Station		Goole (Guardian Glass)		St. Neots (Little Barford)
	Caythorpe		Hatfield Power Station	8	Avonmouth Max Refill
	Ferny Knoll (AM Paper)		Hornsea Max Refill		Centrax Industrial
			Billingham ICI (Terra Billingham)		
	Holford		Thornton Curtis (Humber Refinery, aka Immingham)		Langage Power Station
	Partington Max Refill		Eastoft (Keadby Blackstart)		Marchwood Power Station
	Roosecote Power Station (Barrow)		Eastoft (Keadby)		Seabank (Seabank Power Station phase II)
	Sellafield Power Station		Phillips Petroleum, Teesside		Abson (Seabank Power Station phase I)
	Harwarden (Shotton, aka Shotton Paper)		Rough Max Refill		Terra Nitrogen (aka ICI, Terra Severnside)
	Stublach (Cheshire)		Rosehill (Saltend Power Station)	8.1	Didcot
	Willington Power Station		Saltfleetby Storage (Theddlethorpe)		Barton Stacey Max Refill (Humbly Grove)
	Pickmere (Winnington Power, aka Brunner Mond)		Spalding 2 (South Holland) Power Station	9	Barking (Horndon)
	Wyre Power Station		Wragg Marsh (Spalding)		Coryton 2 (Thames Haven) Power Station
2.1	Shotwick (Bridgewater Paper)		Stallingborough		Stanford Le Hope (Coryton)
	Burton Point (Connah's Quay)		Staythorpe		Middle Stoke (Damhead Creek, aka Kingsnorth Power Station)
	Deeside		Sutton Bridge Power Station		Epping Green (Enfield Energy, aka Brimsdown)
	Hole House Max Refill		Thornton Curtis (Killingholme)		Grain Power Station
	Weston Point (Castner Kelner, aka ICI Runcorn)		West Burton Power Station		Bacton (Great Yarmouth)
	Weston Point (Rocksavage)		Zeneca (ICI Avecia, aka 'Zenica')		Medway (aka Isle of Grain Power Station, NOT Grain Power)
	Shellstar (aka Kemira, not Kemira CHP)				Ryehouse
					Tilbury Power Station

Chapter three

Customer capacity – exit

3.3.4
NTS/DN exit zones

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

Figure 3.14
NTS exit zones

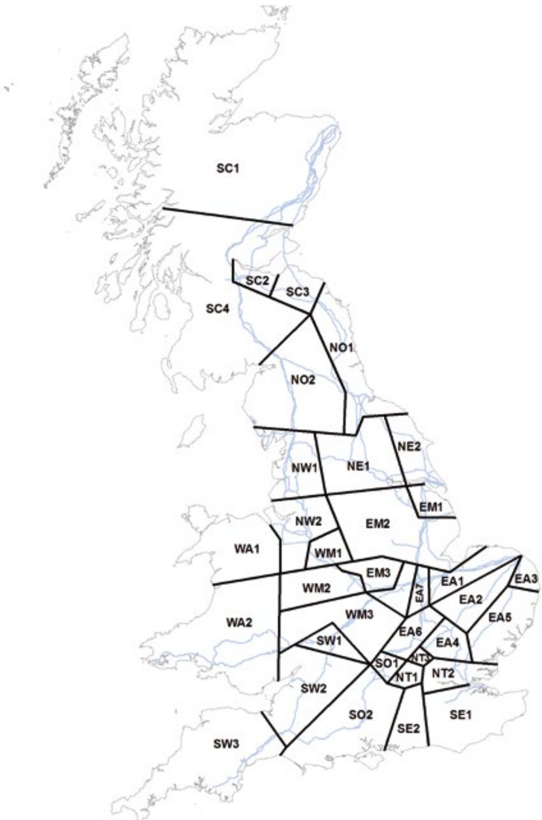


Table 3.3
NTS/DN exit zones

Exit Zone	Offtake	Exit Zone	Offtake	Exit Zone	Offtake
EA1	Eye	NO1	Guyzance	SC4	Drum
	West Winch		Cowpen Bewley	SE1	Tatsfield
	Brisley Bacton Terminal		Coldstream		Shorne
	Bacton Terminal		Corbridge		Farningham
EA2	Bacton Terminal		Thrintoft		Isle of Grain (LNG
	Great Wilbraham		Saltwick	SE2	Winkfield (SE)
	Roudham Heath		Humbleton	SO1	North Stoke (Ipsden)
EA3	Bacton Terminal		Little Burdon	SO2	Mappowder
	Yelverton		Elton		Braishfield ‘A’
EA4	Matching Green	NO2	Wetheral		Winkfield (SO)
	Royston		Keld	SW1	Fiddington
	Whitwell		Tow Law		Evesham
EA5	Hardwick	NT1	Winkfield (NIL)		Ross
EM1	Thornton Curtis ‘A’	NT2	Horndon ‘A’	SW2	Littleton Drew
	Walesby	NT3	Peters Green		Avonmouth (LNG)
EM2	Kirkstead	NW1	Blackrod		Easton Grey
	Sutton Bridge		Samlesbury		Cirencester
	Silk Willoughby		Lupton		Ilchester
	Gosberton	NW2	Mickle Trafford		Pucklechurch
	Blyborough		Malpas	SW3	Kenn (South)
EM3	Alrewas Compressor		Warburton		Aylesbeare
	Blaby		Weston Point	WA2	Dyffryn Clydach
	Tur Langton		Holmes Chapel		Dynevor Arms Tee
EM4	Market Harborough		Eccleston		Gilwern
	Caldecott		Audley	WM1	Aspley
NE1	Towton	SC1	Careston		Audley
	Rawcliffe		Balgray		Milwich
	Baldersby		Kinknockie	WM2	Shustoke
	Pannal		Aberdeen		Austrey
	Asselby	SC2	Broxburn		Alrewas Compressor
	Burley Bank		Armadale	WM3	Ross
NE2	Ganstead	SC3	Hulme		Rugby
	Hornsea		Soutra		Leamington Spa
	Easington	SC4	Nether Howleugh		Stratford-Upon-Avon
	Pickering		Lockerbie		
	Paull		Pitcairngreen BV		

Customer capacity – entry

3.4 Customer capacity – entry

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

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

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

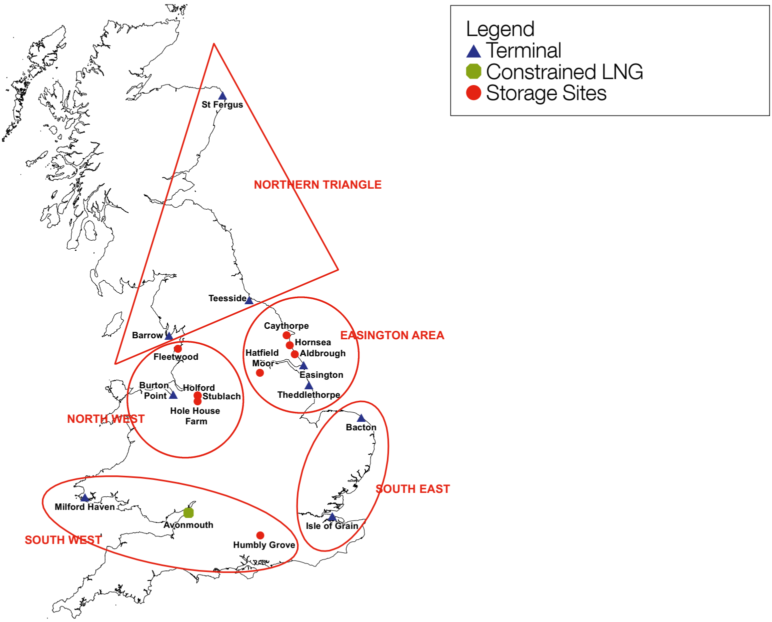
3.4.1
Entry planning scenarios

Chapter 2, section 2.2 discussed the uncertainties in the future supply mix that arise from both existing supplies and potential new developments. The available supplies, in aggregate, are greater than peak demand. The supply uncertainty is further increased by the Gas Transporter Licence requirements for us to make obligated capacity available to shippers up to and including the gas flow day. This creates a situation where we are unable to take long-term auctions as the definitive signal from shippers about their intentions to flow gas. We are continuing to develop our processes to better manage the risks that arise from such uncertainties as part of our System Flexibility work.

To help our understanding of entry capability, we use the concept of entry zones which contain groups of ASEPs (Figure 3.15). These zones are discussed in further detail in 3.4.2. The entry points in each zone often make use of common sections of infrastructure to transport gas, and therefore have a high degree of interaction. There are also interactions between supplies in different zones which mean that interactions between supplies must also be determined when undertaking entry capability analysis. Examples are the interactions between Milford Haven and Bacton, or Easington and Bacton entry points where shared infrastructure assists capacity provision at both ASEPs by moving gas east–west or west–east across the country.

Customer capacity – entry

Figure 3.15
Zonal grouping of interacting supplies



Key scenarios we examine through the planning process include:

High west to east flows generated by increased entry flows in the west travelling east across the country to support demands in the east and south east of the UK, including IUK export.

High south to north flows created by reduced entry flows into St Fergus, with a corresponding increase in entry flows in the south, requiring gas to be moved from south to north.

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

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

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

3.4.2
Available (unsold) NTS entry capacity

Table 3.4 indicates the quantities of obligated and unsold NTS entry capacity at each ASEP within each entry zone. This unsold capacity (obligated less any previously sold or reserved) is available at each relevant ASEP and could also be used to make capacity available at other ASEPs through entry capacity substitution. Substitution may also be possible across entry zones.

Table 3.4
Quantities of entry capacity by zone

Entry Zone	ASEP	Obligated Capacity GWh/day	Unsold Capacity 2016/2017 GWh/day	2020/2021 GWh/day	2023/2024 GWh/day
Northern Triangle	Barrow	340.01	185.6	45.71	60.32
	Canonbie	0	0	0	0
	Glenmavis	99	99	99	99
	St Fergus	1,670.70	1,220.09	1,571.98	1,641.30
	Teesside	445.09	243.67	368.54	442.5
North West	Burton Point	73.5	29.37	65.13	73.5
	Cheshire	542.7	28.59	28.59	28.59
	Fleetwood	650	650	650	650
	Hole House Farm	296.6	13.16	13.16	13.16
	Partington	215	215	215	215
Easington Area	Caythorpe	90	0	0	0
	Easington (incl. Rough)	1,407.15	106.20	106.20	393.98
	Garton	420	0	0	280
	Hatfield Moor (onshore)	0.3	0.3	0.3	0.3
	Hornsea	233.1	27.31	27.31	233.1
	Hatfield Moor (storage)	25	3	3	3
	Theddlethorpe	610.7	581.87	610.7	610.7
South West	Avonmouth	179.3	179.3	179.3	179.3
	Barton Stacey	172.6	82.6	82.6	172.6
	Dynevor Arms	49	49	49	49
	Milford Haven	950	0	0	150
	Wytch Farm	3.3	3.3	3.3	3.3
South East	Bacton	1,297.80	860.53	1,034.36	1,181.82
	Bacton UKCS	485.60	0.00	0.00	0.00
	Isle of Grain	699.68	35.38	35.38	35.38

Customer capacity – entry

Table 3.4 contains the ASEP names as defined in the NTS Licence. For clarity, the Garton ASEP contains the Aldborough storage facility, the Barton Stacey ASEP contains the Humbly Grove storage facility, and the Cheshire ASEP contains the Hill Top Farm, Holford and Stublach gas storage facilities. More information on storage facilities can be found in Appendix 5 table A5.4.

Appendix 5 figures A5.2 A to H provide further information about the level of booked and obligated entry capacity at each ASEP, excluding those that are purely storage. The figures also provide data points representing historic maximum utilisation and the range of future peak flow scenarios for these ASEPs. While all un-booked capacity can be considered for entry capacity substitution, future bookings may change and the gap between the scenario peak flow data and the obligated capacity level may be a better indication of the capacity available for substitution. Using this indicator, significant capacity for substitution exists at St Fergus and Theddlethorpe.

Entry zone – Northern triangle

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

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

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

Entry zone – North West

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

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

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

Entry zone – Easington area

ASEPs: Caythorpe, Easington (incl. Rough), Garton, Hatfield Moor (onshore), Hornsea, Hatfield Moor (storage), Theddlethorpe. All these ASEPs use common routes out of the Yorkshire area.

The quantity of unsold capacity in this region indicates a limited scope for additional capacity to be made available via entry capacity substitution. Potential non-Planning Act reinforcements, including compressor reverse flow modifications, could release some additional capacity but significant pipeline reinforcement would be needed, resulting in long (Planning Act) timescales.

Entry zone – South West

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

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

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

Entry zone – South East

ASEPs: Bacton UKCS, Bacton IP, Isle of Grain.

The ASEPs use common infrastructure away from the Bacton area.

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

Impact of legislative change

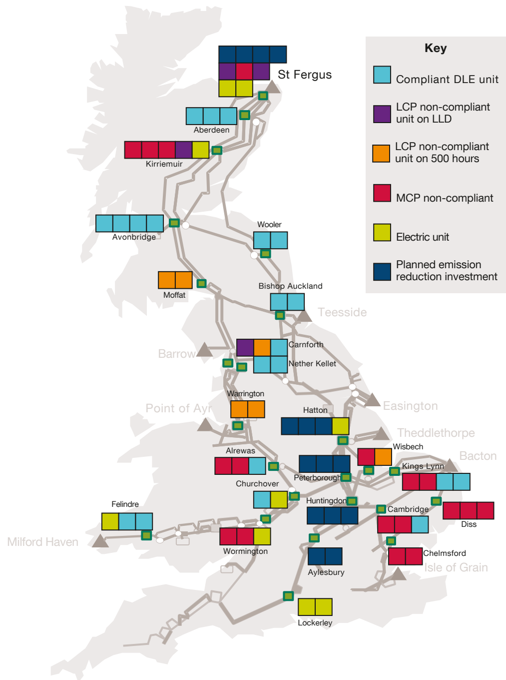
Chapter three

3.5
Impact of legislative change

Industrial Emissions Directive
As we outlined in section 2.4, two elements of IED, the Integrated Pollution Prevention and Control Directive (IPPC) and the Large Combustion Plant Directive (LCP), heavily impact our current compressor fleet (Figure 3.16).

The following sections detail the impact of the legislation before Chapter 5 covers what we are doing to address these legislative changes to ensure our compressor fleet is compliant by 2023.

Figure 3.16
Impact of IED on our current compressor fleet[3]



[3] After seeking further clarification, one of the units at St Fergus was re-classified and so is not subject to LCP. Therefore, in this document you will see reference to 16 units rather than 17.

3.5.1
IED stakeholder engagement

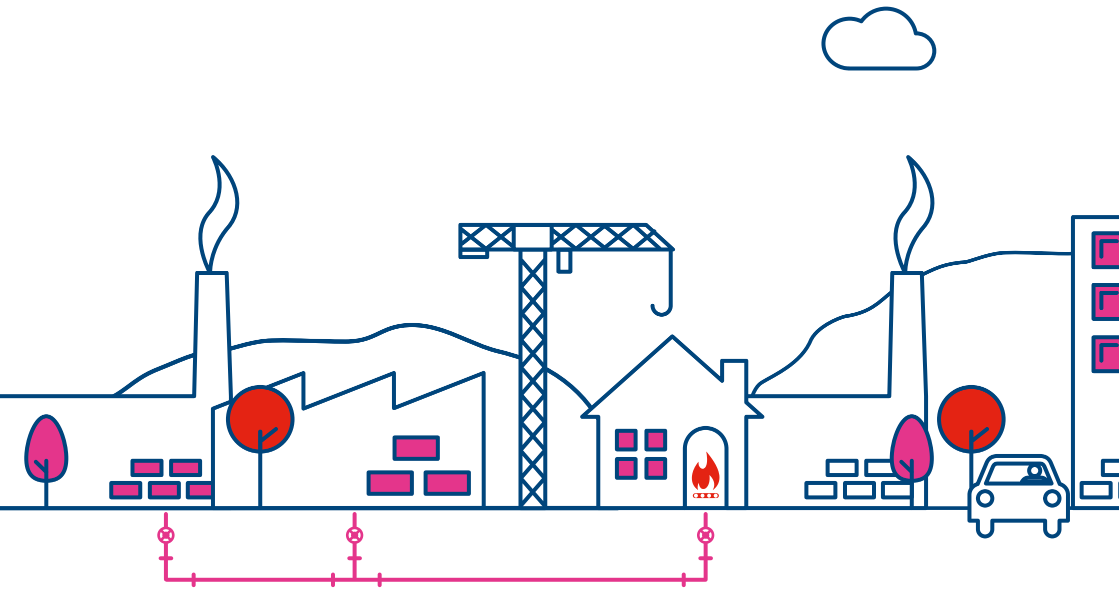
During 2015/16 further discussions have taken place with Ofgem and the Environmental Regulators. The 2016 running hours for Compressor Installations, and the commencement and continuation of emissions reduction projects, were agreed during these discussions with the UK Environmental Regulators. During 2016 we have developed our compressor strategy, further details of which are given in Chapter 5.

3.5.2
Medium Combustion Plant (MCP) directive

As outlined in section 2.4, the MCP Directive will affect a further 26 of the NTS compressor units. Other combustion plants, such as pre-heat systems, are also captured as part of this Directive. During 2016/17 we will undertake an audit of this plant type and develop mitigation plans.

3.5.3
Best Available Technique references (BREF)

As defined in Chapter 2, section 2.4 BREF has been adopted under IPPC and IED. The BREF for combustion plant is currently in draft form and is due to be finalised in 2017. We will be taking BREF into account when determining the Best Available Technique (BAT) for all options considered on IED non-compliant units going forward. We do not anticipate any significant changes to the BAT process we currently follow when assessing our compressor options.



Chapter four

System operation

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

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

Key insights

- As the System Operator we must provide a safe and reliable network. We know you want to flow gas using within-day profiles that meet your operational, commercial and contractual drivers, and you want minimal restrictions.
- Our challenge is to make the most efficient investment decisions to make the most of our existing network before we build new assets.
- We are enhancing our forecasting, analytical, decision support and reporting capabilities, by improving our processes and investing in our systems and tools.
- We are deferring investment in assets by continuously improving our approach to optimise our existing network.

Introduction

4.1 Introduction

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

The way we operate the NTS is affected by a number of obligations, unchanged since the 2015 *GTYS* publication.

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

Environment:
- We must minimise our environmental impact.

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

You have told us that you value the ability to flow gas using within-day profiles to meet your operational, commercial and contractual needs, with minimal restrictions. You want us to maximise our performance in this area.
To do this, we are focusing on:
- operating the NTS effectively and efficiently to maximise its capability while meeting our statutory and commercial obligations
- developing methods (including analytical capabilities) to quickly identify, manage and mitigate any network issues to minimise the impact on you
- optimising, scheduling and managing access to the NTS for maintenance and construction activities to minimise the impact on you
- providing you with flexibility to flow gas at the most efficient profile for you, even where this flexibility exceeds contractual rights. As you would expect, we must make sure that this operational flexibility does not create unacceptable system risks or have a detrimental impact on our other customers.

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

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

What are System Operator capabilities?

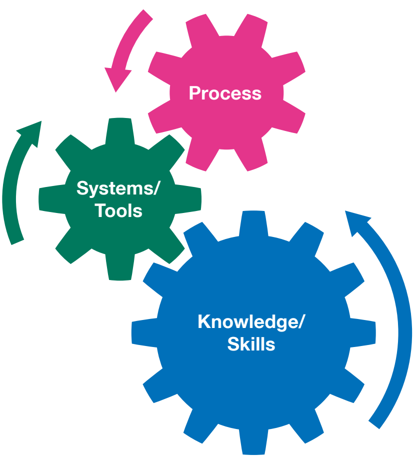
4.2
What are System Operator capabilities?

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

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

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

Figure 4.2
Key inputs required for our SO capabilities



Deciding between System Operator capabilities and assets

4.3
Deciding between System Operator capabilities and assets

We use our Network Development Process (NDP) to assess system capability requirements; this was introduced in Chapter 1. Here we discussed how we consider and improve the capability of the system and use the NDP to assess our capability as the SO.

Following on, Chapter 2 explored some of the triggers for this process and Chapter 3 described the Need Case stage of the NDP where we calculate the NTS's capability requirements.

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

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

We do this through the use of our Whole Life Prioritisation scoring model as detailed in Appendix 7 (Network Development Process). This uses a qualitative approach comparing a range of solutions against key criteria including: flexibility, customer charges, future proofing, current capability and obligations, resilience, and barriers to new investment. We use this scoring method to rank the available options for the next stages of our processes. These can be asset or non-asset solutions, or sometimes a combination of the two. At the Establish Portfolio stage no options are fully discounted nor final choices made. These are the least regrets options used to set the bounds for further investigation and options development. Should optioneering result in the breaking of these bounds the projects will return to earlier stages of the process for reassessment.

An asset solution may not always be the most efficient way to meet a system capability requirement and deliver financial benefits to the industry and consumers by reducing costs and minimising the risks of balancing the system. We therefore, in our role as the SO, consider our non-asset solutions.

A non-asset solution, in simple terms, is where we 'sweat our assets' by assessing what the maximum capability is of our existing network. We also look at contractual solutions. We may be willing to accept commercial risk rather than invest in a more expensive asset solution.

Deciding between System Operator capabilities and assets

This approach has recently been undertaken to assess the pipeline investment, which was originally planned to replace capabilities lost with the anticipated closure of the Avonmouth LNG (Liquefied Natural Gas) storage facility. Risk analysis alongside changing demands in the South West has now demonstrated that we do not need to build the pipeline at this time, and the right decision is to accept the associated risk increase.

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

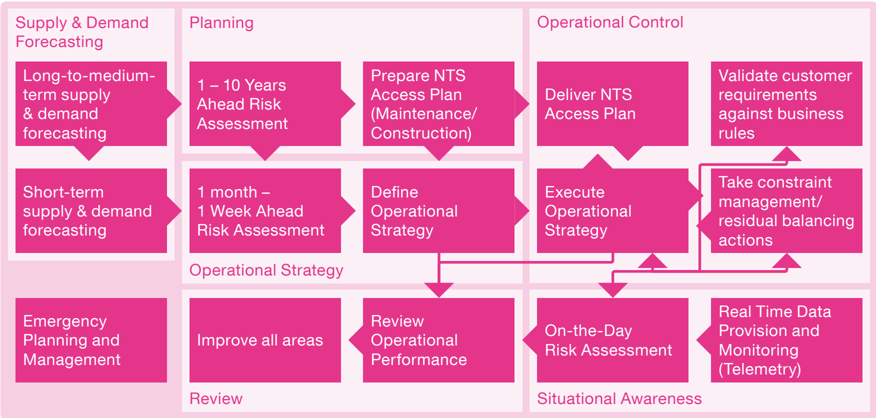
We are constantly reviewing our current systems and processes in order to refine what we do and how we do it. This maximises the value we get from our existing network (through improved forecasting, analysis, risk assessment and decision making (across all time horizons) before we invest in asset solutions.

Investing in our System Operator capabilities

4.4
Investing in our System Operator capabilities

Our SO capabilities can be grouped into categories. These have been summarised in Figure 4.3 below.

Figure 4.3
Our SO operational processes



In the following sections we focus on our operational capabilities. We use a combination of these capabilities to deliver our daily operational strategies and plans to make sure we provide a safe and reliable network for you.

Figure 4.3 gives an example of how information flows between our operational capabilities; it does not represent our organisational structure. We are committed to developing our people to make sure they have the right knowledge, skills and experience to drive efficiency and maximise our process and system performance to deliver a reliable network for our customers.

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

Investing in our System Operator capabilities

4.4.1
Supply and demand forecasting

What is it?

- Effective and accurate forecasting of gas supply and demand is critical to our SO decision-making processes, particularly with increasingly uncertain future supply and demand patterns.
- Our supply and demand forecasts are based on our *Future Energy Scenarios* (see Chapter 2) as well as the latest market information. Forecasts are produced annually, monthly, weekly and daily, depending on the activity being undertaken.
- The forecasts feed into Planning Network Access (one to ten years ahead), Planning and Procuring activities (one month to one week ahead), and real time Operational Control and Situational Awareness of the NTS (day ahead to within day).
- We share our forecasts with you through our information provision systems to facilitate an efficient market[1], by helping you manage your supply/demand balance position.

Drivers for change

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

How are we improving?
Process

Long to medium term

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

Short term

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

[1] http://marketinformation.natgrid.co.uk/gas/frmPrevalingView.aspx

Systems/Tools

Long to medium term

- We are currently undertaking a project to rationalise our existing long-term forecasting tools, using statistical methods and mapping of our functional requirements across teams. This is to best understand which are the most appropriate tools to be using in the long term, so we have a consistent approach and fit for purpose inputs, to conducting planning activities over medium to long timescales.

Short term

- We now have a working prototype supply and demand forecasting tool, funded through the Ofgem Network Innovation Allowance (NIA) scheme. Delivered in early 2016, this is now in a period of testing and benchmarking against existing short-term tools and associated processes, to assess and determine its incorporation into our operational activities.
- For more information on this project (*Enhanced Operational Forecasting*), please visit the Smarter Networks Portal via the link provided below. **http://www.smarternetworks.org/Project.aspx?ProjectID=1810**

Investing in our System Operator capabilities

4.4.2 Planning

What is it?

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

Drivers for change

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

How are we improving?

Process

- We continue to develop improved relationships and ways of working with our TO colleagues in National Grid Gas Transmission, to ensure that construction and maintenance activities can be delivered without risking our ability to provide a safe and reliable network for you to supply or use gas.
- We are exploring changes to the way Assured Offtake Pressures are agreed between ourselves and Distribution Network Operators (DNOs). Changing this process may improve our current network capability, enabling us to defer asset investment.

Systems/Tools

- Given the increasingly uncertain environment and the range of time horizons, the number of possible supply and demand forecasts that we need to consider has increased in recent years. The ability to effectively analyse this wide range of scenarios in order to understand the impact on system operation and capability is becoming increasingly vital to our operational and planning activities.
- During 2016 we have developed and are continuing to develop our ability to undertake multi-scenario network analysis over both planning and operational timescales. Compared to existing analysis techniques and activities, this capability will allow us to better understand the operational impact of a greater number of forecast scenarios than we have previously been capable of with our current tools and processes.
- We use the new multi-scenario analysis approach to assess future Need Cases and evaluate network access requests. When combined with the improvements in our long-to-medium-term supply and demand forecasting capabilities, this enables us to develop more comprehensive, robust and probabilistic long-term commercial, investment and operational strategies. This helps us to minimise costs for the community.
- This also allows us to develop a more informed NTS Access Plan with reduced risk of maintenance activities on your assets being cancelled or deferred as a result of operational constraints.
- The next step in the evolution of this enhancement has been to reduce the computation time of undertaking multi-scenario network analysis, through the development of a process called ‘pattern clustering’. This process, undertaken in collaboration with the University of Warwick Mathematics Institute, significantly reduces the number of supply and demand forecasts required to be analysed. It does this by condensing (‘clustering’) large groups of forecasts to a lower but still representative and accurate set.

Investing in our System Operator capabilities

4.4.3 Operational strategy

What is it?

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

Drivers for change

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

How are we improving?

Process

- We regularly review and develop our short-term strategy processes to ensure efficiency and to confirm that we are continuing to deliver the needs of our control room, who, in turn, deliver for you.

Systems/Tools

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

4.4.4
Situational Awareness

What is it?

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

Drivers for change

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

How are we improving?

Process

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

Systems/Tools

- In July 2016 we replaced our core control room and support systems with the new Gas Control Suite (GCS). The new system provides enhanced telemetry and data analytics functionality to the control room and support teams.
- Over the past year we have continued to develop the use of the real-time version of our network analysis software, SIMONE (Online), in our control room and within-day support activities. SIMONE (Online) is connected to our Supervisory Control and Data Acquisition (SCADA) systems and receives your flow notifications as well as our telemetered data.
- SIMONE (Online) allows us to undertake current state and predicted future operational risk assessments. We are developing further enhancements to this package that will maximise the benefits of real-time simulation to provide continuous advice to our control room. This will allow us to anticipate constraints on the network ahead of time, enabling us to put mitigating physical and commercial actions in place to minimise the risk of your operation being affected.
- Our Enhanced Gas Measurement Programme, due for completion by March 2017, is replacing ageing gas quality monitoring equipment with the latest technology. This means the gas used in your home appliances is compliant with specifications defined by the HSE.

Investing in our System Operator capabilities

4.4.5 Operational Control

What is it?

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

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

Drivers for change

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

How are we improving?

Process

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

Systems/Tools

- The replacement of our current core control room and support systems, with the new Gas Control Suite (GCS), has improved the way that we collate and present operational data in our control room. This now allows us to bring together relevant information from all other operational capabilities to ensure that the control room makes operational decisions and takes control actions based upon the most up-to-date data and analysis. This will now enable us to mitigate issues to minimise the risk of your operation being affected.
- With increasing market volatility and uncertainty, we anticipate that you will face increasing challenges in managing your daily balancing position. To help you with this, we will be investing in improved within-day information provision systems to ensure the market is able to operate effectively and efficiently.

4.4.6 Review

What is it?

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

Drivers for change

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

How are we improving?

Process

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

Systems/Tools

- Our new systems, in particular the new GCS, will help us to draw conclusions more quickly, ensure that effective learning is developed and fed back into our other operational processes and systems so that we continuously improve our service to you.
- The availability and quality of operational data are key to an effective operational day review. As part of the delivery of GCS we are investing in new software to store and visualise data in new and innovative ways, which will allow us to complete more in-depth data analysis.

System operation

4.5
Need Case review

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

4.5.1
Asset health

A significant number of the Need Cases completed this year have been related to asset health projects. These Need Cases look at the impact of removing the assets/sites from the network and assessing the potential impact. Optioneering is then completed looking at the full range of Rule, Tools or Assets. More detail on some of the bigger projects are detailed below:

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

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

Changing UK supplies and demand meant we should assess the future requirements of the site in order to efficiently invest in asset health. With clear requirements for the site it will allow a more detailed assessment to be completed determining what functionality needs to be retained as the site is rationalised. Work is on-going to develop the optimal solution for the site.

Feeder 9 Humber Crossing

As the sole transportation route across the river Humber, Feeder 9 is one of the most critical pipelines on the NTS. It regularly transports between 70 mcm/d and 100 mcm/d and plays a pivotal role in the provision of entry capacity in the Easington area and the UK gas market as whole. There are continuing concerns over the integrity of the pipeline due to rapid and unpredictable estuary movements.

Analysis using our four *Future Energy Scenarios* demonstrates that there is a long-term requirement for Feeder 9. Through our strategic optioneering process we have determined that a replacement pipeline in a tunnel is the most credible long-term solution. We are therefore progressing with a replacement pipeline solution, as well as continuing to monitor the existing crossing on an increased frequency.

Summary of plant without a Need Case

Other assessments have confirmed there is no Need Case for:

- Wormington compressor aftercoolers
- Huntingdon compressor aftercoolers
- The Orenda compressor units at Churchover compressor station.

The disconnection works will be combined with other project work on the three sites.

System operation

4.5.2
Deferred asset investment

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

Avonmouth
Allowances to replace the operational service currently provided by the LNG storage facility at Avonmouth were agreed as part of RIIO-T1. Our analysis and work with stakeholders, most notably the Health and Safety Executive and Wales & West Utilities, determined that a physical build at this time is not in consumer interests.

We continue to monitor the capacity and forecast flow position in the South West Region. The booked capacity position has not notably changed since 2013. Therefore although our risk of capacity buy back in this region still exists, the Need Case remains insufficient to initiate a physical solution. In addition the latest *FES* indicates a significant reduction in 1-in-20 demand in 2020, further supporting our no build position at this time.

The delivery of the Avonmouth output has been part of the Mid-Period Review process, as was agreed at the time of the Final Proposals in RIIO-T1. At the time of publication, Ofgem's minded to position is to reduce our load-related expenditure allowance by £168.8 million to reflect the amount allowed for the pipeline’s output[2].

[2] Consultation on the mid-point review (MPR) of RIIO-T1

Scotland 1-in-20

To secure Scotland under our 1-in-20 obligation we have continued to assess the Need Case for the Scotland 1-in-20 suite of projects.

Our analysis has been updated based on the latest *FES* publication and it indicates that if agreement (from SGN) to reduce some of the higher Assured Offtake Pressures (AOPs) in Scotland can be obtained, it would be possible to meet the minimum St Fergus flow levels into early RIIO-T2.

Over the last 12 months we have been in discussion with SGN on the impact to their network of reducing the AOPs. They have indicated the potential to accept a reduction to their Southern Scotland offtake AOPs but would require investment to accept any reductions at their Northern Scotland offtake AOPs. The reduced Southern Scotland AOPs can be maintained under peak 1-in-20 conditions into early RIIO-T2. However, through the same period, reduced AOPs cannot be maintained at lower demand levels and will continue to be managed through current operational tools. Evidence suggests that UK continental shelf supplies will continue to reduce which means the reduced AOPs are not an enduring solution. Based on these results we are continuing to progress the below options with SGN:

- The reduction of AOPs in Southern Scotland.
- An off-peak AOP reduction for Northern Scotland.
- Optimisation and cost implications of investing in the Distribution Network vs investment in the NTS.

With a partial reduction in AOP allowing us to maintain 1-in-20 capabilities beyond RIIO-T1, we have deferred the potential NTS investment while we continue discussions with SGN. Should the partial AOP reduction not be possible and due to a four-year build period we would need to start to progress our asset solution by 2018, based on the current FES.

We are continuing to assess the inherent NTS risk and the change in this profile at lower demand levels which is not addressed by the reduced AOP solution.

We have assessed the potential for a contractual solution to incentivise additional entry flows at St Fergus, such as a diversion of flows from Easington. Our current view is that this would have no benefits over the other options being considered, including asset reinforcement – it would be more expensive, complex to deliver and would provide less security.

Chapter five

Asset development

This chapter considers the most efficient way of delivering current and future network needs where asset investment has been evaluated as the preferred option. It sets out sanctioned National Transmission System (NTS) reinforcement projects, projects under construction in 2016/17, and potential investment options for later years as a result of the Industrial Emissions Directive (IED) and our asset health review. These are assessed against the scenarios and sensitivities in our *Future Energy Scenarios (FES)* publication. This chapter also explores the Establish Portfolio stage of our Network Development Process (NDP).

Key insights

- Increasing uncertainty around supply and demand scenarios makes planning future capability on the NTS more challenging.
- All of our gas-driven compressors that produce emissions above the IED threshold must comply with new requirements by 31 December 2023.
- The decline of flows from St Fergus means we must be able to move more gas south-to-north. We currently have limited capability to do this, but we do have time to assess potential solutions against the network changes resulting from the IED. Flows are monitored and we expect to meet the necessary timescales to deliver any investments.
- Delivering Asset Health works is a key Ofgem RIIO measure, in terms of allowances and output. Over the next three years we will make effective asset management decisions so we can deliver the right levels of network performance for our customers and stakeholders.

Introduction

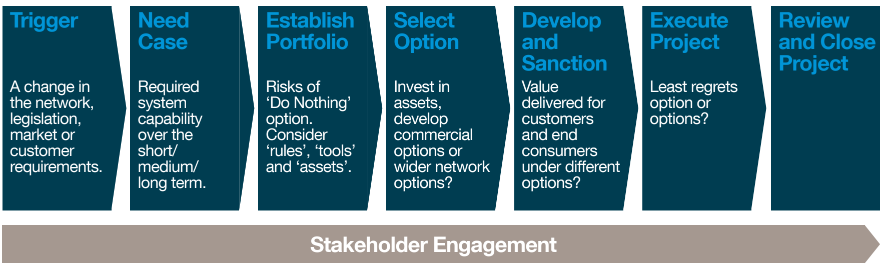
5.1
Introduction

Chapter 1 introduced our Network Development Process (NDP). In this penultimate chapter we expand on the asset solution element of the ‘Establish Portfolio’ stage. This stage is only reached if a solution to a trigger cannot be found within the existing capabilities of the system.

The aim of this stage is to establish a portfolio of, in this case, physical investment options that address the Need Case. A range of options are investigated during the network analysis phase, including a ‘Do Nothing’ option. This allows for the comparison of options both in terms of effectiveness at meeting the Need Case requirements and overall cost. The implications of each option we have considered are summarised and discussed at stakeholder engagement workshops. The options are then narrowed down to identify a preferred option which not only addresses the Need Case but delivers the most cost-effective solution.

Figure 5.1 shows the stages of the NDP between Need Case and project closure.

Figure 5.1
The Network Development Process



Current projects

5.2
Industrial Emissions Directive

Further to the reopener submission as detailed in the 2015 *GTYS*, we are now able to provide an update on our plan of work to ensure compliance with the IED requirements by 2023.

Kirriemuir Compressor
At Kirriemuir we originally proposed to:
- enter Unit D (RB211) into the Limited Life Derogation (LLD), followed by decommissioning once the available hours were exhausted or at the required legislative deadline
- de-rate and re-wheel Unit E, and
- decommission and replace Unit C.

However, this plan was based on the draft Medium Combustion Plant (MCP) Directive (see Chapter 4, section 2.4 for more information regarding MCP) requiring all non-compliant compressor units to be addressed by 2025. Subsequently, in part due to our international lobbying, this deadline has moved back to 2030 in the final directive. In response to this, and as communicated during Ofgem's IED consultation, we have put on hold the decommissioning and replacement of Unit C.

In March 2016 we discovered an in-service failure on Unit D which is anticipated to be uneconomical to repair given the LLD status of the machine. As a result, in 2016/17 we are progressing the re-wheel of Unit E and the decommissioning of Unit D.

St. Fergus Compressor
At St. Fergus we proposed two programmes of work; the first to continue to reduce our fleet emissions in accordance with IPPC and the second to address the LCP requirements.

In terms of LCP, we proposed to enter Units 2A and 2D into the LLD. This action has been completed and the necessary approvals received from the Scottish Environmental Protection Agency (SEPA).

With regard to IPPC we proposed to replace two Avon units to reduce emissions. The range of flows through the terminal is such that significant running of the Avon units will continue to be necessary despite the introduction of the electric drives. As such these Avon units continue to be some of our highest polluting machines. Design work is in progress to assess replacement options.

Hatton Compressor
The proposed option at Hatton compressor station was to enter all three existing units at the site into LLD and then replace them with three smaller units. We have revised our plans and currently have entered one of the existing units into the 500 hours derogation, and the remaining two units into the LLD. This decision is based on the positive progress of the electric VSD unit which was operationally accepted in early 2016.

Moffat Compressor
As per the proposal, the derogations have been obtained from the Environment Agency and the asset health works are being planned.

Warrington Compressor
As per the proposal, the derogations have been obtained from the Environment Agency and the asset health works are being planned.

5.3
Integrated Pollution Prevention and Control (IPPC) directive

5.3.1
IPPC phase 1 and 2

Phases 1 and 2 of our IPPC Emissions Reduction Programme are now complete. Replacement compressor units have been operationally accepted and commissioned as follows:

- **Early 2015**
  St Fergus (two new electrically driven units)
  Kirriemuir (one new electrically driven unit).
- **Early 2016**
  Hatton (one new electrically driven unit).

Current projects

5.3.2
IPPC phase 3

Phase 3 of the Emissions Reduction Programme includes investment at the Huntingdon and Peterborough compressor stations, to comply with IPPC NOx and CO emissions limits by 2021.

Extensive network analysis completed in 2014 confirmed that both sites are critical to current and future network operation. The analysis assessed network flows across a range of supply and demand conditions using our data produced from our *Future Energy Scenarios*. This showed that future capability requirements are very similar to current capability provided at these sites.

The operation of both sites is affected by supply flows (from the terminals to the north, Bacton terminal and Liquefied Natural Gas (LNG) imports from the Milford Haven and Isle of Grain terminals in the south) and demand in the south of the system. The sites are needed to manage network flows in the south and east of the system, particularly at the 1-in-20 peak day demand level described by our Design Standard[1] as defined in our transportation licence.

Peterborough and Huntingdon compressor stations are critical to maintaining flows and pressures on the NTS. At high demand levels, for example during winter, they are required to operate together. At lower demands they can be used interchangeably depending on network flows. This interchangeability can provide network resilience, for example by allowing maintenance to be undertaken on one of the sites or maintaining minimum system pressures during unplanned outages.

Peterborough is also a key site for the north–south, east–west and west–east transfer of gas to manage flows from the north, from Milford Haven LNG terminal and to/or from Bacton terminal.

The early stages of the Front End Engineering Design (FEED) study concluded that electrically driven compressors were not viable at Peterborough but remained a possibility at Huntingdon. However, following the tender process for Huntingdon the Best Available Technique (BAT) assessment concluded that electric drives do not represent the BAT. The BAT identified that for IPPC phase 3, a 15.3 MW gas turbine is the most cost-effective solution to reduce emissions.

The feasibility and conceptual design stages of the FEED study were completed in 2015/16. The main works contract tender process is also complete and the contract has been awarded.

Our objective in delivering these projects is to achieve a minimal whole life cost solution that meets specifications. As part of this we have undertaken Investment Challenge and Reviews (IC&R) on these projects. This resulted in a number of challenges to the design. The net reduction in cost has been estimated at £4.7 million to date.

Identical planning applications were submitted for both Peterborough and Huntingdon in 2015. The planning consent for Huntingdon was granted in January 2016. However, the planning application for Peterborough was rejected in November 2015. A second planning application for Peterborough was submitted early in 2016, with significant enhancements to the visual impact of the compressor trains, and consent was granted in April 2016.

[1] To plan the system to meet the 1-in-20 peak aggregate daily demand, including but not limited to, within-day gas flow variations on that day.

The delay to planning at Peterborough meant that only the 2016/17 early works at Huntingdon could progress to contract award in March 2016.

In 2015/16 a review of the delivery programmes across both sites was undertaken. The project delivery strategy was revised to commence early works at Huntingdon in 2016/17, with Peterborough following in 2017/18. Due to the planning delays there is now no planned early works phase at Peterborough in 2016. The entire work scope at Peterborough will be delivered via the Main Works Contract (MWC) to be awarded in 2016/17.

A significant quantity of essential asset health investment has been identified at both Peterborough and Huntingdon. These asset health works are financially separate from IPPC 3 and 4 core and extraordinary works scopes, but will be delivered using the mechanism of the IPPC Early Works and Main Works Contracts to take advantage of contractual and outage efficiencies.

5.3.3 IPPC phase 4

For IPPC, as per the May 2015 re-opener we identified Peterborough, Huntingdon and St Fergus as the next priority sites for emission reduction. The works at Peterborough and Huntingdon are progressing alongside IPPC phase 3 works. At St Fergus we are progressing the pre-work sanction stage of development.

Current projects

5.4
Large Combustion Plant Directive

The LCP has been superseded by IED. In this respect, the IED mirrors the requirements set out in the LCP. Of our 64 gas-driven compressor units, 16 are affected by the LCP. To decide what we should do we have looked at each affected site on a unit-by-unit basis. Work to comply with the LCP is currently underway at Aylesbury compressor station. Options for the other sites which have non-compliant units are included in our IED Investment: Ofgem Submission.

To comply with the LCP, all installations with a thermal input over 50 MW must have Emission Limit Values (ELVs) below the following:

- carbon monoxide (CO) – 100 mg/Nm3
- nitrogen oxide (NOx) – 75 mg/Nm3 for existing installations
- nitrogen oxide (NOx) – 50 mg/Nm3 for new installations.

5.4.1
Aylesbury compressor

We received an upfront allowance under RIIO-T1 to fund the LCP Phase 1 works on two units at Aylesbury. The existing gas compressor units at this site have a thermal input over 50 MW and therefore are required to comply with the LCP directive. The existing units are compliant with the nitrogen oxide (NOx) Emission Limit Values (ELVs) stated in the directive but are non-compliant with the carbon monoxide (CO) ELVs.

Aylesbury compressor is a key site in a series of stations between Hatton in Lincolnshire and Lockerley in the South West. These sites move flows around the system and are critical to support 1-in-20 peak day demand levels in the South West.

At lower demand levels than the 1-in-20 peak day demand, these compressors can also be operated to manage linepack within the system, maintaining system resilience to plant failure, plant unavailability and within-day flow variation to the levels experienced on the network today. Under lower demand conditions Aylesbury provides an important role as a gas-powered backup site to Lockerley compressor station (downstream of Aylesbury). Lockerley only has electrically driven compressor units installed as a consequence of strict local planning constraints.

Network analysis completed in 2014 determined that Aylesbury is required to meet 1-in-20 peak day demand levels in the south of the system. We also identified that the site may require enhancement to accommodate additional flows from the Bacton or Isle of Grain terminals, or to support system pressures if new Combined Cycle Gas Turbines (CCGTs) connect in the South West.

The Aylesbury FEED study highlighted that the CO ELV can be achieved by the addition of a CO oxidation catalyst in the exhaust stack. A planning application for an increase to the stack height was accepted in 2015. We are working with Siemens to develop this innovative solution, and the necessary permit variation has been accepted by the Environment Agency. A number of other asset-related works are being delivered at Aylesbury during as part of an overall upgrade package. The project is set for completion in December 2016, subject to outages.

5.5
Medium Combustion Plant Directive

As we indicated in Chapter 2, section 2.4, the MCP directive is currently in draft. Based on the draft legislation we have anticipated the likely impact on our compressor fleet. However, further analysis will need to be undertaken to assess what options are available to comply with this new legislation. Stakeholder engagement activities, as used with the IED and IPPC programmes, will be undertaken to ensure the best possible solutions are found.

5.6
Asset health review

As indicated in Chapter 2, section 2.5, the NTS is ageing. This means that asset health is becoming a more prominent issue for us.

Previously, the strategy we adopted for asset health investment was to focus on maintaining the condition of our primary and secondary assets (entry points, pipelines, multi-junctions, compressor stations and axit points) to avoid costly asset replacement. This strategy reduces the risk of long outages and network disruption.

For every asset health issue we are now considering whether the asset is still required, or if there is a more suitable alternative option. We consider all options including whether to maintain, replace or remove the asset. Reviewing each case like this will drive the most cost-effective solutions at each site.

Future projects

5.7
Meeting future flow patterns

The way gas enters and exits the NTS is changing. As we identified in our *Future Energy Scenarios* publication, the degree of change is highlighted by our four scenarios, offering insight into gas usage behaviour both for the consumer and the supplier.

All of our scenarios predict a decline in St Fergus flows. Historically the NTS was designed and operated to move the majority of UK gas supply from St Fergus (north) to demand in England and Wales (south). Lower supplies from St Fergus could make it difficult to meet current obligations in Scotland in a 1-in-20 demand scenario and we have been considering options to mitigate this risk. Commercial options are currently being progressed, as discussed in Chapter 4.

As part of our ongoing strategy, flows are monitored and the flow decline has not been as severe as was expected at the time of the RIIO price submission. As discussed in Chapter 4, we do need to determine by 2018 whether an asset-based solution will need to be implemented, but this does allow time to assess potential solutions against the network changes which the IED will bring.

Chapter six

Way forward

This chapter outlines our plans to continue the development of the *Gas Ten Year Statement (GTYS)* and how we propose to engage with you over the coming year. We have continued with a publication format based on feedback received over 2014/15, but are always interested in your views throughout the year to shape future publications.

Key insights

- We have continued with the document format used for *GTYS* 2015, which was generated based on feedback received from previous publications.
- You can help us to shape the *GTYS* by telling us which areas are/are not of value to you. Please do this by contacting us via our *GTYS* mailbox **Box.SystemOperator.GTYS@ nationalgrid.com**
- You can check our project progress at our Talking Networks website[1].

[1] http://talkingnetworkstx.consense.co.uk/

6.1
Continuous development of *GTYS*

GTYS is an opportunity for us to outline our current operational and asset-based plans for developing the National Transmission System (NTS) to ensure we continue to meet the needs of our customers and stakeholders. We use this document to highlight any challenges that we see facing our future operation and planning of the NTS. As part of our annual review of the *GTYS* we analyse all customer and stakeholder feedback to ensure the publication is valuable for you and is fit for purpose.

We want to continue to engage with you, by involving you in our decision-making process, providing transparency on our processes and keeping you informed of our plans.

We have adopted the following principles to enable the *GTYS* to continue to add value:

- Seek to identify and understand the views and opinions of all our customers and stakeholders.
- Provide opportunities for engagement throughout the *GTYS* process, enabling constructive debate.
- Create an open and two-way communication process around assumption, drivers and outputs.
- Respond to all customer and stakeholder feedback and demonstrate how this has been considered.

Current projects

6.2
2015/16 stakeholder feedback and engagement

From the feedback used to shape *GTYS* 2015, we have continued to align this year's publication around the initial stages of our Network Development Process (NDP).

GTYS 2016 also continues to:
- try and provide greater clarity on which Direct Connect offtakes are located in each exit region (see Chapter 3)
- include information on storage injectability by site as this would be of interest to you (see Appendix 5).

2016 publication feedback
Over 2016/17 as part of the enagagement around the inaugural *Gas Future Operability Planning* document (please see Chapter 1 for further information), we are keen to get your views on both publications, as well as the following topics:
- Asset Health.
- Industrial Emissions Directive.
- Network Development Policy.
- System Flexibility.

We welcome your feedback and comments on this edition of *GTYS* as it helps us to tailor the document to areas you value. Below are some questions which we are particularly keen to get your feedback on.
- Does the *GTYS*:
  - explain the process we follow in order to develop the NTS?
  - illustrate the future needs and development of the NTS in a coordinated and efficient way?
  - provide information to assist you in identifying opportunities to connect to the NTS?
- Which areas of the *GTYS* are of most value to you?
- Which areas of the *GTYS* can we improve?
- Is there any additional information you would like to see included in the *GTYS*?

We are happy to receive your feedback through either our *GTYS* mailbox (**.Box.System Opertor.GTYS@nationalgrid.com**) or through any other opportunities where we get to meet over the coming year. We look forward to hearing from you.

Chapter seven

Appendix 1 **National Transmission System (NTS) maps**

Figure A1.1
Scotland (SC) – NTS

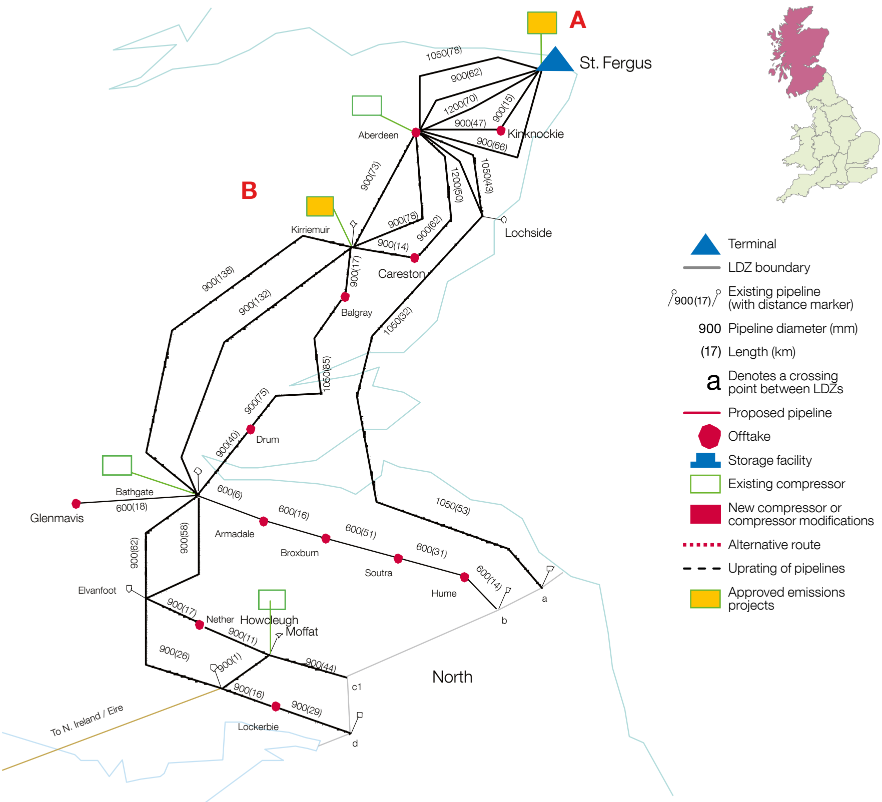
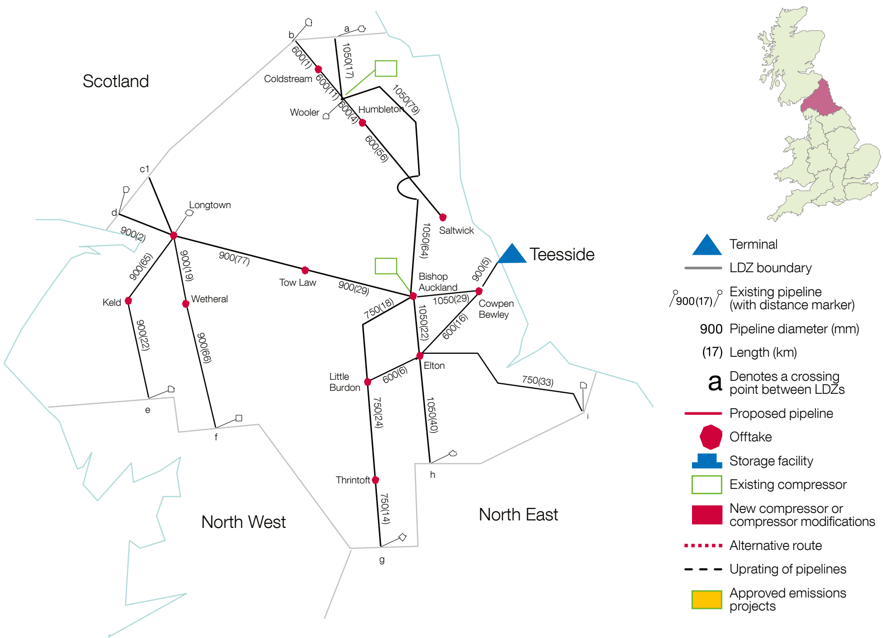


Figure A1.2
North (NO) – NTS



Appendix 1 **National Transmission System (NTS) maps**

Figure A1.3
North West (NW) – NTS

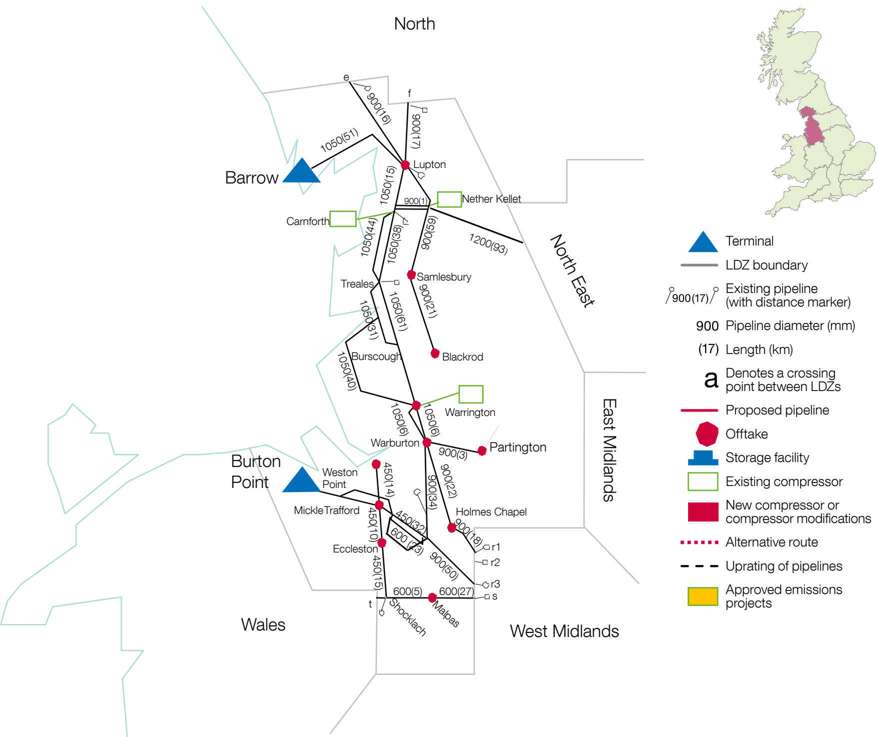
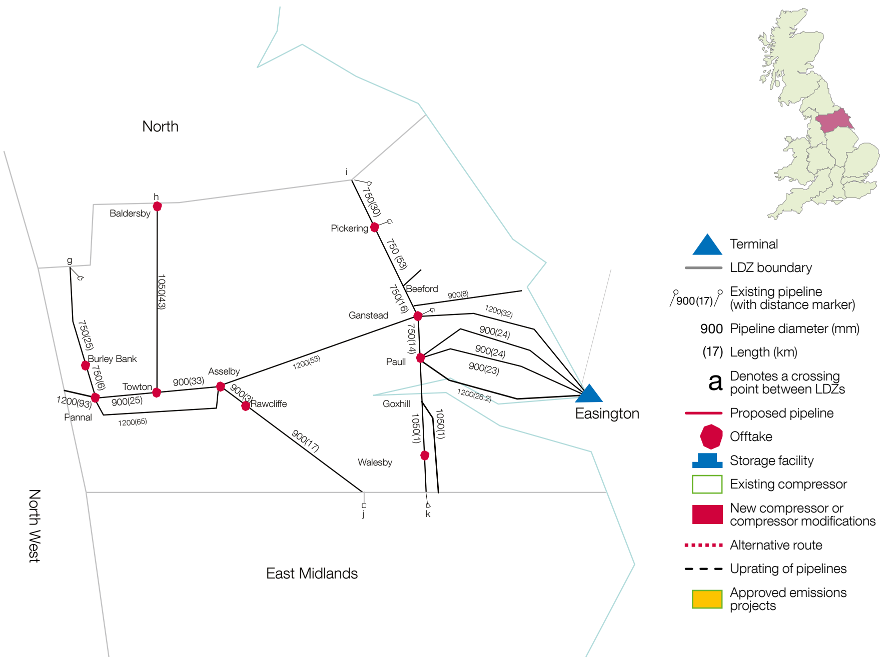
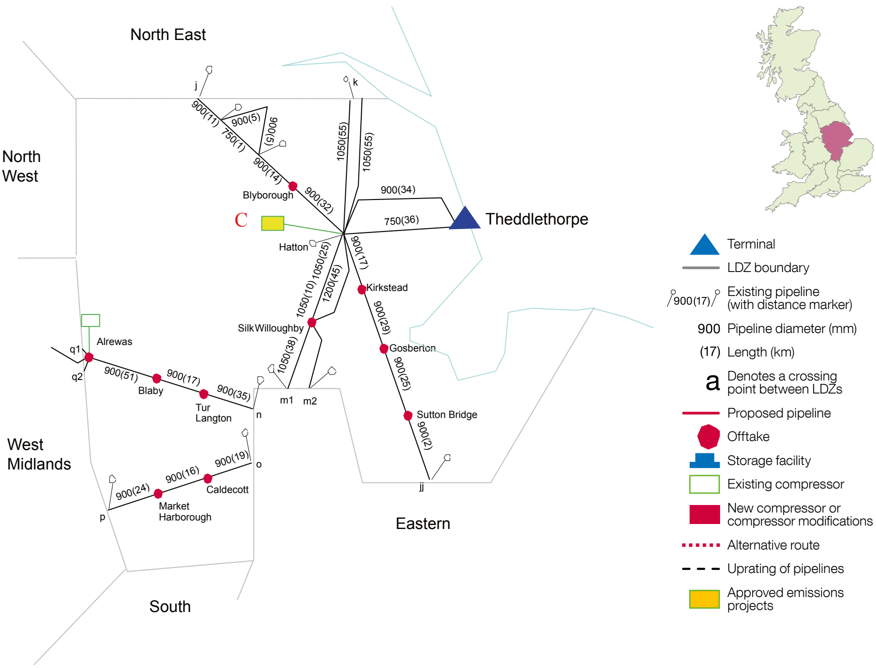


Figure A1.4
North East (NE) – NTS



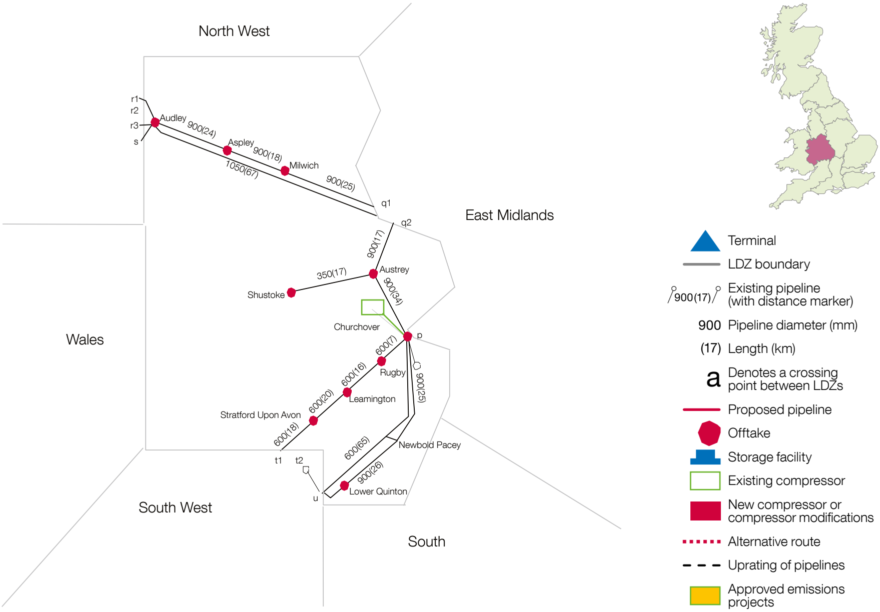
Appendix 1 National Transmission System (NTS) maps

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
- Proposed pipeline
- Offtake
- Storage facility
- Existing compressor
- New compressor or compressor modifications
- Alternative route
- Uprating of pipelines
- Approved emissions projects

Figure A1.6
West Midlands (WM) – NTS



Appendix 1 **National Transmission System (NTS) maps**

Figure A1.7
Wales (WN & WS) – NTS

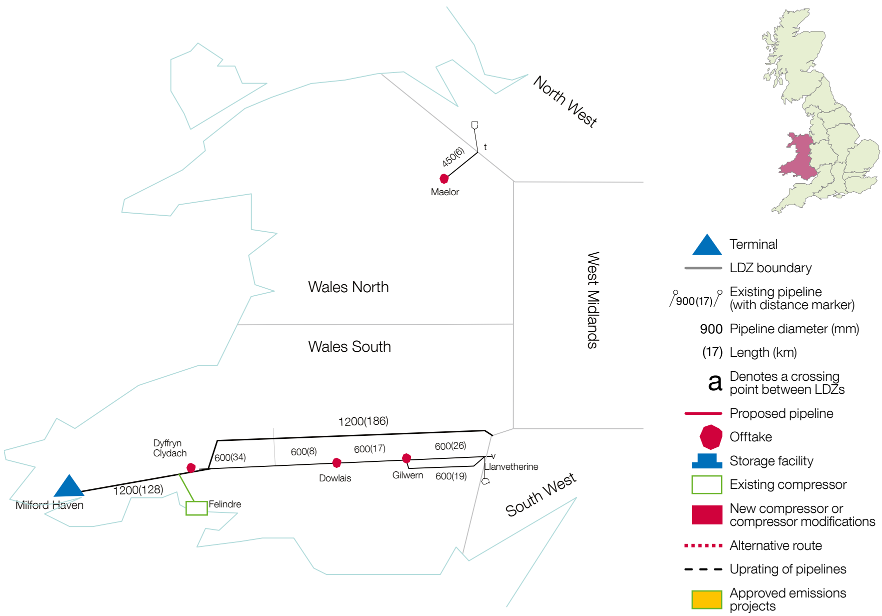
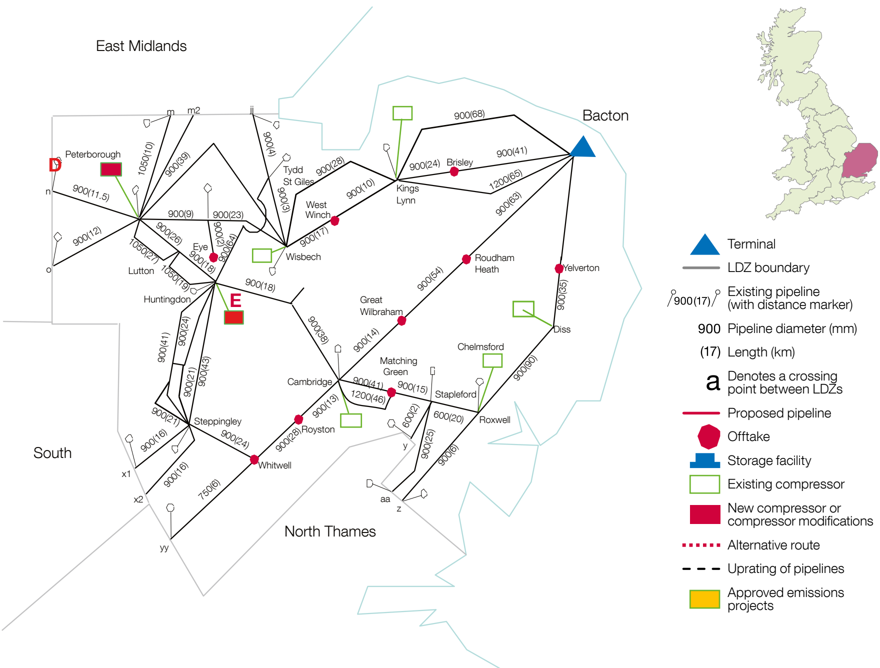


Figure A1.8
Eastern (EA) – NTS



Appendix 1 **National Transmission System (NTS) maps**

Figure A1.9
North Thames (NT) – NTS

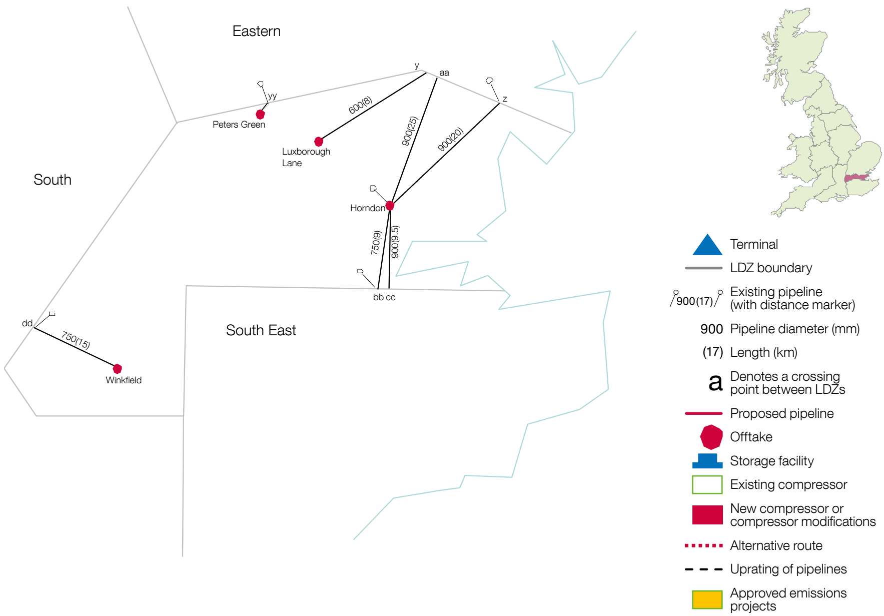
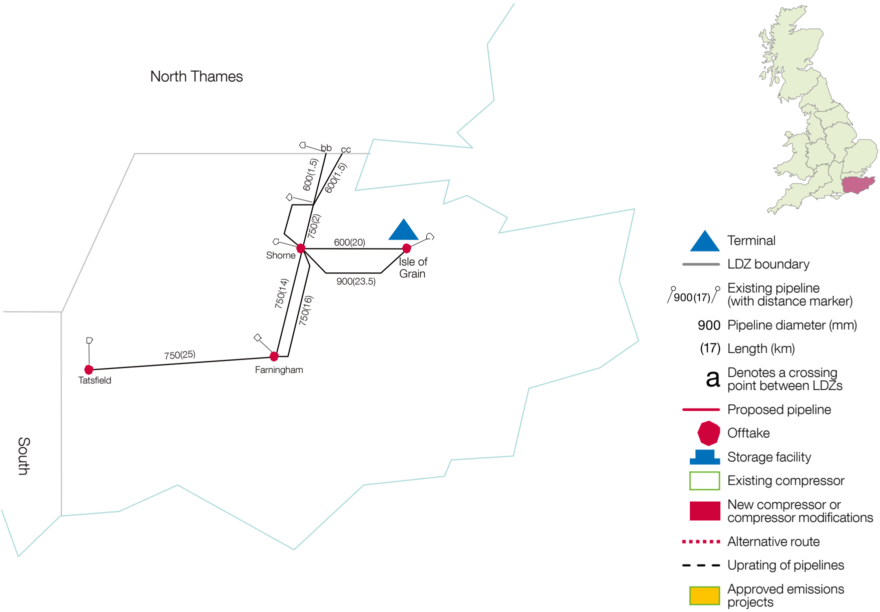


Figure A1.10
South East (SE) – NTS



Appendix 1 **National Transmission System (NTS) maps**

Figure A1.11
South (SO) – NTS

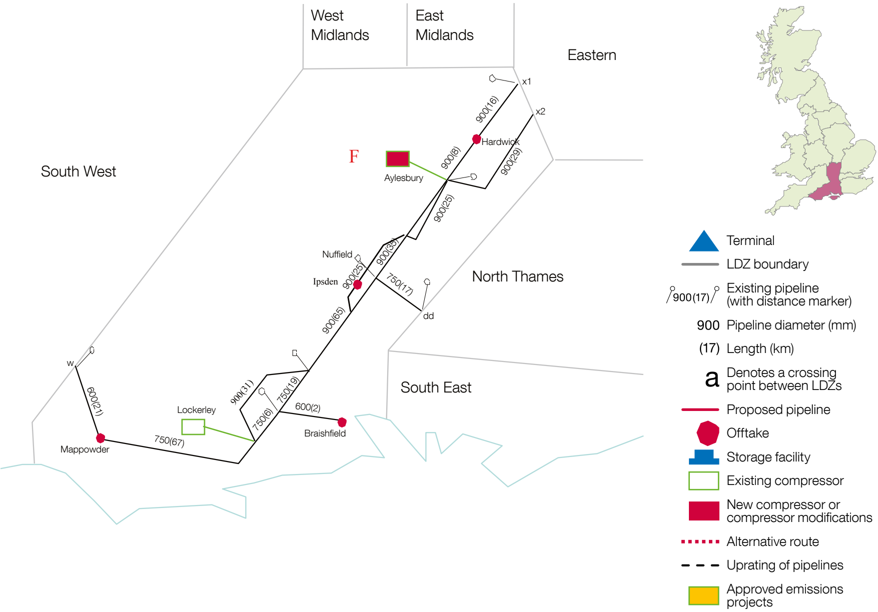
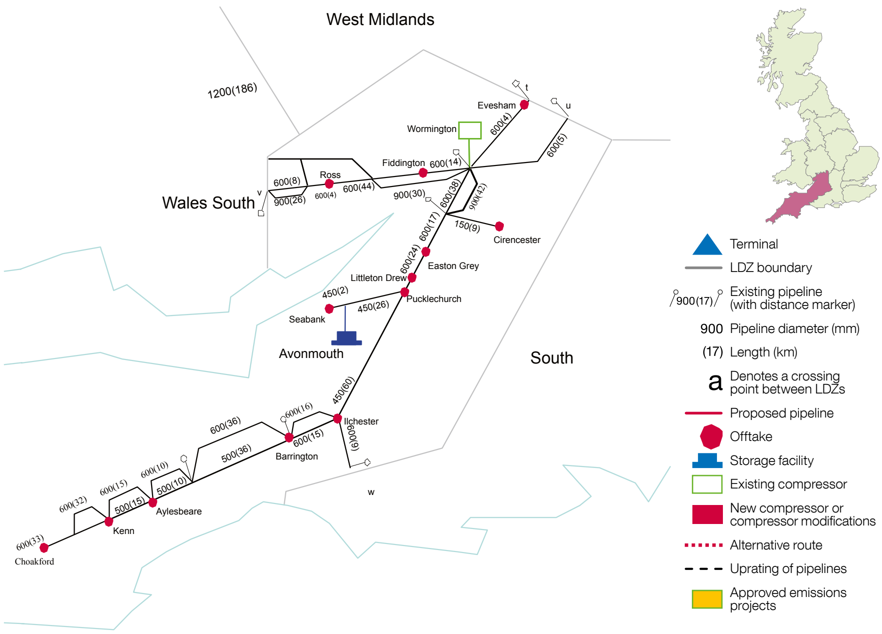


Figure A1.12
South West (SW) – NTS



Appendix 2 **Customer connections and capacity information**

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

We require a network entry agreement, storage connection agreement or interconnector agreement, as appropriate, with the respective operators of all delivery, storage and interconnector facilities.

These agreements establish, among other things, the gas quality specification, the physical location of the delivery point and the standards to be used for both gas quality and the measurement of flow.

2.1.1 Renewable gas connections

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

We welcome these developments and would like to help connect these supply sources to the network, but note that all existing network entry quality specifications, as detailed in the following section, still apply.

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

It should be recognised that the pressure requirements of biomass-derived renewable gas mean it may need to be connected to the gas distribution networks instead of the National Transmission System. For information about connections to the gas distribution networks, please read the documents for the relevant distribution network.

The twelve local distribution zones (LDZs) are managed within eight gas distribution networks. The owners of the distribution networks are: Scotland and South of England (South LDZ and South East LDZ) are owned and managed by Scotia Gas Networks – operating as Scotland Gas Networks and Southern Gas Networks respectively. For information visit **http://www.scotiagasnetworks.co.uk/**

Wales and the West (Wales LDZ and South West LDZ) is owned and managed by Wales and West Utilities. For information visit **http://www.wwutilities.co.uk/**

North of England (North LDZ and Yorkshire LDZ) is owned by Northern Gas Networks, who have contracted operational activities to United Utilities Operations. For information visit **http://www.northerngasnetworks.co.uk/**

North West, London, West Midlands and East of England (East Midlands LDZ and East Anglia LDZ) are owned and managed by National Grid. To contact National Grid-owned DNs about new connections please go to **www.nationalgrid.com**

2.1.2 Network entry quality specification

For any new entry connection to our system, the connecting party should tell us as soon as possible what the gas composition is likely to be. We will then determine whether gas of this composition would be compliant with our statutory obligations and our existing contractual obligations. From a gas quality perspective our ability to accept gas supplies into the NTS is affected by a range of factors, including the composition of the new gas, the location of the system entry point, volumes provided and the quality and volumes of gas already being transported within the system.

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

- our ability to continue to meet statutory obligations, including, but not limited to, the Gas Safety (Management) Regulations 1996 (GS(M)R))
- the implications of the proposed gas composition on system running costs
- the implications of the new gas supply on our ability to continue to meet our existing contractual obligations.

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

Appendix 2 **Customer connections and capacity information**

Table A2.1
Gas Quality Specification

Gas Element	Quality Requirement
Hydrogen sulphide	Not more than 5 mg/m^3
Total sulphur	Not more than 50 mg/m^3
Hydrogen	Not more than 0.1% (molar)
Oxygen	Not more than 0.001% (molar)
Hydrocarbon dewpoint	Not more than -2°C at any pressure up to 85 barg
Water dewpoint	Not more than -10°C at 85 barg
Wobbe number (real gross dry)	The Wobbe number shall be in the range 47.20 to 51.41 MJ/m^3
Incomplete combustion factor (ICF)	Not more than 0.48
Soot index (SI)	Not more than 0.60
Carbon dioxide	Not more than 2.5% (molar)
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
	Ofgem agree that No NGG action required
Organo halides	Not more than 1.5 mg/m^3
Radioactivity	Not more than 5 becquerels/g
Odour	Gas delivered shall have no odour that might contravene any statutory obligation. GS(M)R states transmission or distribution of odoured gas is not permitted at a pressure above 7 barg.
Pressure	The delivery pressure shall be the pressure required to deliver natural gas at the delivery point into our entry facility at any time, taking into account the back pressure of our system at the delivery point, which will vary from time to time. The entry pressure shall not exceed the maximum operating pressure at the delivery point
Delivery temperature	Between 1°C and 38°C

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

The Calorific Value (CV) of gas, which is dry, gross and measured at standard conditions of temperature and pressure, is usually quoted in Megajoules per cubic metre (MJ/m^3). CV shall normally be in the range of 46.9MJ/m^3 to 42.3MJ/m^3 but the Wobbe number provides the overriding limit.

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

2.1.3
Gas quality developments

The CEN (Comité Europeén de Normalisation, the European committee for standardisation) gas quality standard has now been formally adopted. At present, its application is voluntary within EU Member States, however, the European Commission has expressed its intention to make it binding via an amendment to the EU Network Code on Interoperability and Data Exchange Rules, now Regulation 2015/703.

To this end, in December 2015, the EC invited the European Network of Transmission System Operators for Gas (ENTSOG) to prepare a detailed analysis – focusing on the entire gas value chain in all relevant Member States – on the impacts and issues associated with codifying the standard, including consistency with the provisions already part of Regulation 2015/703 and, based on the results of the analysis, submit to ACER a proposal to amend the Interoperability Network Code by 30 June 2017.

ENTSOG accepted this invitation and, during the course of calendar year 2016, organised three stakeholder workshops and ran two consultations for EU stakeholders to contribute their views about such a legally binding gas quality specification and the policy issues that ENTSOG had identified. Along with other European TSOs, National Grid Transmission has supported ENTSOG in this programme of work. ENTSOG will be publishing its impact analysis and its amendment proposal (which could be a proposal to not amend the Interoperability Code) in December 2016.

The most important safety parameter in any natural gas quality specification – Wobbe Index – does not at present appear in the CEN standard. The EC has expressed its wish that it should and therefore, in parallel to this ENTSOG process, in 2016, CEN established a new group under the Sector Forum Gas group to progress a harmonised Wobbe Index range. The 'pre-normative' stage of this work is expected to last until 2019, following which a public enquiry and standardisation/voting procedures would be required in order to incorporate this parameter into the standard.

Within GB carbon dioxide limits have been the subject of industry debate (UNC Modification Proposals 0498 and 0502) in seeking to bring additional gas to market from the UKCS. This debate centred on whether a higher limit at the Teesside entry terminals would be more economic and efficient than upstream installation of carbon dioxide removal plant and operating it when necessary. The other side of the debate included consideration of potential impacts for operators downstream of NTS exit points in terms of potential costs for plant integrity, operation, and emissions. In September 2015, Ofgem directed that these Modifications should be implemented with effect from 1 October 2020.

Oxygen limits at network entry points have also been debated with UNC modifications 0581s and 0561s sought to increase the oxygen limits at Grain and BBL IP to 0.02% respectively. Both modifications were approved by the UNC Panel. Any further changes to oxygen limits will be considered on an individual basis.

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

At the end of its 'three-phase' gas quality exercise, initiated in 2003, the UK Government reaffirmed in 2007 that it will not propose any changes to the GB gas specifications in the GS(M)R to the Health and Safety Executive until at least 2020.

Appendix 2 **Customer connections and capacity information**

This position is now under review. During 2016 SGN concluded a Network Innovation Project called Opening up the Gas Market (OGM). The project involved a year-long field trial of wider Wobbe gas injected and utilised within Oban, one of the Scottish Independent Undertakings (SIUs). In review of the findings from OGM they have recommended that the upper Wobbe Index limit be increased to 53.25 MJ/m^3. In conjunction they have recommended that the Gas Quality specification contained in GS(M)R is transferred to an IGEM standard. An industry working group has been established by IGEM to explore this further. More information about the OGM project can be found on the SGN website **https://www.sgn.co.uk/oban/**

Appendix 2
The PARCA Framework Process

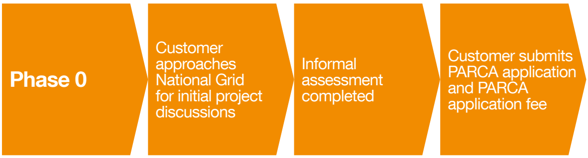
2.2
The PARCA Framework Process

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

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

2.2.1
Overview of the four phases

Phase 0 – Bilateral Discussions (no defined timescales)



This phase is a bilateral discussion phase between the customer and National Grid with no defined timescales. It allows the customer and National Grid to understand each other's processes and potential projects before the customer decides whether to formally enter the PARCA process. If the customer wants to proceed into the PARCA process after these discussions, they must submit a valid PARCA application form and pay a PARCA application fee. Our PARCA application form can be by using the following link: **http://www2.nationalgrid.com/UK/Services/Gas-transmission-connections/PARCA-framework/PARCA-Framework-1/**

Appendix 2
The PARCA Framework Process

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

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

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

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

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

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

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

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

Figure A2.1
Annual Entry and Exit capacity application windows

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

PARCA window

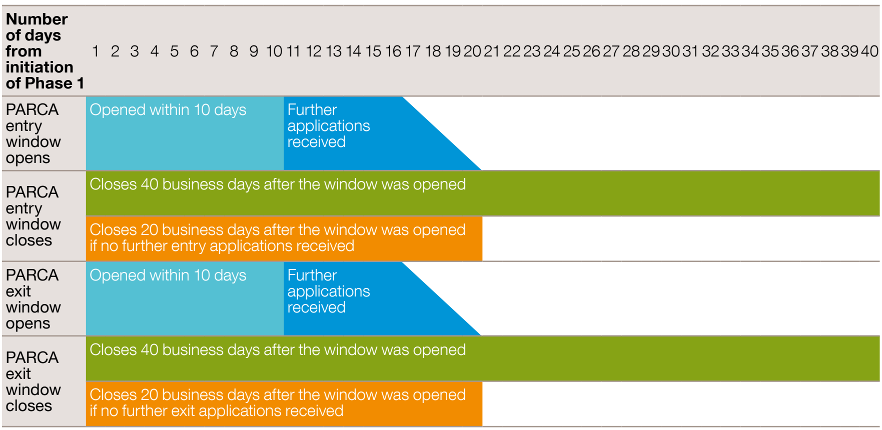
The purpose of the PARCA window is to encourage those customers considering applying for a PARCA to submit their application at this time, so that we can assess how to meet their capacity need alongside other potential projects.

For any PARCA application deemed competent outside a relevant PARCA window, within 10 business days of the initiation of the Phase 1 works of that PARCA we will open (where a window is not already open) either a PARCA entry or exit window. A notice will be published on our PARCA webpages, which can be found by using the following link: **http://www2.nationalgrid.com/UK/Services/Gas-transmission-connections/PARCA-Framework/**

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

The diagram below (Figure A2.2) shows the PARCA window timeline:

Figure A2.2
PARCA window timeline



Appendix 2
The PARCA Framework Process

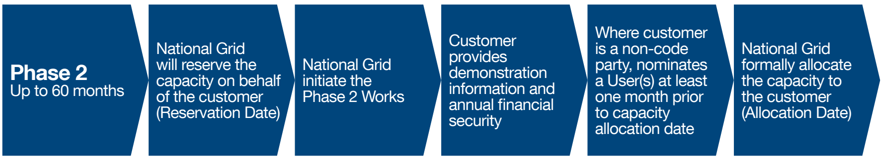
The PARCA window is open for a maximum of 40 consecutive business days but will close after 20 consecutive business days if no further PARCA applications have been received within that time. There are two types of PARCA window:

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

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

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

Phase 2 – (up to 60 months)



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

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

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

Phase 3 – (up to 24 months)

Phase 3
Up to 24 months → We will conduct network reinforcement if this is required → Capacity is delivered (Registration Date)

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

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

Appendix 3 **Meet the teams**

3.1 Our Gas Customer Account Management Team

Our role is to effectively manage business relationships with all our gas industry customers and stakeholders through ownership of the overall customer experience.

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

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

Our dedicated customer account management team will be your first point of contact:

Hayley Burden
Gas Customer Manager
hayley.burden@nationalgrid.com

Melissa Albray
Gas Customer Account Manager

Carrie Bury
Gas Customer Account Manager

Tracy Phipps
Gas Customer Account Manager

3.2 Our Gas Contract Management Team

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

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

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

Eddie Blackburn
Gas Contract Portfolio Manager
eddie.j.blackburn@nationalgrid.com

Andrea Godden
Gas Contracting Commercial Manager

Belinda Agnew
Gas Connections Contract Manager

Claire Gumbley
Gas Connections Contract Manager

Louise McGoldrick
Gas Connections Contract Manager

Richard Hounslea
Gas Connections Contract Manager

Steven Ruane
Gas Connections Contract Manager

Jeremy Tennant
Gas Connections Support Assistant

Appendix 4 **Actual flows 2015/16**

This appendix describes annual and peak flows during the calendar year 2015 and gas year 2015/16.

Annual forecasts are based on average weather conditions. Therefore, when comparing actual demand with forecasts, demand has been adjusted to take account of the difference between the actual weather and the seasonal normal weather. The result of this calculation is the weather-corrected demand.

Actual demands incorporate a reallocation of demand between 0–73.2 MWh/y and >73.2 MWh/y firm load bands to allow for reconciliation, loads crossing between thresholds, etc. The load band splits shown in Table A4.1 are slightly different from those incorporated in the National Grid Accounts.

Table A4.1 provides a comparison of actual and weather-corrected demands during the 2015 calendar year with the forecasts presented in the 2015 *GTYS*. Annual demands are presented in the format of LDZ and NTS load bands/categories, consistent with the basis of system design and operation.

Table A4.1
Annual demand for 2015 (TWh) – LDZ/NTS split

	Actual Demand (TWh)	Weather-Corrected Demand (TWh)	*GTYS* (2014) GG Demand
0–73 MWh	320	326	316
73–732 MWh	46	46	44
>732 MWh Firm	160	161	170
Total LDZ Consumption	**525**	**533**	**530**
NTS Industrial	23	23	24
NTS Power Generation	168	168	154
Exports	148	148	123
Total	**340**	**340**	**300**
Total Consumption	**865**	**873**	**830**
Shrinkage	7	7	6
Total System Demand	**872**	**880**	**836**

Table A4.1 indicates that our 1-year ahead forecast for 2015 was accurate to 0.8% at an LDZ level. The combined forecasts of the NTS Industrial, NTS Power Generation and Exports were accurate to 11.5%. Total system demand was accurate to 4.1%.

4.1
Peak and minimum flows

4.1.1
System entry – maximum day flows

For the 2015/16 gas year, the day of highest supply to the NTS was also the day of highest demand. This was 20 January 2016, when 367.8mcm fed a demand of 366.5mcm. These are both higher than the highest supply and demand days in the 2014/15 gas year (supply: 364.1 mcm on 19 January 2015; demand: 364.9mcm on 2 February 2015).

The day of lowest supply and demand for the 2015/16 gas year was 7 August 2016 (supply: 111.9mcm; demand: 114.9mcm) which are both lower than the lowest supply and demand days in the 2014/15 gas year (supply and demand both 142mcm on 12 September 2015).

Table A4.2
Physical NTS entry flows: 20 January 2016 (mcm/d)

Terminal	Maximum Day	*GTYS* (2015) GG Supply Capability	Highest Daily
Bacton inc. IUK and BBL	61	151	69
Barrow	6	8	7
Easington inc. Rough & Langeled	105	118	121
Isle of Grain (excl. LDZ inputs)	0	59	7
Milford Haven	35	86	62
Point of Ayr (Burton Point)	0	2	3
St Fergus	77	102	95
Teesside	18	24	22
Theddlethorpe	7	7	10
Sub-total	310	558	396
MRS & LNG Storage	58	104	58
Total	**367**	**661**	**454**

Notes
– The maximum supply day for 2015/16 refers to NTS flows on 20 January 2016
– This was the overall highest supply day, but individual terminals may have supplied higher deliveries on other days
– Supply Capability refers to that published in the 2015 *Gas Ten Year Statement*. Conversions to mcm have been made using a CV of 39.6MJ/m^3
– Due to linepack changes, there may be a difference between total demand and total supply on the day
– Figures may not sum exactly due to rounding.

Appendix 4 **Actual flows 2015/16**

4.1.2
System entry – minimum day flows

Table A4.3
Physical NTS entry flows: 7 August 2016 (mcm/d)

Terminal	Maximum Day
Bacton inc. IUK and BBL	15
Barrow	0
Easington inc. Rough & Langeled	22
Isle of Grain (excl. LDZ inputs)	0
Milford Haven	19
Point of Ayr (Burton Point)	1
St Fergus	37
Teesside	12
Theddlethorpe	6
Sub-total	111
MRS & LNG Storage	1
Total	**112**

Notes
– The minimum supply day for 2015/16 refers to NTS flows on 7 August 2016. This was the overall lowest supply day, but individual terminals may have supplied lower deliveries on other days.
– Due to linepack changes, there may be a difference between total demand and total supply on the day.
– Figures may not sum exactly due to rounding.

4.1.3
System exit – maximum and peak day flows

Table A4.4 shows actual flows out of the NTS on the maximum demand day of gas year 2015/16 compared to the forecast peak flows.

Table A4.4
Physical LDZ demand flows: 20 January 2016 (mcm/d)

LDZ	Maximum day	*GTYS* (2015) 1-in-20 undiversified GG peak
Eastern	22	29
East Midlands	26	35
North East	16	22
Northern	14	18
North Thames	27	37
North West	29	42
Scotland	21	30
South East	27	38
Southern	22	28
South West	16	20
West Midlands	23	30
Wales (North & South)	14	21
LDZ Total	**257**	**350**
NTS Total	**110**	**149**
Compressor Fuel Usage (CFU)	**1**	
Total	**367**	**499**

Notes
- The maximum day for gas year 2015/16 refers to 20 January 2016. This was the overall highest demand day, but individual LDZs may have seen higher demands on other days.
- NTS actual loads include interconnector demand.
- Due to linepack changes, there may be a difference between total demand and total supply on the day.
- The **Gone Green** 1-in-20 Peak Day Firm Demand forecast was published in the 2015 *Gas Ten Year Statement* Conversions to mcm have been made using a CV of 39.6MJ/m^3.
- Figures may not sum exactly due to rounding.

Appendix 4 **Actual flows 2015/16**

4.1.4
System exit – minimum day flows

Table A4.5
Physical LDZ demand flows: 7 August 2016 (mcm/d)

Terminal	Maximum Day
Eastern	3
East Midlands	4
North East	4
Northern	4
North Thames	4
North West	7
Scotland	5
South East	3
Southern	4
South West	2
West Midlands	3
Wales (North & South)	4
LDZ Total	**48**
NTS Total	**43**
Compressor Fuel Usage (CFU)	**0**
Total	**91**

Notes
– The minimum day for gas year 2015/16 refers to 7 August 2016 (Demand:114.9 mcm which includes 24 mcm Storage Injection). This was the overall lowest demand day, but individual LDZs may have seen lower demands on other days.
– NTS actual loads include interconnector demand.
– Due to linepack changes, there may be a small difference between total demand and total supply on the day.
– Figures may not sum exactly due to rounding.

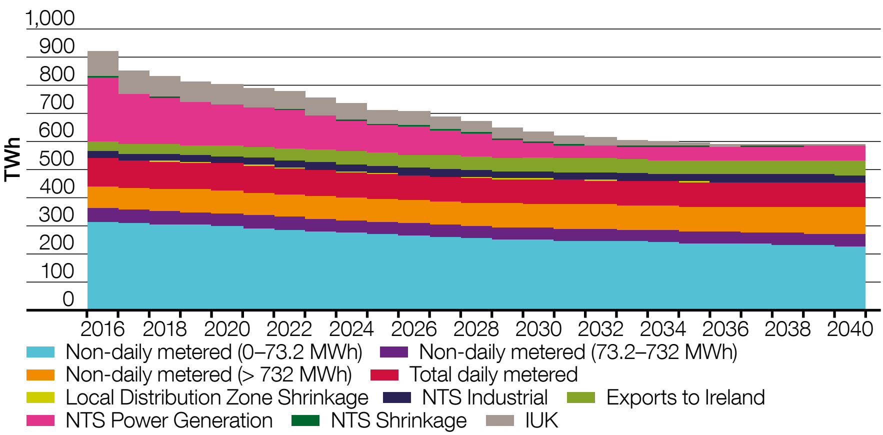
Appendix 5 **Gas demand and supply volume scenarios**

5.1 Demand

Table A5.1A
***Slow Progression:** Annual demand*

	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040
Non-daily metered (0-73.2 MWh)	315	310	306	302	298	292	286	280	274	268	264	260	256	253	250	248	246	244	241	239	237	234	232	230	228
Non-daily metered (73.2-732 MWh)	48	47	47	47	46	46	46	45	45	45	45	44	44	44	44	44	44	43	43	43	43	43	43	43	43
Non-daily metered (> 732 MWh)	78	79	79	80	80	80	81	81	82	82	83	83	84	84	85	85	86	86	87	87	89	90	92	93	94
Total Non-daily metered	**440**	**436**	**432**	**428**	**424**	**418**	**412**	**406**	**400**	**395**	**391**	**387**	**384**	**381**	**379**	**377**	**375**	**374**	**371**	**369**	**369**	**368**	**367**	**366**	**365**
Total Daily Metered	100	95	96	96	97	95	94	92	91	90	87	86	86	86	86	86	86	86	86	86	86	87	87	88	88
Local Distribution Zone Shrinkage	3	3	3	3	3	3	3	3	3	3	3	2	2	2	2	2	2	2	2	2	2	2	2	2	2
Total Local Distribution Zone	**543**	**534**	**531**	**527**	**523**	**516**	**508**	**500**	**494**	**488**	**481**	**476**	**472**	**469**	**467**	**465**	**463**	**461**	**459**	**457**	**457**	**456**	**456**	**455**	**455**
NTS Industrial	24	25	25	25	26	26	26	26	26	26	26	26	26	26	26	26	26	26	26	26	26	26	26	26	26
Exports to Ireland	34	34	37	33	36	38	41	44	45	48	47	49	48	48	50	50	50	50	49	50	51	51	52	53	53
NTS Power Generation	229	175	162	154	145	141	139	121	110	97	101	88	83	63	54	46	45	44	47	48	46	48	49	50	50
NTS Consumption	287	233	224	212	207	204	205	190	181	171	175	163	157	137	130	122	121	120	122	124	123	125	127	128	129
NTS Shrinkage	4	3	3	3	3	3	3	3	3	4	4	4	3	3	3	3	3	3	3	3	4	3	3	3	3
Total excluding IUK	834	771	758	743	733	723	716	694	678	662	659	642	633	610	600	590	588	585	585	584	583	585	586	587	588
IUK	86	79	75	72	68	65	62	61	57	52	49	45	41	37	33	29	25	21	17	13	9	7	5	3	1
Total including IUK	**920**	**851**	**834**	**815**	**802**	**787**	**778**	**755**	**735**	**714**	**708**	**687**	**674**	**647**	**633**	**619**	**612**	**606**	**602**	**597**	**592**	**592**	**591**	**590**	**589**

Figure A5.1A
***Slow Progression:** Annual demand*



Appendix 5 **Gas demand and supply volume scenarios**

Table A5.1B
Gone Green: *Annual demand*

	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040
Non-daily metered (0-73.2 MWh)	308	298	288	278	268	260	252	244	235	225	216	209	202	195	189	184	179	174	170	166	162	158	155	151	148
Non-daily metered (73.2-732 MWh)	47	46	46	46	46	46	46	46	46	45	45	45	45	44	44	44	43	43	42	42	41	40	40	38	38
Non-daily metered (> 732 MWh)	78	79	80	81	82	84	85	87	89	90	92	93	95	96	97	98	98	98	98	98	98	98	98	98	97
Total Non-daily metered	**433**	**423**	**415**	**406**	**397**	**390**	**383**	**377**	**369**	**361**	**354**	**347**	**341**	**336**	**330**	**325**	**320**	**315**	**311**	**306**	**301**	**297**	**292**	**287**	**283**
Total Daily Metered	100	95	94	94	93	93	93	93	91	91	91	92	92	92	92	92	92	92	92	91	90	90	89	88	87
Local Distribution Zone Shrinkage	3	3	3	3	3	3	3	3	3	3	3	2	2	2	2	2	2	2	2	2	2	2	2	2	2
Total Local Distribution Zone	**536**	**521**	**512**	**503**	**493**	**486**	**479**	**473**	**463**	**454**	**447**	**441**	**436**	**430**	**425**	**420**	**414**	**410**	**404**	**399**	**394**	**388**	**383**	**377**	**371**
NTS Industrial	23	24	25	25	25	24	24	24	25	25	25	25	24	24	24	24	24	24	24	24	23	23	23	22	22
Exports to Ireland	36	37	41	38	41	42	45	49	50	52	52	53	52	51	53	53	53	54	54	55	57	58	60	61	63
NTS Power Generation	236	191	164	144	115	82	70	73	80	77	70	62	57	56	64	68	78	88	99	110	125	143	168	181	189
NTS Consumption	296	252	230	207	181	149	139	147	155	153	146	140	134	131	141	146	156	166	177	189	206	224	250	264	273
NTS Shrinkage	4	3	3	3	3	3	3	3	3	4	4	4	3	3	3	3	3	3	3	3	4	3	3	3	3
Total excluding IUK	835	776	745	713	677	638	622	623	621	611	597	585	573	565	569	569	574	579	585	591	603	616	636	644	648
IUK	86	80	76	73	69	65	61	60	57	52	48	45	41	36	33	29	25	21	17	13	9	7	5	3	1
Total including IUK	**921**	**856**	**821**	**786**	**746**	**703**	**683**	**683**	**678**	**663**	**645**	**630**	**613**	**601**	**602**	**597**	**598**	**600**	**602**	**604**	**612**	**623**	**641**	**647**	**649**

Figure A5.1B
Gone Green: *Annual demand*

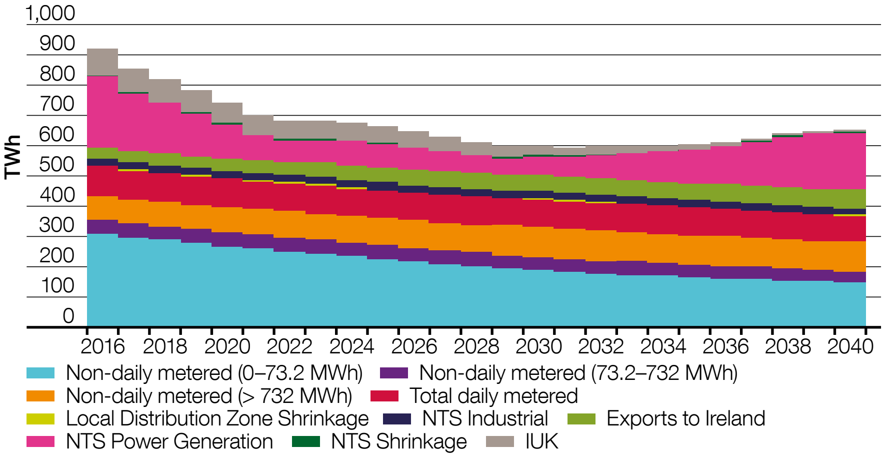
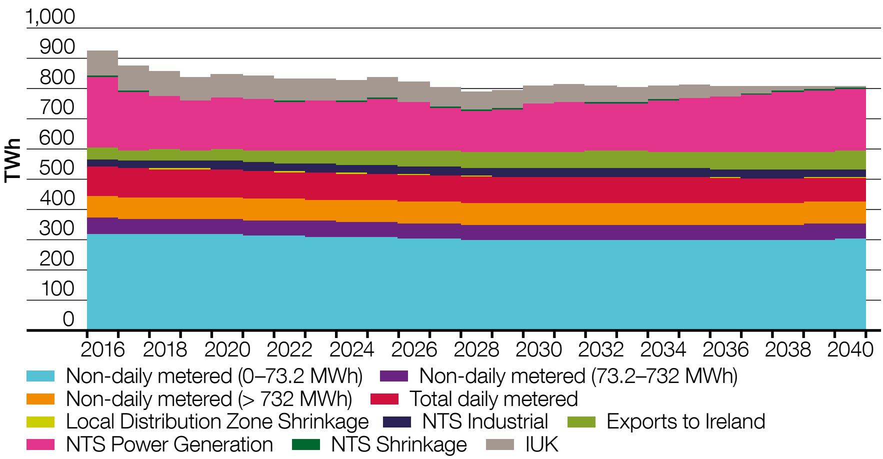


Table A5.1C
***No Progression:** Annual demand*

	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040
Non-daily metered (0-73.2 MWh)	321	320	319	319	318	315	313	311	309	307	305	303	301	300	299	300	300	300	300	301	301	301	301	302	303
Non-daily metered (73.2-732 MWh)	50	50	50	50	50	49	49	49	49	49	49	49	49	49	49	49	49	49	49	49	49	49	49	49	49
Non-daily metered (> 732 MWh)	73	73	73	73	73	73	73	73	73	73	72	72	73	72	72	72	73	73	73	72	73	73	73	73	73
Total Non-daily metered	**443**	**443**	**442**	**441**	**440**	**438**	**435**	**433**	**431**	**429**	**427**	**425**	**423**	**421**	**421**	**421**	**422**	**422**	**422**	**422**	**422**	**422**	**423**	**424**	**424**
Total Daily Metered	98	93	92	91	91	90	89	88	88	87	87	86	86	86	85	85	84	84	84	84	82	81	81	81	80
Local Distribution Zone Shrinkage	3	3	3	3	3	3	3	3	3	3	3	2	2	2	2	2	2	2	2	2	2	2	2	2	2
Total Local Distribution Zone	**544**	**539**	**537**	**535**	**534**	**530**	**527**	**524**	**521**	**519**	**516**	**514**	**511**	**509**	**509**	**508**	**508**	**508**	**509**	**509**	**506**	**505**	**506**	**506**	**506**
NTS Industrial	24	25	25	25	25	26	26	26	26	27	27	27	27	27	27	27	27	27	27	27	27	27	27	27	27
Exports to Ireland	34	34	39	35	39	41	43	46	49	52	52	54	54	55	56	57	58	58	56	57	58	58	59	60	60
NTS Power Generation	235	194	172	163	169	166	161	163	159	170	159	143	134	141	156	162	157	159	169	175	182	190	197	203	207
NTS Consumption	294	253	236	223	234	233	230	235	235	248	238	224	215	222	240	246	242	244	252	259	266	275	283	289	294
NTS Shrinkage	4	3	3	3	3	3	3	3	3	4	4	4	3	3	3	3	3	3	3	3	4	3	3	3	3
Total excluding IUK	842	795	776	762	771	766	760	762	759	770	758	741	730	735	752	758	754	756	764	771	776	784	792	799	804
IUK	85	82	80	78	77	75	73	71	69	67	66	63	61	58	57	55	52	50	46	41	33	25	17	11	5
Total including IUK	**927**	**877**	**856**	**840**	**848**	**841**	**833**	**833**	**828**	**838**	**823**	**804**	**791**	**794**	**808**	**812**	**806**	**806**	**810**	**812**	**809**	**809**	**809**	**810**	**809**

Figure A5.1C
***No Progression:** Annual demand*



Appendix 5 **Gas demand and supply volume scenarios**

Table A5.1D
***Consumer Power:** Annual demand*

	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040
Non-daily metered (0-73.2 MWh)	320	318	316	314	309	304	300	296	291	287	284	282	279	277	275	273	271	270	268	266	265	264	263	261	260
Non-daily metered (73.2-732 MWh)	53	54	54	55	56	56	56	57	57	57	57	57	57	57	57	57	57	58	58	58	58	58	58	58	58
Non-daily metered (> 732 MWh)	77	78	79	80	81	81	82	82	83	84	84	85	86	86	87	87	88	89	90	90	91	91	92	92	92
Total Non-daily metered	**449**	**449**	**449**	**448**	**446**	**441**	**438**	**435**	**431**	**427**	**426**	**424**	**422**	**420**	**419**	**418**	**417**	**416**	**415**	**414**	**414**	**413**	**412**	**411**	**410**
Total Daily Metered	101	97	96	95	94	93	93	93	93	93	91	90	90	90	90	90	91	91	92	92	92	92	92	92	92
Local Distribution Zone Shrinkage	3	3	3	3	3	3	3	3	3	3	3	2	2	2	2	2	2	2	2	2	2	2	2	2	2
Total Local Distribution Zone	**553**	**549**	**548**	**546**	**543**	**537**	**534**	**530**	**526**	**523**	**519**	**516**	**514**	**512**	**511**	**511**	**510**	**509**	**509**	**508**	**508**	**507**	**506**	**506**	**505**
NTS Industrial	24	25	25	25	25	25	25	25	25	26	26	26	26	26	26	26	27	27	27	27	27	27	27	27	27
Exports to Ireland	37	37	40	36	38	39	44	47	50	55	54	56	56	57	60	61	62	62	60	62	64	65	67	68	70
NTS Power Generation	233	208	187	163	128	97	81	87	96	83	62	55	52	47	42	43	30	31	39	33	26	26	22	20	20
NTS Consumption	294	269	252	224	191	162	151	159	172	164	142	137	134	130	128	130	119	119	126	122	117	118	115	116	118
NTS Shrinkage	4	3	3	3	3	3	3	3	3	4	4	4	3	3	3	3	3	3	3	3	4	3	3	3	3
Total excluding IUK	851	822	804	773	737	702	688	693	702	690	665	656	651	645	643	644	633	632	639	633	628	629	625	625	626
IUK	87	86	86	87	87	86	86	87	87	93	97	99	102	102	103	102	103	102	98	95	89	86	82	78	74
Total including IUK	**938**	**908**	**890**	**861**	**825**	**789**	**774**	**780**	**789**	**782**	**761**	**755**	**754**	**748**	**746**	**746**	**735**	**734**	**737**	**728**	**718**	**715**	**707**	**703**	**700**

Figure A5.1D
***Consumer Power:** Annual demand*

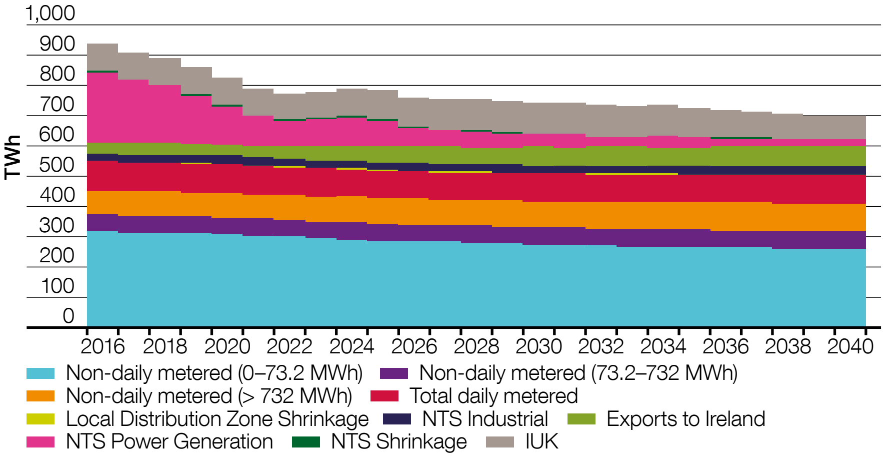
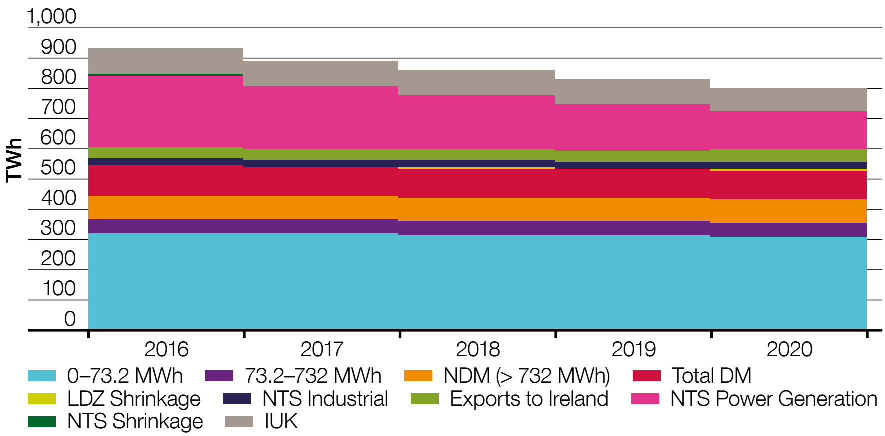


Table A5.1E
Updated Forecast[1]: Annual demand

	2016	2017	2018	2019	2020
Non-daily metered (0-73.2 MWh)	322	319	316	312	308
Non-daily metered (73.2-732 MWh)	48	49	49	50	51
Non-daily metered (> 732 MWh)	74	75	76	76	77
Total Non-daily metered	**444**	**443**	**441**	**438**	**436**
Total Daily Metered	99	94	93	93	92
Local Distribution Zone Shrinkage	3	3	3	3	3
Total Local Distribution Zone	**546**	**540**	**537**	**534**	**531**
NTS Industrial	24	25	25	25	26
Exports to Ireland	35	35	39	36	39
NTS Power Generation	232	192	165	151	125
NTS Consumption	290	252	229	212	190
NTS Shrinkage	4	3	3	3	3
Total excluding IUK	840	795	769	749	724
IUK	85	82	80	78	77
Total including IUK	**926**	**877**	**849**	**827**	**801**

Figure A5.1E
Updated Forecast: Annual demand



[1] An update to the 2016 *Future Energy Scenarios* was undertaken in September 2016 in preparation of our 2016 *Winter Outlook Report*. This updated forecast is included throughout Appendix 5.

Appendix 5 **Gas demand and supply volume scenarios**

Table A5.1F
***Slow Progression:** 1-in-20 peak day undiversified demand*

National	2015/16	2016/17	2017/18	2018/19	2019/20	2020/21	2021/22	2022/23	2023/24	2024/25	2025/26	2026/27	2027/28	2028/29	2029/30	2030/31	2031/32	2032/33	2033/34	2034/35	2035/36	2036/37	2037/38	2038/39	2039/40	2040/41
Scotland	331.9	329.0	326.7	323.9	320.2	316.3	312.2	307.7	302.7	299.4	296.2	293.2	289.9	287.9	286.3	284.9	282.6	281.5	280.0	278.4	276.7	276.5	275.9	275.0	273.1	273.6
Northern	210.8	209.3	207.1	204.8	202.4	200.6	197.9	195.2	191.7	189.8	188.0	186.3	184.1	182.8	181.5	181.0	179.7	179.3	178.3	177.0	175.5	176.4	176.0	175.4	174.3	174.1
North West	472.0	468.0	463.6	459.0	452.6	448.6	442.4	436.0	428.2	423.9	419.6	415.9	410.7	408.6	406.0	403.9	400.9	400.1	397.7	395.1	391.9	392.6	391.7	390.3	387.3	388.3
North East	246.8	245.2	242.9	240.6	237.3	235.2	232.0	228.9	224.9	222.7	220.6	218.8	216.3	215.4	214.2	213.2	211.9	211.7	210.8	209.6	208.2	208.8	208.6	208.1	206.8	207.3
East Midlands	400.5	398.0	394.4	390.3	384.5	380.9	375.5	370.0	363.5	359.3	355.4	352.3	347.9	346.6	344.3	342.1	339.3	339.0	337.0	335.1	332.3	332.5	331.8	330.7	328.2	329.4
West Midlands	348.4	347.3	344.4	340.8	335.9	332.9	328.4	323.7	318.2	314.6	311.1	308.4	304.7	303.6	301.5	299.8	297.3	297.0	295.3	293.8	291.3	291.5	291.0	290.1	288.1	289.1
Wales North	42.7	43.0	42.5	42.0	41.4	41.1	40.5	39.9	39.2	38.9	38.5	38.3	37.8	37.7	37.5	37.4	37.2	37.2	37.1	37.0	36.8	37.0	37.0	37.0	36.9	36.9
Wales South	194.3	190.8	187.1	186.7	184.8	182.7	179.8	176.9	173.8	172.3	170.7	169.1	167.1	166.1	165.1	164.3	163.3	162.7	161.9	160.9	159.9	160.1	159.7	159.0	158.2	158.5
Eastern	317.5	315.9	313.5	310.9	306.9	304.4	300.4	296.2	291.0	288.3	285.2	282.7	279.4	278.4	276.6	275.3	273.0	273.0	271.5	270.0	268.0	268.8	268.3	267.6	265.8	267.0
North Thames	404.9	403.6	400.2	396.6	391.3	388.1	383.2	378.0	371.4	368.0	364.0	361.0	357.0	355.9	353.7	352.0	349.1	349.3	347.6	345.6	343.2	344.1	343.7	343.2	341.0	342.5
South East	435.4	433.0	429.4	426.0	420.8	417.4	412.3	406.6	399.3	395.5	391.2	387.9	383.4	361.6	359.2	357.1	353.9	353.7	351.7	349.2	346.4	347.0	346.2	345.4	342.9	344.2
Southern	311.7	310.5	308.3	306.2	302.6	299.9	296.2	292.4	287.4	286.0	282.2	279.3	260.4	259.8	258.2	257.0	254.8	254.7	253.6	252.2	250.5	251.3	250.9	250.5	249.2	250.2
South West	229.9	229.2	227.9	226.2	223.5	221.5	218.4	215.6	212.0	210.0	207.7	206.0	203.7	203.3	202.3	201.4	199.8	199.8	199.2	198.4	197.1	197.6	197.5	197.0	196.1	197.0
Total LDZ	**3947**	**3923**	**3888**	**3854**	**3804**	**3770**	**3719**	**3667**	**3603**	**3569**	**3531**	**3499**	**3442**	**3408**	**3386**	**3369**	**3343**	**3339**	**3322**	**3302**	**3278**	**3284**	**3278**	**3269**	**3248**	**3258**
NTS Industrial	131	131	131	150	143	143	143	150	150	150	150	150	150	150	150	150	150	150	150	150	150	150	150	150	150	150
NTS Power Generation	1325	1253	1228	1228	1207	1261	1352	1283	1173	1136	991	991	874	874	764	725	654	654	634	634	634	634	634	634	634	634
Exports via Moffat	231	274	296	311	339	351	365	367	394	404	404	404	404	404	404	404	404	404	404	404	404	404	404	404	404	404
Exports via IUK	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total NTS	**1687**	**1658**	**1656**	**1689**	**1689**	**1755**	**1860**	**1800**	**1717**	**1690**	**1545**	**1545**	**1428**	**1428**	**1318**	**1279**	**1208**	**1208**	**1188**	**1188**	**1188**	**1188**	**1188**	**1188**	**1188**	**1188**
Total	**5634**	**5581**	**5544**	**5543**	**5493**	**5525**	**5580**	**5467**	**5321**	**5258**	**5076**	**5044**	**4871**	**4836**	**4704**	**4648**	**4550**	**4547**	**4509**	**4490**	**4465**	**4472**	**4466**	**4457**	**4435**	**4446**

Figure A5.1F
***Slow Progression:** 1-in-20 peak day undiversified demand*

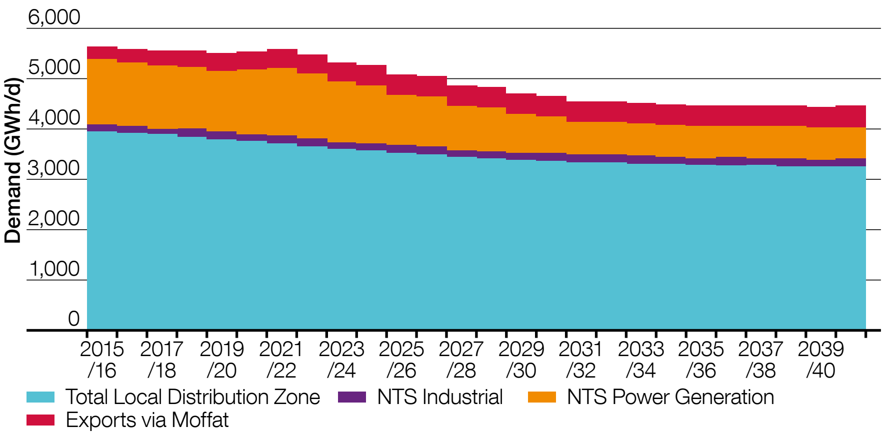
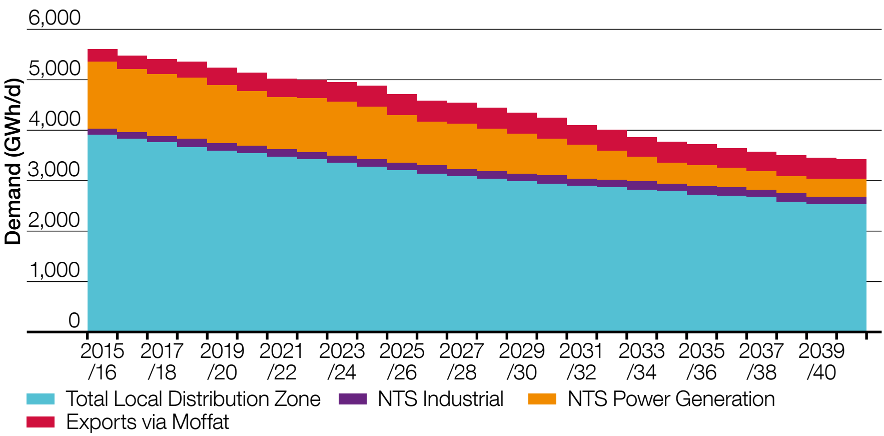


Table A5.1G
***Gone Green:** 1-in-20 peak day undiversified demand*

National	2015/16	2016/17	2017/18	2018/19	2019/20	2020/21	2021/22	2022/23	2023/24	2024/25	2025/26	2026/27	2027/28	2028/29	2029/30	2030/31	2031/32	2032/33	2033/34	2034/35	2035/36	2036/37	2037/38	2038/39	2039/40	2040/41
Scotland	328.6	321.1	315.6	309.5	302.3	296.8	292.3	287.4	281.3	276.1	270.7	265.6	260.2	255.8	252.1	248.2	243.5	240.3	236.8	233.1	228.9	225.9	222.3	218.4	213.3	212.4
Northern	208.8	204.6	200.5	196.2	191.8	189.2	186.3	183.4	179.3	176.5	173.5	170.7	167.4	164.8	162.4	160.5	157.9	156.2	154.1	151.5	148.7	147.8	145.7	143.3	140.2	139.4
North West	467.0	456.8	447.7	438.4	427.0	421.1	414.1	407.6	398.3	391.3	384.0	377.6	369.7	364.6	359.3	353.7	347.4	344.0	339.2	333.8	327.3	324.2	319.6	314.1	307.1	306.5
North East	244.2	239.3	234.7	230.1	224.2	221.2	217.7	214.5	209.8	206.4	202.9	199.7	195.9	193.3	190.7	187.9	184.7	183.0	180.6	177.6	174.1	172.3	169.7	166.6	162.6	162.0
East Midlands	396.2	388.3	380.7	372.6	362.5	357.1	351.1	345.4	337.5	331.0	324.5	318.8	312.0	307.9	303.2	298.0	292.5	289.6	285.4	281.0	275.4	272.4	268.3	263.7	257.6	257.4
West Midlands	344.5	338.7	332.2	325.1	316.5	311.9	306.9	302.0	295.3	289.8	283.9	279.0	273.2	269.8	265.6	261.3	256.2	253.7	250.1	246.5	241.5	238.7	235.3	231.3	226.2	226.1
Wales North	42.3	42.0	41.1	40.3	39.4	38.9	38.3	37.8	37.1	36.6	36.1	35.7	35.1	34.7	34.4	34.0	33.5	33.3	32.9	32.4	31.8	31.6	31.1	30.5	29.9	29.7
Wales South	193.1	188.0	182.1	179.5	175.8	173.3	170.5	168.0	164.9	162.6	160.1	157.8	155.0	153.0	151.4	149.6	147.6	146.1	144.5	142.6	140.6	139.7	138.0	97.2	95.0	94.8
Eastern	314.1	308.3	302.7	296.9	289.6	285.8	281.5	277.4	271.2	266.9	261.9	257.7	252.6	249.6	246.3	242.6	238.2	236.3	233.1	229.8	225.7	223.8	220.9	217.5	213.0	213.2
North Thames	400.6	393.8	386.5	378.9	369.5	364.8	359.5	354.4	346.6	341.1	334.7	329.5	323.2	319.6	315.3	310.5	304.7	302.4	298.3	293.9	288.5	285.7	281.8	277.5	271.5	271.6
South East	431.0	422.6	414.1	406.3	396.0	390.0	384.3	378.4	369.2	342.4	334.8	328.5	321.4	316.8	311.7	306.2	299.9	297.1	292.8	288.1	282.5	279.7	276.0	271.9	266.2	266.3
Southern	308.3	303.1	297.8	292.6	285.8	282.0	277.9	275.2	268.6	264.0	243.5	239.6	234.8	232.1	228.9	225.4	221.2	219.2	216.3	213.2	209.3	207.5	204.7	201.6	197.7	197.7
South West	227.4	223.5	219.7	215.6	210.5	207.5	204.1	201.3	196.9	193.6	189.9	186.9	183.1	181.3	178.8	176.2	173.0	171.4	169.3	167.1	164.1	162.5	160.2	157.6	154.4	154.4
Total LDZ	**3906**	**3830**	**3756**	**3682**	**3591**	**3540**	**3485**	**3433**	**3356**	**3278**	**3200**	**3147**	**3084**	**3043**	**3000**	**2954**	**2900**	**2873**	**2833**	**2791**	**2738**	**2712**	**2673**	**2591**	**2535**	**2532**
NTS Industrial	131	131	132	150	143	143	143	150	150	150	150	150	150	150	150	150	150	150	150	150	150	150	150	150	150	150
NTS Power Generation	1325	1253	1228	1224	1175	1106	1020	1056	1056	1044	950	892	891	850	783	747	659	577	487	425	425	389	355	355	355	355
Exports via Moffat	231	274	296	311	339	351	365	367	394	404	404	404	404	404	404	404	404	404	404	404	404	404	404	404	404	404
Exports via IUK	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total NTS	**1687**	**1658**	**1656**	**1685**	**1657**	**1600**	**1529**	**1573**	**1600**	**1598**	**1504**	**1446**	**1445**	**1404**	**1337**	**1301**	**1213**	**1131**	**1041**	**979**	**979**	**943**	**909**	**909**	**909**	**909**
Total	**5593**	**5489**	**5412**	**5367**	**5248**	**5139**	**5014**	**5006**	**4956**	**4876**	**4705**	**4593**	**4528**	**4447**	**4337**	**4255**	**4113**	**4004**	**3875**	**3770**	**3718**	**3655**	**3583**	**3501**	**3444**	**3441**

Figure A5.1G
***Gone Green:** 1-in-20 peak day undiversified demand*



Appendix 5 **Gas demand and supply volume scenarios**

Table A5.1H
***No Progression:** 1-in-20 peak day undiversified demand*

National	2015/16	2016/17	2017/18	2018/19	2019/20	2020/21	2021/22	2022/23	2023/24	2024/25	2025/26	2026/27	2027/28	2028/29	2029/30	2030/31	2031/32	2032/33	2033/34	2034/35	2035/36	2036/37	2037/38	2038/39	2039/40	2040/41
Scotland	332.3	333.2	333.2	333.0	331.5	330.1	328.7	326.7	324.4	323.6	322.2	320.7	318.5	317.5	317.3	317.3	316.5	317.0	317.3	317.3	316.5	316.8	317.3	317.6	316.8	317.6
Northern	211.1	211.7	210.8	209.9	208.8	208.6	207.3	206.1	204.1	203.7	203.0	202.1	200.4	199.8	199.1	199.4	199.0	199.5	199.6	199.2	198.0	199.1	199.4	199.4	198.8	198.9
North West	473.1	473.8	472.6	471.5	468.2	467.8	465.1	462.5	458.3	457.6	455.8	454.0	450.2	449.6	448.8	448.6	447.7	449.3	449.2	448.9	446.7	448.5	449.0	449.2	447.7	449.2
North East	247.5	248.3	247.7	247.3	245.5	245.4	244.0	242.8	240.7	240.3	239.5	238.7	236.8	236.7	236.3	236.2	235.8	236.7	236.9	236.8	235.8	236.7	237.1	237.3	236.7	237.5
East Midlands	401.5	403.1	402.3	401.2	398.1	397.6	395.2	393.1	389.6	388.5	386.9	385.3	382.1	382.1	381.3	380.8	379.9	381.5	381.7	381.7	379.6	380.9	381.3	381.7	380.6	382.1
West Midlands	349.1	351.8	351.2	350.3	347.8	347.5	345.7	343.9	340.9	340.1	338.6	337.4	334.7	334.7	333.9	333.8	332.8	334.4	334.6	334.6	332.8	333.9	334.5	334.8	334.0	335.2
Wales North	42.8	43.5	43.3	43.1	42.8	42.8	42.5	42.2	41.8	41.8	41.6	41.5	41.2	41.1	41.1	41.1	41.0	41.2	41.2	41.2	41.1	41.3	41.4	41.4	41.4	41.5
Wales South	194.4	193.3	189.9	189.4	188.1	187.1	185.6	184.4	182.7	182.1	181.2	180.3	178.7	178.1	177.5	177.3	176.7	176.7	176.6	176.5	175.6	176.0	176.0	175.9	175.5	175.8
Eastern	317.7	319.3	319.1	318.8	316.9	316.8	315.1	313.5	310.7	310.3	308.8	307.5	304.9	304.9	304.1	304.1	303.1	304.7	304.8	304.9	303.3	304.6	305.1	305.4	304.5	305.9
North Thames	404.9	407.6	407.0	406.4	403.6	403.6	401.5	399.5	395.9	395.4	393.6	392.1	389.1	389.2	388.3	388.3	387.1	389.3	389.5	389.5	387.5	389.1	389.8	390.3	389.1	390.9
South East	435.9	437.1	436.1	436.3	434.0	433.9	431.6	429.4	425.0	424.9	423.0	421.2	418.0	417.2	416.9	417.0	415.6	397.5	417.5	417.4	415.7	417.2	418.0	418.7	417.6	419.2
Southern	311.4	313.2	313.1	313.2	311.5	311.1	309.6	308.2	305.4	305.3	303.8	302.5	300.2	300.0	299.6	299.6	298.7	300.1	300.4	301.3	299.4	299.9	284.6	285.3	284.7	286.0
South West	230.3	232.0	232.3	232.4	231.3	231.1	229.8	228.8	226.9	226.7	225.7	224.8	223.1	223.4	223.1	223.1	222.5	223.6	224.1	224.4	223.5	224.4	224.9	225.2	225.0	226.0
Total LDZ	**3952**	**3968**	**3959**	**3953**	**3928**	**3923**	**3902**	**3881**	**3846**	**3840**	**3824**	**3808**	**3778**	**3774**	**3767**	**3767**	**3756**	**3752**	**3773**	**3774**	**3755**	**3768**	**3758**	**3762**	**3752**	**3766**
NTS Industrial	131	131	131	143	143	143	143	150	150	150	150	150	150	150	150	150	150	150	150	150	150	150	150	150	150	150
NTS Power Generation	1250	1212	1221	1122	1085	1197	1218	1200	1255	1177	1177	1081	1147	1152	1152	1186	1186	1186	1088	1015	1015	1152	1152	1186	1186	1186
Exports via Moffat	394	404	404	404	404	404	404	404	404	404	404	404	404	404	404	404	404	404	345	345	345	404	404	404	404	404
Exports via IUK	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total NTS	**1776**	**1747**	**1756**	**1669**	**1632**	**1744**	**1766**	**1754**	**1809**	**1731**	**1731**	**1635**	**1701**	**1706**	**1706**	**1740**	**1740**	**1740**	**1583**	**1510**	**1510**	**1706**	**1706**	**1740**	**1740**	**1740**
Total	**5728**	**5715**	**5715**	**5622**	**5560**	**5667**	**5667**	**5635**	**5655**	**5571**	**5554**	**5443**	**5479**	**5480**	**5473**	**5506**	**5496**	**5491**	**5357**	**5284**	**5265**	**5474**	**5464**	**5502**	**5492**	**5505**

Figure A5.1H
***No Progression:** 1-in-20 peak day undiversified demand*

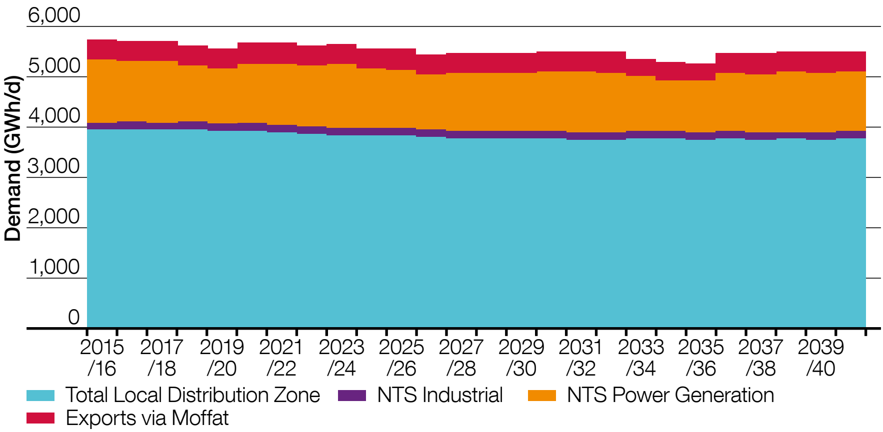
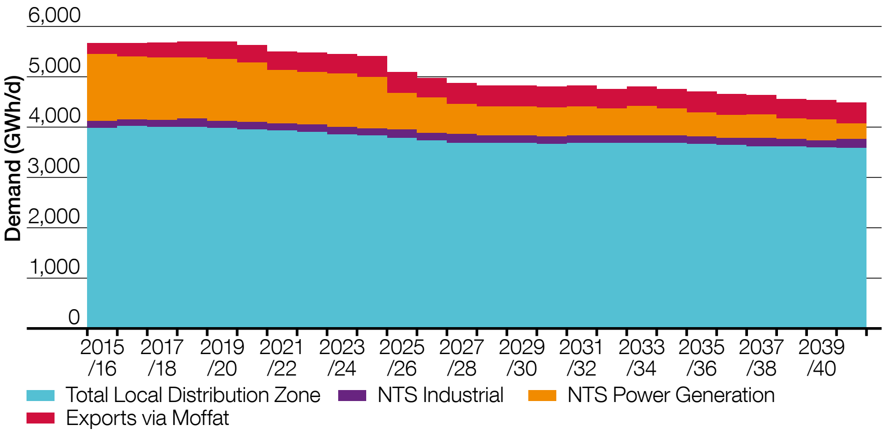


Table A5.1I
***Consumer Power**: 1-in-20 peak day undiversified demand*

National	2015/16	2016/17	2017/18	2018/19	2019/20	2020/21	2021/22	2022/23	2023/24	2024/25	2025/26	2026/27	2027/28	2028/29	2029/30	2030/31	2031/32	2032/33	2033/34	2034/35	2035/36	2036/37	2037/38	2038/39	2039/40	2040/41
Scotland	335.7	338.4	338.7	338.8	336.7	333.9	331.7	329.1	325.7	323.6	322.0	320.6	318.2	316.8	316.0	315.2	313.4	313.1	312.8	312.2	311.0	311.4	311.2	310.5	308.6	309.1
Northern	213.0	214.5	214.0	213.3	211.8	210.7	209.1	207.6	205.0	204.0	203.3	202.6	201.0	200.2	199.3	199.2	198.3	198.3	198.0	197.2	195.8	197.0	196.6	196.0	194.7	194.6
North West	477.5	480.1	479.3	478.6	474.1	471.6	467.9	464.4	458.6	456.1	454.2	452.9	449.0	447.9	446.3	445.1	442.8	443.2	442.2	440.9	438.0	439.8	439.1	437.7	434.5	435.5
North East	250.0	252.0	251.7	251.6	249.5	248.4	246.8	245.3	242.6	241.5	241.0	240.6	239.0	238.8	238.3	237.8	237.0	237.6	237.5	236.9	235.7	236.7	236.5	236.0	234.5	235.0
East Midlands	405.5	408.7	408.3	407.5	403.4	401.0	397.8	394.7	389.9	387.2	385.4	384.2	380.9	380.4	378.9	377.5	375.3	376.0	375.3	374.5	372.1	373.2	372.7	371.7	369.1	370.4
West Midlands	352.8	356.9	356.9	356.3	352.9	351.0	348.5	345.9	342.0	339.7	338.0	337.1	334.3	334.0	332.6	331.5	329.5	330.1	329.4	328.9	326.6	327.5	327.1	326.3	324.0	325.0
Wales North	43.3	44.2	44.1	44.0	43.7	43.6	43.3	43.1	42.7	42.6	42.6	42.7	42.4	42.5	42.5	42.5	42.4	42.6	42.6	42.6	42.4	42.6	42.6	42.5	42.3	42.3
Wales South	195.6	195.2	192.2	191.4	189.6	188.0	186.1	184.8	182.6	181.6	180.7	141.0	139.5	139.0	138.2	137.7	175.5	175.2	174.9	174.3	173.3	134.9	134.5	133.8	132.8	133.1
Eastern	320.8	323.6	323.7	323.7	321.0	319.5	317.3	315.1	311.3	309.9	308.6	307.9	305.5	305.2	304.2	303.5	301.6	302.5	301.9	301.3	299.4	300.6	300.1	299.4	297.1	298.4
North Thames	409.6	414.3	414.4	414.3	410.8	409.0	406.5	403.8	399.0	397.2	395.4	394.6	391.7	391.5	390.2	389.2	386.9	388.3	387.7	386.9	384.5	386.0	385.6	384.9	382.1	383.6
South East	439.3	441.5	440.9	441.5	437.2	434.5	431.4	428.0	422.3	419.7	397.2	395.7	392.2	391.4	389.6	388.1	385.3	386.1	385.2	384.0	381.4	382.7	382.0	381.1	378.3	379.6
Southern	314.5	317.4	317.7	318.1	315.7	313.9	311.9	309.9	306.2	306.0	303.7	302.3	284.3	284.2	283.3	282.6	280.8	281.4	281.1	280.4	278.8	279.9	279.5	278.8	277.1	278.1
South West	232.6	235.4	236.0	236.3	234.7	233.4	231.8	230.5	228.0	227.0	226.1	225.7	224.1	224.4	223.9	223.5	222.3	222.9	222.9	222.8	221.6	222.4	222.2	221.7	220.5	221.4
Total LDZ	**3990**	**4022**	**4018**	**4016**	**3981**	**3959**	**3930**	**3902**	**3856**	**3836**	**3798**	**3748**	**3702**	**3696**	**3683**	**3673**	**3691**	**3697**	**3691**	**3683**	**3660**	**3635**	**3630**	**3620**	**3596**	**3606**
NTS Industrial	131	131	132	150	143	143	143	150	150	150	150	150	150	150	150	150	150	150	150	150	150	150	150	150	150	150
NTS Power Generation	1325	1253	1228	1228	1227	1178	1060	1055	1055	1019	745	683	626	584	582	582	582	515	569	529	496	461	461	398	398	324
Exports via Moffat	231	274	296	311	339	351	365	367	394	404	404	404	404	404	404	404	404	404	404	404	404	404	404	404	404	404
Exports via IUK	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total NTS	**1687**	**1658**	**1656**	**1689**	**1709**	**1672**	**1569**	**1572**	**1599**	**1573**	**1299**	**1237**	**1180**	**1138**	**1136**	**1136**	**1136**	**1069**	**1123**	**1083**	**1050**	**1015**	**1015**	**952**	**952**	**878**
Total	**5677**	**5680**	**5674**	**5705**	**5690**	**5630**	**5499**	**5474**	**5455**	**5409**	**5097**	**4985**	**4882**	**4834**	**4819**	**4809**	**4827**	**4766**	**4814**	**4766**	**4710**	**4649**	**4644**	**4572**	**4547**	**4484**

Figure A5.1I
***Consumer Power**: 1-in-20 peak day undiversified demand*

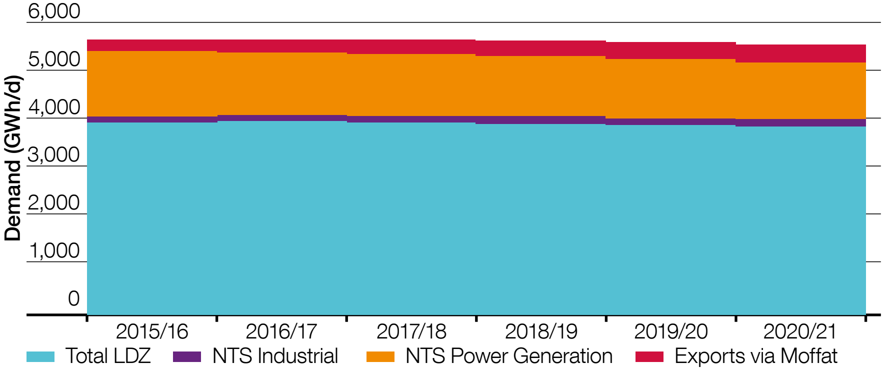


Appendix 5 **Gas demand and supply volume scenarios**

Table A5.1J
Updated Forecast: 1-in-20 peak day undiversified demand

National	2015/16	2016/17	2017/18	2018/19	2019/20	2020/21
Scotland	333.0	333.8	333.0	331.7	329.2	327.0
Northern	211.6	212.0	210.7	209.1	207.3	206.4
North West	474.3	474.5	472.0	469.2	464.2	462.3
North East	248.1	248.7	247.5	246.2	243.6	242.7
East Midlands	402.5	403.8	401.9	399.3	394.8	393.0
West Midlands	350.0	352.3	350.8	348.7	345.1	343.6
Wales North	43.0	43.6	43.2	43.0	42.5	42.3
Wales South	194.5	194.1	191.0	189.8	187.0	184.2
Eastern	318.6	319.7	318.6	317.1	314.0	312.8
North Thames	405.7	408.2	406.6	404.7	400.8	399.6
South East	437.2	437.4	435.0	433.9	431.7	430.2
Southern	312.2	313.7	312.7	311.8	309.1	307.7
South West	230.9	232.3	232.0	231.2	229.3	228.3
Total LDZ	**3961.5**	**3974.1**	**3955.0**	**3935.4**	**3898.6**	**3880.3**
NTS Industrial	131.4	131.4	131.8	143.7	137.1	137.1
NTS Power Generation	1324.5	1274.2	1274.2	1228.1	1228.1	1171.1
Exports via Moffat	231.0	273.7	296.3	310.9	339.0	350.5
Exports via IUK	0	0	0	0	0	0
Total NTS	**1687**	**1679**	**1702**	**1683**	**1704**	**1659**
Total	**5648**	**5653**	**5657**	**5618**	**5603**	**5539**

Figure A5.1J
Updated Forecast: 1-in-20 peak day undiversified demand

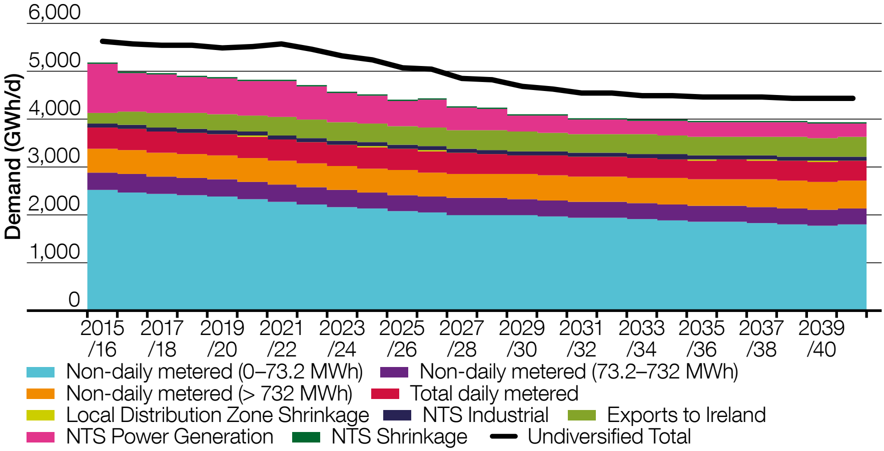


Chapter seven

Table A5.1K
***Slow Progression:** 1-in-20 peak day diversified demand*

Diversified Peak	2015/16	2016/17	2017/18	2018/19	2019/20	2020/21	2021/22	2022/23	2023/24	2024/25	2025/26	2026/27	2027/28	2028/29	2029/30	2030/31	2031/32	2032/33	2033/34	2034/35	2035/36	2036/37	2037/38	2038/39	2039/40	2040/41
Non-daily metered (0-73.2 MWh)	2528	2482	2448	2420	2377	2341	2285	2232	2171	2130	2085	2046	2014	2009	1987	1968	1943	1932	1913	1892	1867	1854	1837	1817	1792	1797
Non-daily metered (73.2-732 MWh)	372	373	368	366	361	359	357	354	348	347	345	343	341	342	340	339	337	338	338	337	335	336	336	335	333	334
Non-daily metered (> 732 MWh)	483	493	495	498	500	503	505	506	504	509	510	514	516	523	526	529	529	536	539	541	546	558	568	577	583	588
Total Non-daily metered	3384	3348	3311	3284	3238	3204	3147	3093	3024	2985	2940	2903	2872	2875	2854	2836	2809	2806	2791	2771	2747	2748	2741	2729	2708	2719
Total Daily Metered	443	446	444	444	443	444	442	440	438	440	440	440	422	402	402	403	403	404	403	404	403	408	411	413	413	414
Local Distribution Zone Shrinkage	8	8	8	8	8	7	7	7	7	7	7	7	7	7	7	6	6	6	6	6	6	6	6	5	5	5
Total LDZ	**3835**	**3803**	**3763**	**3735**	**3689**	**3655**	**3597**	**3540**	**3470**	**3432**	**3387**	**3349**	**3301**	**3283**	**3263**	**3245**	**3218**	**3216**	**3200**	**3180**	**3156**	**3162**	**3158**	**3147**	**3127**	**3139**
NTS Industrial	74	77	79	80	81	82	82	82	82	83	83	83	83	83	83	83	83	84	84	84	84	84	84	84	83	84
Exports to Ireland	231	274	296	311	339	351	365	367	394	404	404	404	404	404	404	404	404	404	404	404	404	404	404	404	404	404
NTS Power Generation	1036	826	791	761	754	727	756	709	608	594	528	576	466	451	343	342	293	301	295	293	292	283	291	300	305	294
NTS Consumption	1341	1177	1167	1152	1174	1159	1203	1157	1083	1080	1015	1063	953	938	830	829	781	789	783	781	780	771	779	788	792	781
NTS Shrinkage	12	11	9	9	9	9	9	9	9	10	10	10	10	9	9	9	10	9	9	9	10	10	9	9	9	9
Total excluding IUK	5187	4991	4939	4896	4871	4824	4809	4706	4562	4522	4411	4422	4263	4230	4103	4084	4008	4014	3992	3971	3946	3943	3947	3945	3928	3929
IUK	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total including IUK	**5187**	**4991**	**4939**	**4896**	**4871**	**4824**	**4809**	**4706**	**4562**	**4522**	**4411**	**4422**	**4263**	**4230**	**4103**	**4084**	**4008**	**4014**	**3992**	**3971**	**3946**	**3943**	**3947**	**3945**	**3928**	**3929**
Total Undiversified	5634	5581	5544	5543	5493	5525	5580	5467	5321	5258	5076	5044	4871	4836	4704	4648	4550	4547	4509	4490	4465	4472	4466	4457	4435	4446
Low power	693	348	281	234	218	195	200	166	121	107	88	95	77	72	19	20	17	16	15	16	16	15	16	16	16	16
High power	1036	920	851	910	893	892	978	1043	1001	1041	1007	1056	973	1006	909	932	832	799	791	807	796	822	816	817	810	819
Diversified Total + High Power	5187	5085	4999	5045	5011	4988	5031	5041	4955	4969	4890	4902	4770	4785	4669	4674	4547	4513	4488	4485	4450	4482	4472	4462	4433	4455
Diversified Total + Low Power	4844	4512	4429	4369	4336	4291	4253	4163	4075	4035	3971	3941	3874	3852	3778	3762	3733	3730	3713	3693	3670	3675	3671	3661	3640	3652

Figure A5.1K
***Slow Progression:** 1-in-20 peak day diversified demand*



Appendix 5 **Gas demand and supply volume scenarios**

Table A5.1L
***Gone Green:** 1-in-20 peak day diversified demand*

Diversified Peak	2015/16	2016/17	2017/18	2018/19	2019/20	2020/21	2021/22	2022/23	2023/24	2024/25	2025/26	2026/27	2027/28	2028/29	2029/30	2030/31	2031/32	2032/33	2033/34	2034/35	2035/36	2036/37	2037/38	2038/39	2039/40	2040/41
Non-daily metered (0-73.2 MWh)	2494	2400	2315	2235	2138	2072	2005	1944	1856	1792	1728	1666	1599	1552	1504	1457	1411	1382	1349	1316	1278	1252	1222	1214	1179	1179
Non-daily metered (73.2-732 MWh)	367	365	362	363	360	361	359	357	352	352	352	351	347	345	342	339	334	333	330	326	319	314	308	305	295	294
Non-daily metered (> 732 MWh)	484	493	499	505	508	519	528	537	543	557	569	580	586	596	605	608	606	610	610	608	605	608	608	616	611	613
Total Non-daily metered	3345	3258	3176	3102	3005	2952	2892	2838	2751	2702	2649	2596	2532	2493	2451	2404	2351	2325	2289	2250	2203	2175	2139	2135	2085	2086
Total Daily Metered	444	446	445	447	447	450	452	454	454	437	425	428	428	430	431	433	432	432	430	428	425	426	425	382	377	375
Local Distribution Zone Shrinkage	8	8	8	8	8	7	7	7	7	7	7	7	7	7	7	6	6	6	6	6	6	6	6	5	5	5
Total LDZ	**3797**	**3712**	**3629**	**3557**	**3460**	**3409**	**3351**	**3298**	**3213**	**3146**	**3081**	**3031**	**2967**	**2929**	**2889**	**2843**	**2790**	**2764**	**2726**	**2683**	**2633**	**2606**	**2569**	**2523**	**2467**	**2466**
NTS Industrial	73	76	78	79	78	78	78	78	78	79	79	79	79	78	78	78	78	78	78	77	76	75	74	73	71	71
Exports to Ireland	231	274	296	311	339	351	365	367	394	404	404	404	404	404	404	404	404	404	404	404	404	404	404	404	404	404
NTS Power Generation	1039	907	802	733	740	613	467	449	454	497	457	439	419	376	376	444	441	501	498	522	567	635	692	797	810	821
NTS Consumption	1343	1257	1176	1122	1157	1042	911	894	926	979	940	922	902	859	858	926	922	983	980	1003	1047	1115	1170	1273	1285	1296
NTS Shrinkage	12	11	9	9	9	9	9	9	9	10	10	10	10	9	9	9	10	9	9	9	10	10	9	9	9	9
Total excluding IUK	5151	4980	4815	4688	4626	4461	4271	4201	4148	4135	4031	3963	3879	3797	3756	3778	3722	3756	3715	3696	3690	3731	3748	3806	3762	3772
IUK	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total including IUK	**5151**	**4980**	**4815**	**4688**	**4626**	**4461**	**4271**	**4201**	**4148**	**4135**	**4031**	**3963**	**3879**	**3797**	**3756**	**3778**	**3722**	**3756**	**3715**	**3696**	**3690**	**3731**	**3748**	**3806**	**3762**	**3772**
Total Undiversified	5593	5489	5412	5367	5248	5139	5014	5006	4956	4876	4705	4593	4528	4447	4337	4255	4113	4004	3875	3770	3718	3655	3583	3501	3444	3441
Low power	693	372	291	199	184	124	79	72	68	71	68	64	61	59	22	27	33	51	70	84	103	156	235	356	404	472
High power	1039	958	874	860	906	871	874	917	981	1113	1142	1096	1115	1040	1023	1056	1024	997	938	930	967	1041	1046	1117	1111	1119
Diversified Total + High Power	**5151**	**5031**	**4887**	**4816**	**4793**	**4718**	**4679**	**4670**	**4675**	**4752**	**4716**	**4620**	**4574**	**4461**	**4403**	**4391**	**4304**	**4252**	**4155**	**4103**	**4090**	**4136**	**4103**	**4126**	**4063**	**4070**
Diversified Total + Low Power	**4806**	**4445**	**4304**	**4155**	**4070**	**3971**	**3884**	**3825**	**3762**	**3709**	**3642**	**3588**	**3520**	**3480**	**3402**	**3361**	**3314**	**3306**	**3287**	**3257**	**3225**	**3251**	**3291**	**3366**	**3355**	**3423**

Figure A5.1L
***Gone Green:** 1-in-20 peak day diversified demand*

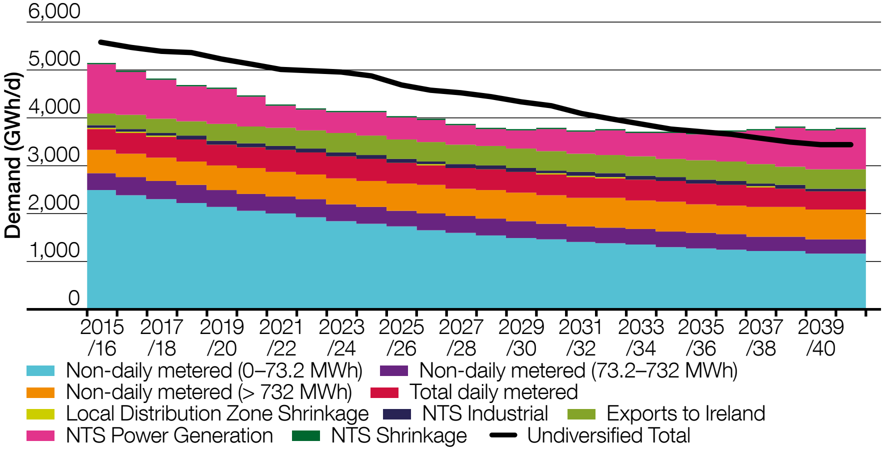
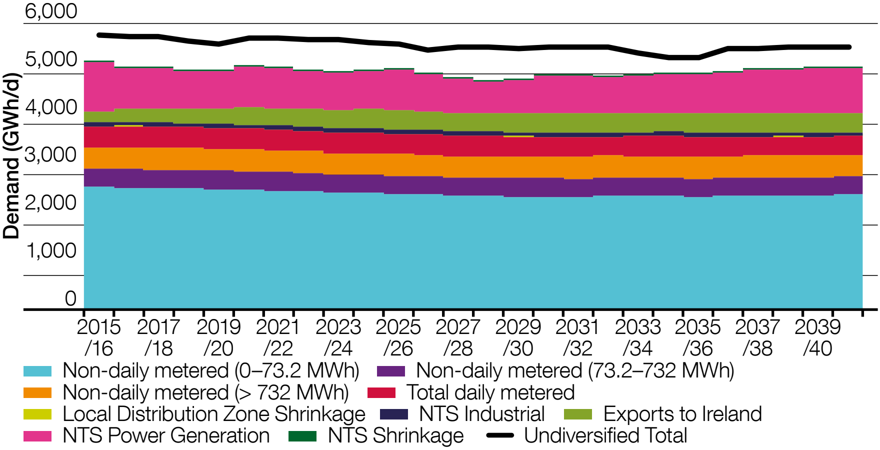


Table A5.1M
***No Progression:** 1-in-20 peak day diversified demand*

Diversified Peak	2015/16	2016/17	2017/18	2018/19	2019/20	2020/21	2021/22	2022/23	2023/24	2024/25	2025/26	2026/27	2027/28	2028/29	2029/30	2030/31	2031/32	2032/33	2033/34	2034/35	2035/36	2036/37	2037/38	2038/39	2039/40	2040/41
Non-daily metered (0-73.2 MWh)	2566	2554	2542	2536	2518	2510	2485	2472	2442	2436	2419	2404	2375	2373	2366	2364	2355	2378	2375	2379	2363	2368	2385	2388	2388	2399
Non-daily metered (73.2-732 MWh)	384	389	388	388	385	386	386	385	382	383	383	383	382	382	383	382	380	385	383	383	380	381	383	383	380	381
Non-daily metered (> 732 MWh)	449	458	457	457	454	455	455	453	450	451	450	450	450	450	450	450	448	453	451	451	448	449	452	453	450	452
Total Non-daily metered	3399	3401	3387	3380	3357	3351	3326	3309	3275	3271	3252	3237	3207	3206	3199	3196	3183	3215	3209	3213	3191	3199	3219	3223	3218	3232
Total Daily Metered	434	438	434	433	430	431	428	426	424	423	423	422	420	419	419	418	417	396	414	415	412	412	396	395	392	392
Local Distribution Zone Shrinkage	8	8	8	8	8	7	7	7	7	7	7	7	7	7	7	6	6	6	6	6	6	6	6	5	5	5
Total LDZ	**3841**	**3847**	**3828**	**3821**	**3795**	**3790**	**3762**	**3743**	**3706**	**3701**	**3682**	**3667**	**3633**	**3632**	**3624**	**3620**	**3606**	**3617**	**3629**	**3633**	**3609**	**3616**	**3621**	**3624**	**3616**	**3629**
NTS Industrial	74	78	79	80	80	82	83	83	83	85	85	85	86	86	86	86	86	86	86	85	85	85	86	85	85	85
Exports to Ireland	231	274	296	311	339	351	365	367	394	404	404	404	404	404	404	404	404	404	404	404	404	404	404	404	404	404
NTS Power Generation	1034	860	849	785	764	852	831	782	786	787	850	774	708	662	696	772	785	765	783	791	812	860	904	922	940	943
NTS Consumption	1340	1212	1224	1176	1184	1284	1279	1232	1264	1275	1339	1263	1198	1152	1186	1262	1275	1255	1273	1281	1301	1349	1394	1412	1428	1432
NTS Shrinkage	12	11	9	9	9	9	9	9	9	10	10	10	10	9	9	9	10	9	9	9	10	10	9	9	9	9
Total excluding IUK	5193	5069	5062	5006	4988	5082	5051	4984	4979	4986	5030	4939	4841	4793	4820	4892	4891	4882	4911	4923	4919	4975	5024	5045	5053	5071
IUK	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total including IUK	**5193**	**5069**	**5062**	**5006**	**4988**	**5082**	**5051**	**4984**	**4979**	**4986**	**5030**	**4939**	**4841**	**4793**	**4820**	**4892**	**4891**	**4882**	**4911**	**4923**	**4919**	**4975**	**5024**	**5045**	**5053**	**5071**
Total Undiversified	5728	5715	5715	5622	5560	5667	5667	5635	5655	5571	5554	5443	5479	5480	5473	5506	5496	5491	5357	5284	5265	5474	5464	5502	5492	5505
Low power	693	334	315	260	223	267	251	232	233	231	263	207	168	155	171	189	198	203	221	244	255	276	318	346	371	394
High power	1034	891	887	872	845	938	1022	1008	1006	1039	1160	1130	1111	1128	1171	1237	1240	1239	1246	1157	1170	1209	1229	1239	1246	1261
Diversified Total + High Power	**5193**	**5100**	**5100**	**5093**	**5068**	**5168**	**5242**	**5210**	**5198**	**5238**	**5340**	**5296**	**5244**	**5259**	**5295**	**5357**	**5346**	**5356**	**5374**	**5289**	**5277**	**5324**	**5348**	**5361**	**5360**	**5388**
Diversified Total + Low Power	**4852**	**4543**	**4528**	**4481**	**4446**	**4497**	**4471**	**4434**	**4426**	**4430**	**4443**	**4372**	**4301**	**4286**	**4295**	**4308**	**4304**	**4320**	**4348**	**4376**	**4362**	**4391**	**4438**	**4468**	**4485**	**4522**

Figure A5.1M
***No Progression:** 1-in-20 peak day diversified demand*



Appendix 5 **Gas demand and supply volume scenarios**

Table A5.1N
***Consumer Power:** 1-in-20 peak day diversified demand*

Diversified Peak	2015/16	2016/17	2017/18	2018/19	2019/20	2020/21	2021/22	2022/23	2023/24	2024/25	2025/26	2026/27	2027/28	2028/29	2029/30	2030/31	2031/32	2032/33	2033/34	2034/35	2035/36	2036/37	2037/38	2038/39	2039/40	2040/41
Non-daily metered (0-73.2 MWh)	2557	2538	2520	2503	2455	2420	2379	2346	2299	2269	2253	2259	2236	2225	2210	2195	2143	2136	2124	2111	2092	2118	2108	2094	2073	2081
Non-daily metered (73.2-732 MWh)	404	419	423	428	430	434	438	440	438	440	442	448	449	450	450	450	444	448	450	450	448	457	458	458	456	458
Non-daily metered (> 732 MWh)	470	488	491	496	498	503	508	511	511	517	522	531	535	540	542	546	544	552	557	560	560	572	576	579	579	581
Total Non-daily metered	3431	3445	3434	3427	3383	3358	3325	3298	3249	3226	3216	3238	3220	3215	3202	3191	3131	3137	3131	3121	3100	3147	3142	3131	3109	3120
Total Daily Metered	441	450	448	449	449	451	450	450	450	452	433	395	378	379	379	381	421	423	424	425	424	389	390	390	389	389
Local Distribution Zone Shrinkage	8	8	8	8	8	7	7	7	7	7	7	7	7	7	7	6	6	6	6	6	6	6	6	5	5	5
Total LDZ	**3880**	**3903**	**3890**	**3883**	**3840**	**3817**	**3783**	**3755**	**3706**	**3685**	**3656**	**3640**	**3605**	**3601**	**3588**	**3578**	**3558**	**3566**	**3561**	**3552**	**3530**	**3541**	**3537**	**3527**	**3503**	**3514**
NTS Industrial	74	77	78	79	80	80	80	80	80	81	81	81	82	82	82	83	83	84	85	85	86	86	87	87	86	87
Exports to Ireland	231	274	296	311	339	351	365	367	394	404	404	404	404	404	404	404	404	404	404	404	404	404	404	404	404	404
NTS Power Generation	1032	907	786	805	742	626	524	461	542	561	467	357	346	312	289	270	287	220	254	284	228	197	200	168	167	161
NTS Consumption	1338	1258	1160	1195	1161	1057	970	908	1016	1045	953	842	832	798	775	757	774	709	743	773	718	687	690	659	657	652
NTS Shrinkage	12	11	9	9	9	9	9	9	9	10	10	10	10	9	9	9	10	9	9	9	10	10	9	9	9	9
Total excluding IUK	5229	5171	5060	5087	5010	4882	4762	4672	4731	4740	4619	4492	4446	4407	4372	4344	4342	4284	4314	4334	4258	4238	4237	4194	4169	4175
IUK	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total including IUK	**5229**	**5171**	**5060**	**5087**	**5010**	**4882**	**4762**	**4672**	**4731**	**4740**	**4619**	**4492**	**4446**	**4407**	**4372**	**4344**	**4342**	**4284**	**4314**	**4334**	**4258**	**4238**	**4237**	**4194**	**4169**	**4175**
Total Undiversified	5677	5680	5674	5705	5690	5630	5499	5474	5455	5409	5097	4985	4882	4834	4819	4809	4827	4766	4814	4766	4710	4649	4644	4572	4547	4484
Low power	693	332	280	235	185	127	95	77	89	92	76	62	59	58	57	57	57	10	11	12	10	10	10	11	10	11
High power	1032	907	857	920	888	919	903	835	961	1012	964	946	948	921	917	882	853	785	774	735	669	665	672	614	613	613
Diversified Total + High Power	**5229**	**5171**	**5131**	**5202**	**5156**	**5175**	**5141**	**5046**	**5151**	**5192**	**5116**	**5081**	**5048**	**5016**	**5001**	**4956**	**4908**	**4849**	**4834**	**4785**	**4698**	**4706**	**4710**	**4641**	**4615**	**4627**
Diversified Total + Low Power	**4890**	**4597**	**4554**	**4516**	**4453**	**4383**	**4333**	**4288**	**4278**	**4271**	**4227**	**4197**	**4159**	**4154**	**4141**	**4131**	**4112**	**4074**	**4070**	**4062**	**4040**	**4051**	**4048**	**4037**	**4013**	**4025**

Figure A5.1N
***Consumer Power:** 1-in-20 peak day diversified demand*

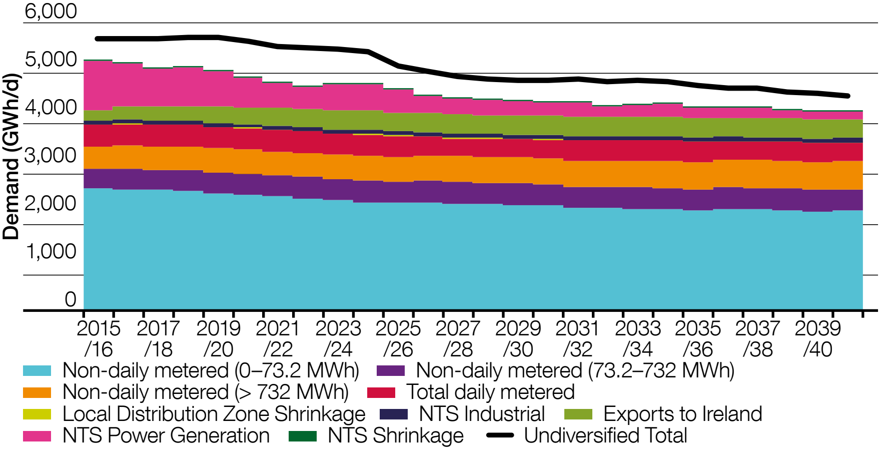
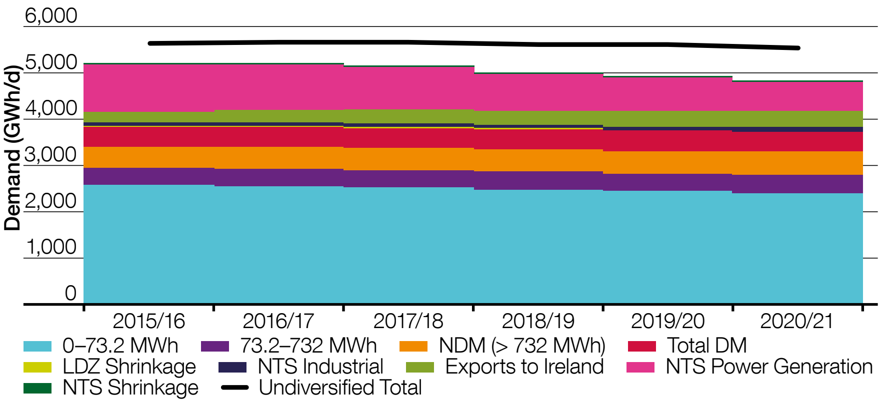


Table A5.10
Updated Forecast: 1-in-20 peak day diversified demand

Diversified Peak	2015/16	2016/17	2017/18	2018/19	2019/20	2020/21
Non-daily metered (0-73.2 MWh)	2580	2554	2520	2492	2446	2417
Non-daily metered (73.2-732 MWh)	372	380	384	390	393	400
Non-daily metered (> 732 MWh)	456	469	472	474	474	479
Total Non-daily metered	3408	3403	3376	3355	3313	3296
Total Daily Metered	435	442	440	440	440	441
Local Distribution Zone Shrinkage	8	8	8	8	8	7
Total LDZ	**3851**	**3853**	**3824**	**3803**	**3760**	**3744**
NTS Industrial	74	77	79	80	81	82
Exports to Ireland	231	274	296	311	339	351
NTS Power Generation Generation	1034	878	813	794	741	629
NTS Consumption	1339	1229	1189	1185	1161	1061
NTS Shrinkage	12	11	9	9	9	9
Total excluding IUK	5202	5093	5022	4997	4930	4814
IUK	0	0	0	0	0	0
Total including IUK	**5202**	**5093**	**5022**	**4997**	**4930**	**4814**
Total Undiversified	5648	5653	5657	5618	5603	5539
Low power	693	352	295	242	193	138
High power	1034	933	871	899	876	830
Diversified Total + High Power	**5202**	**5148**	**5079**	**5102**	**5065**	**5015**
Diversified Total + Low Power	**4861**	**4567**	**4504**	**4445**	**4382**	**4323**

Figure A5.10
Updated Forecast: 1-in-20 peak day diversified demand



Appendix 5 **Gas demand and supply volume scenarios**

5.2
Supply

Figure A5.2A
Peak Bacton scenarios (mcm/d)

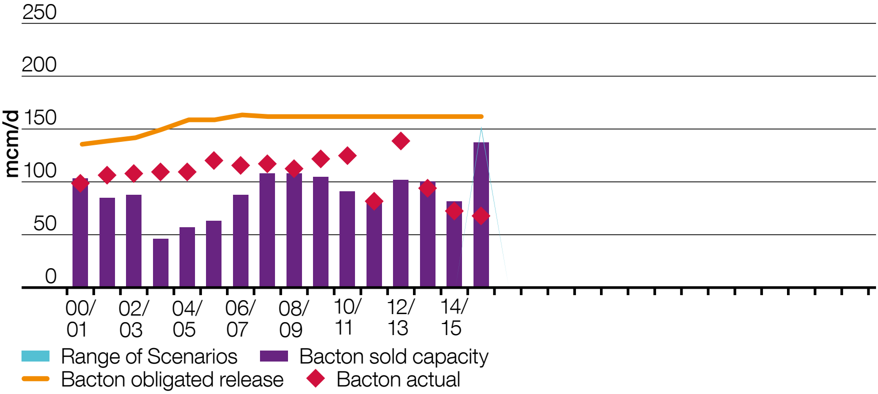


Figure A5.2B
Peak Barrow scenarios (mcm/d)

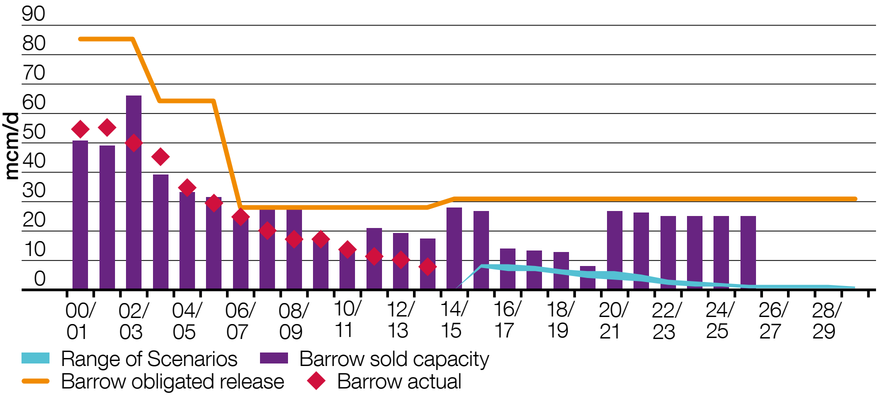


Figure A5.2C
Peak Easington scenarios (mcm/d)

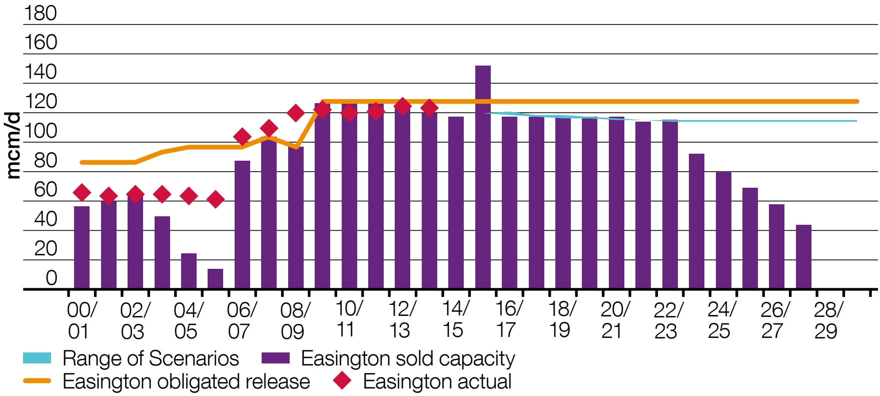
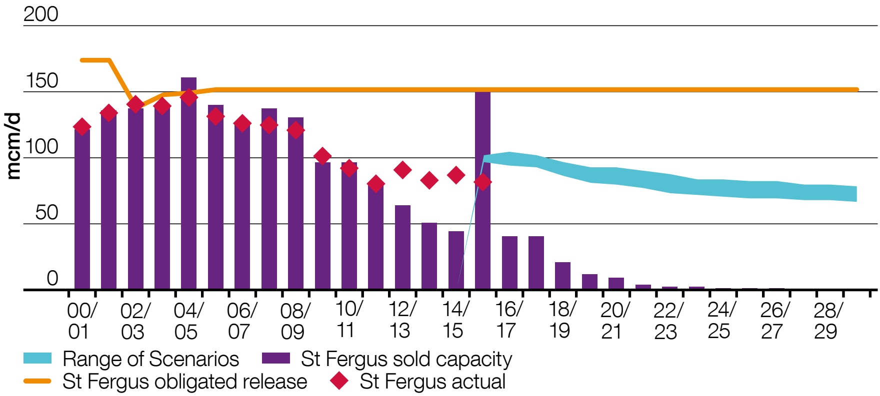


Figure A5.2D
Peak St. Fergus scenarios (mcm/d)



Appendix 5 **Gas demand and supply volume scenarios**

Figure A5.2E
Peak Teesside scenarios (mcm/d)

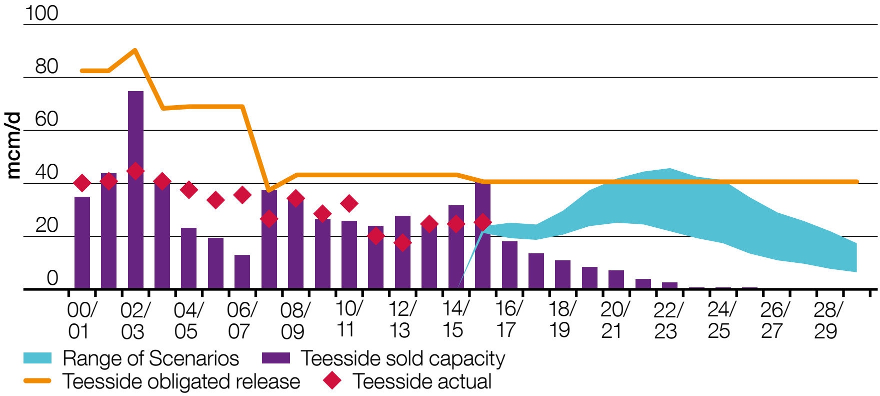


Figure A5.2F
Peak Theddlethorpe scenarios (mcm/d)

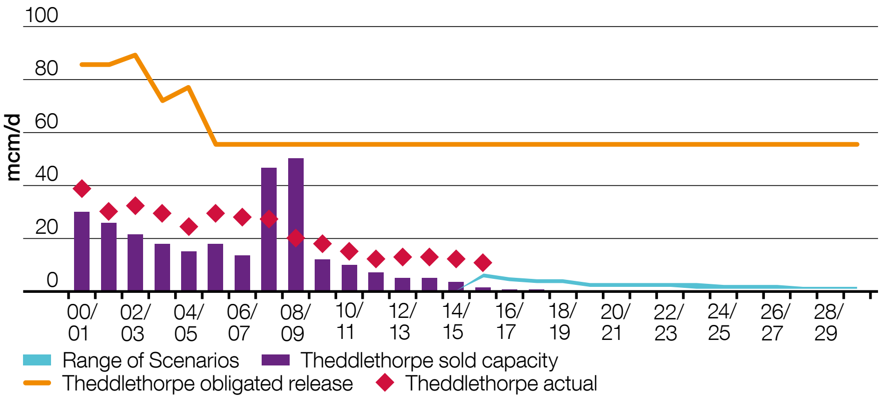


Figure A5.2G
Peak Grain LNG scenarios (mcm/d)

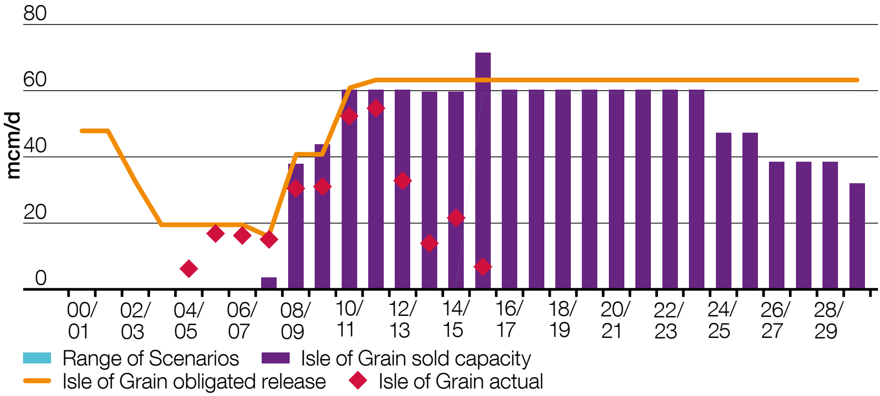
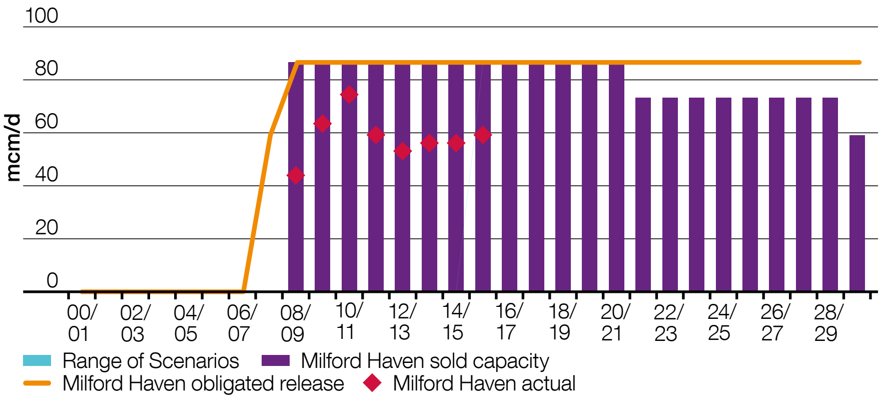


Figure A5.2H
Peak Milford Haven scenarios (mcm/d)



Appendix 5 **Gas demand and supply volume scenarios**

Figure A5.2I
*Annual supply by terminal. **Gone Green** high continent/low LNG case*

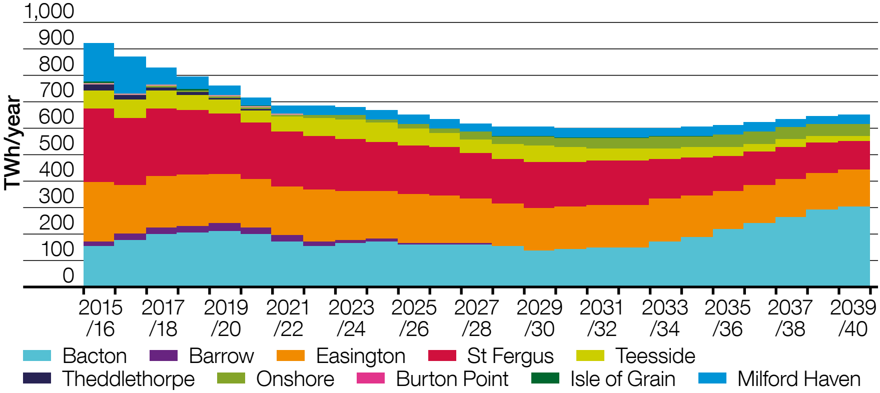


Figure A5.2J
*Annual supply by terminal. **Gone Green** low continent/high LNG case*

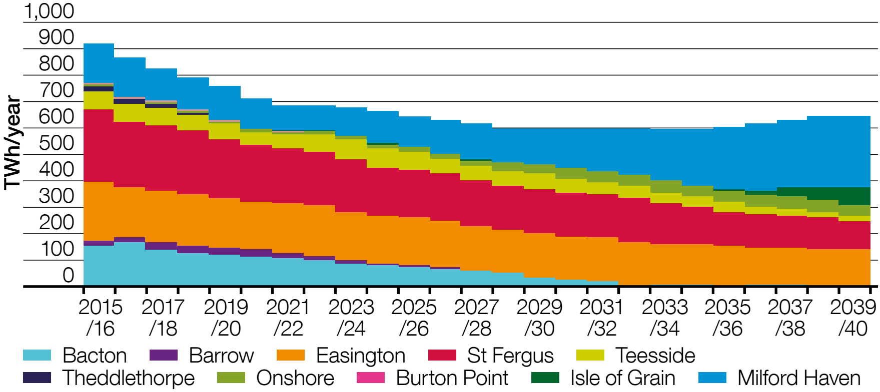


Figure A5.2K
Peak supply by terminal. ***Gone Green***

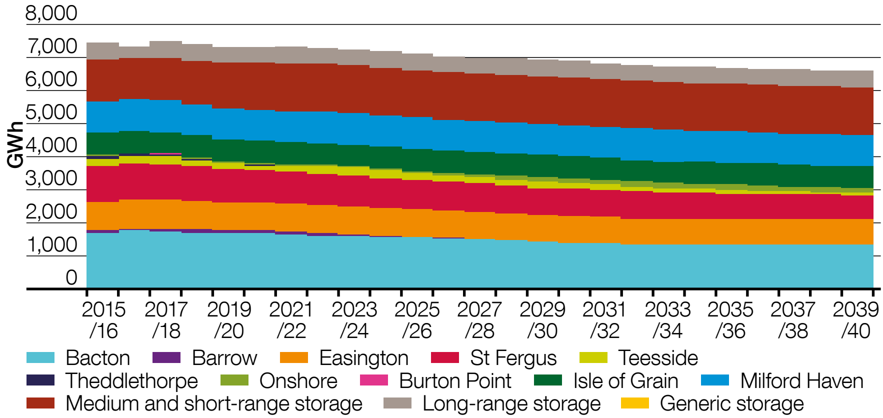
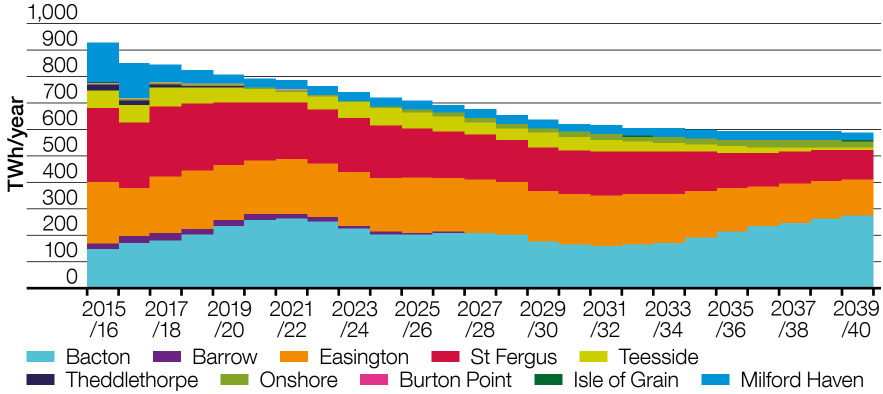


Figure A5.2L
Annual supply by terminal. ***Slow Progression*** *high continent/low LNG case*



Appendix 5 **Gas demand and supply volume scenarios**

Figure A5.2M
*Annual supply by terminal. **Gone Green** high continent/low LNG case*

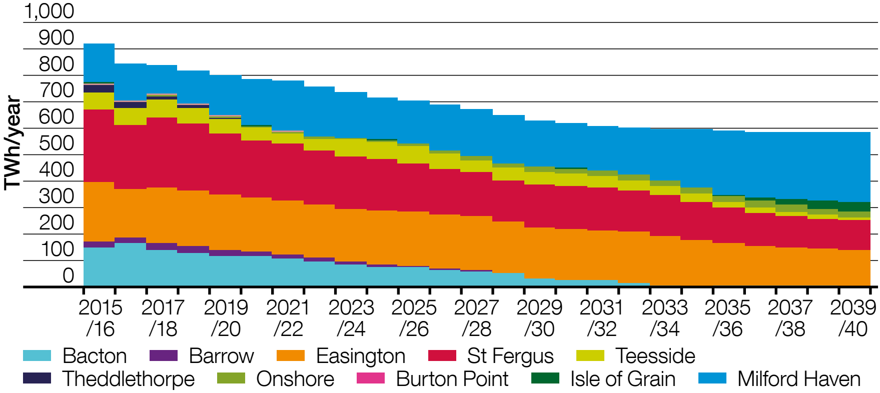


Figure A5.2N
*Peak supply by terminal. **Slow Progression***

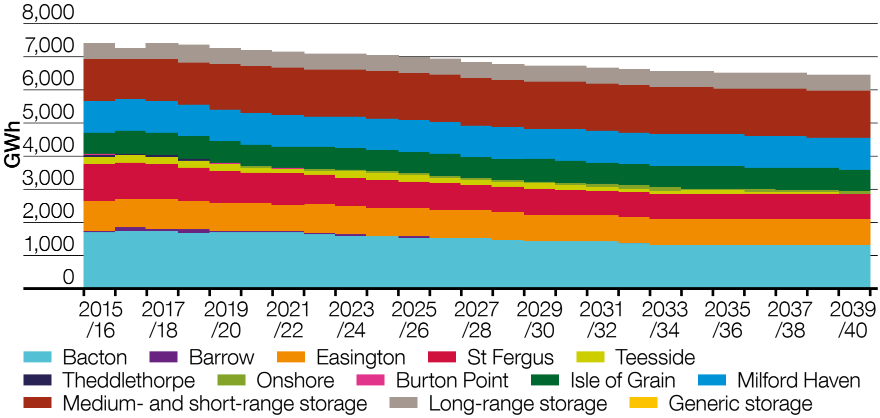


Figure A5.2O
*Annual supply by terminal. **No Progression** high continent/low LNG case*

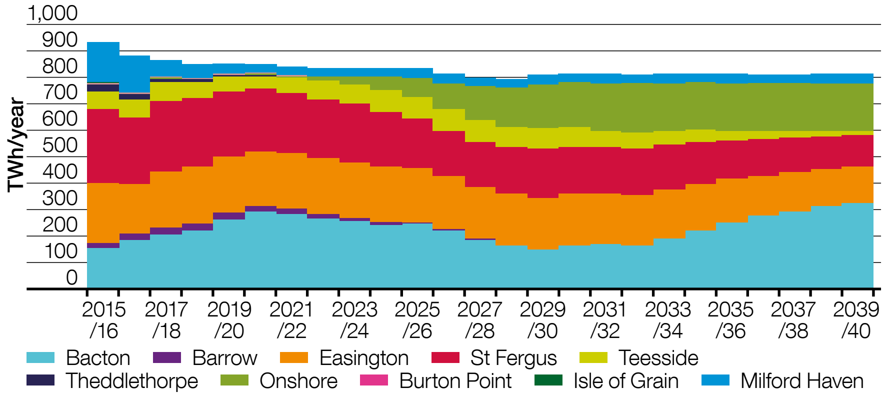
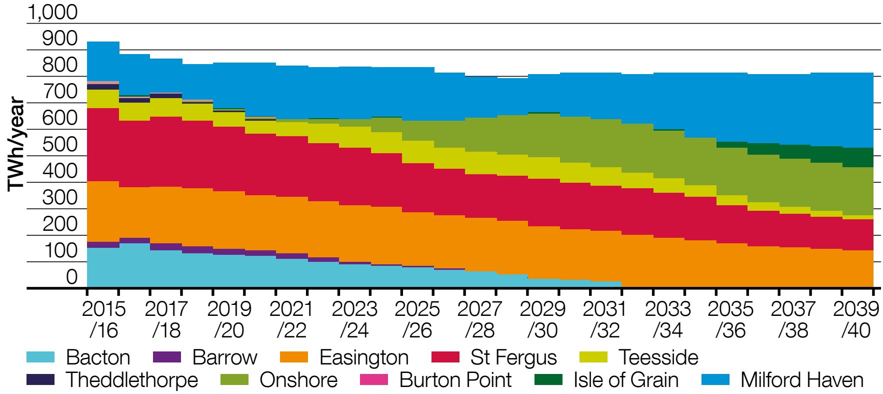


Figure A5.2P
*Annual supply by terminal. **No Progression** low continent/high LNG case*



Appendix 5 **Gas demand and supply volume scenarios**

Figure A5.2Q
*Peak supply by terminal. **No Progression***

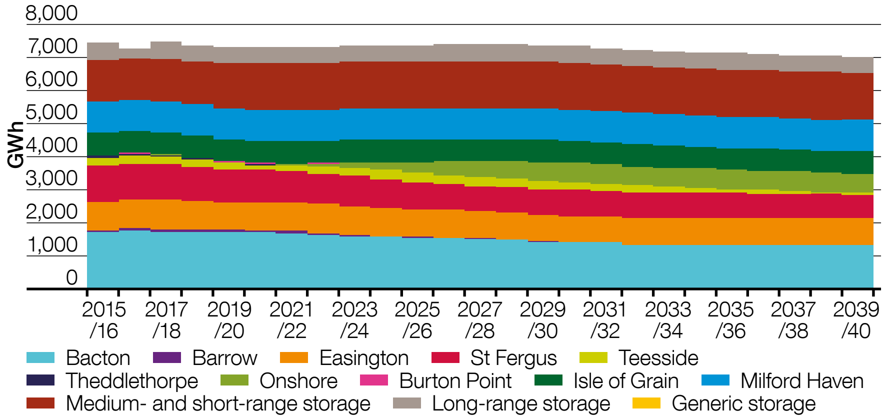


Figure A5.2R
*Annual supply by terminal. **Consumer Power** high continent/low LNG case*

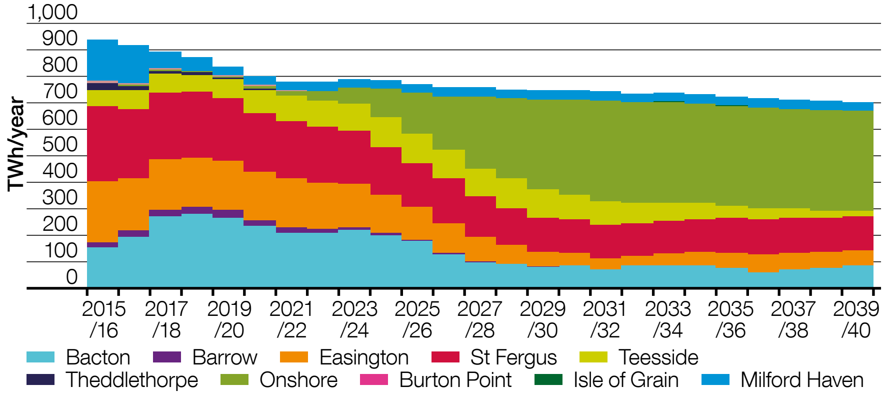


Figure A5.2S
*Annual supply by terminal. **Consumer Power** low continent/high LNG case*

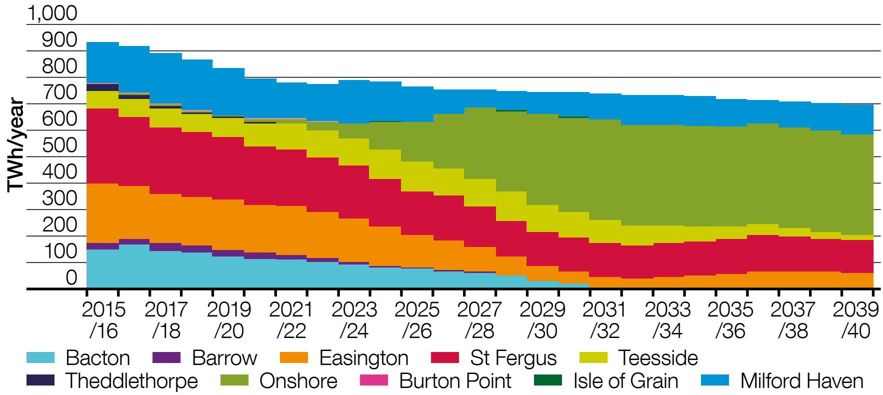
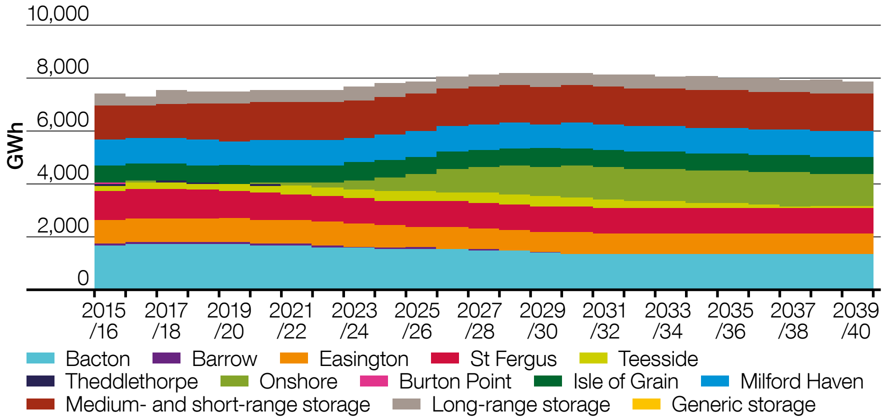
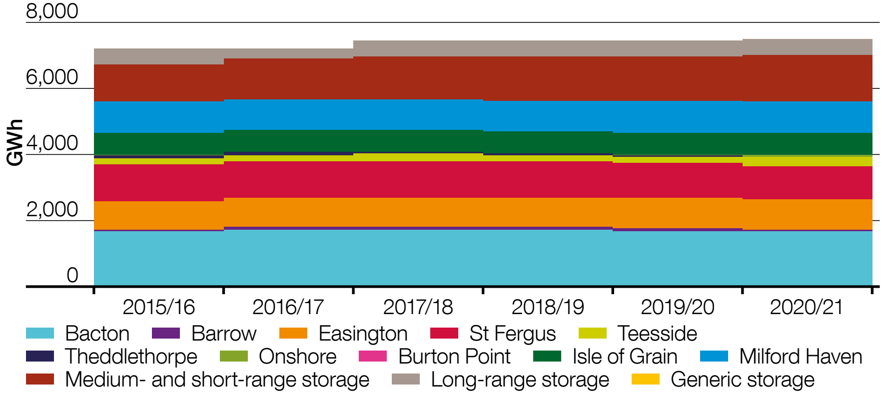


Figure A5.2T
*Peak supply by terminal. **Consumer Power***



Appendix 5 **Gas demand and supply volume scenarios**

Figure A5.2U
Peak supply by terminal. Updated forecast



5.3
UK importation projects

While there are proposals for further import projects, currently no importation projects are under construction. The UK's import capacity is currently around 152 bcm/y. This is split into three near equal sources: the Continent (46 bcm/y), Norway (56 bcm/y)[1] and LNG (49 bcm/y). The UK is served through a diverse set of import routes from Norway, Holland, Belgium and from other international sources through the LNG importation terminals.

Table 5.3A shows existing UK import infrastructure and Table 5.3B shows proposals for further import projects.

Table 5.3A
Existing UK import infrastructure

Project	Operator/Developer	Type	Location	Capacity (bcm/y)
Interconnector	IUK	Pipeline	Bacton	26.9
BBL Pipeline	BBL Company	Pipeline	Bacton	19.5
Isle of Grain 1-3	National Grid	LNG	Kent	20.4
South Hook 1-2	Qatar Petroleum and ExxonMobil	LNG	Milford Haven	21
Dragon 1	Shell/Petronas	LNG	Milford Haven	7.6
Langeled	Gassco	Pipeline	Easington	26.3
Vesterled	Gassco	Pipeline	St Fergus	14.2
Tampen	Gassco	Pipeline	St Fergus	9.8
Gjoa	Gassco	Pipeline	St Fergus	6.2
			Total	**152**

Source: National Grid

[1] Norwegian import capacity through Tampen and Gjøa is limited by available capacity in the UK FLAGS pipeline.

Appendix 5 **Gas demand and supply volume scenarios**

Table 5.3B
Proposed UK import projects[2]

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

Source: National Grid

Please note Tables 5.3A and 5.3B represent the latest information available to National Grid at time of going to press. Developers are welcome to contact us to add to or revise this data.

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

5.4
UK storage projects

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

Table 5.4A
Existing UK storage

Project	Operator/ Developer	Location	Space (bcm)	Approximate max delivery (mcm/d)
Rough	Centrica Storage Limited	Southern North Sea	3.3	41
Aldborough	SSE/Statoil	East Yorkshire	0.3	40
Hatfield Moor	Scottish Power	South Yorkshire	0.07	1.8
Holehouse Farm	EDF Trading	Cheshire	0.022	5
Holford	E.ON	Cheshire	0.2	22
Hornsea	SSE	East Yorkshire	0.3	18
Humbly Grove	Humbly Grove Energy	Hampshire	0.3	7
Hill Top Farm	EDF Energy	Cheshire	0.05	12
Stublach	Storenergy	Cheshire	0.2	15
		Total	**4.7**	**162**

Source: National Grid

Note, due to operational considerations, the space and deliverability will not be fully consistent with that used for operational planning as reported in our 2016/17 *Winter Outlook Report*. In particular the values for Rough do not reflect the reduced space and deliverability in winter 2016/17 due to outage. The values shown should be regarded as indicative of capacity that could be returned to service following completion of testing by Centrica Storage Ltd.

Over the last few years, a number of projects have been put on hold or cancelled. These include Aldborough 2, Baird, Caythorpe and Portland. Table 5.4B shows other proposed storage sites.

Appendix 5 Gas demand and supply volume scenarios

Table 5.4B
Proposed storage[3]

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

Source: National Grid

Please note Tables 5.4A–5.4B represent the latest information available to National Grid at the time of going to press. Developers are welcome to contact us to add to or revise this data.

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

Appendix 6 **EU activity**

6.1 Our activity to date

In Chapter 2.4.2 we discussed the European Union (EU) Third Package of energy legislation which was introduced in 2009. Over the last six years, we have been working with the European Network of Transmission System Operators for Gas (ENTSOG), the European Commission, the Agency for the Cooperation of Energy Regulators (ACER), Ofgem, the UK Government, other Transmission System Operators (TSOs) and the industry to enable the development of several EU gas Network Codes (Capacity Allocation Mechanism (CAM), Balancing (BAL) Interoperability and Data Exchange (INT) and Tariffs (TAR)).

We have influenced the EU Code developments and supported the industry and our customers, through a process of extensive dialogue involving stakeholder working sessions, technical workshops and a number of consultations.

We have changed our contractual arrangements with other TSOs at Bacton (connecting to Belgium and the Netherlands) and at Moffat (connecting Northern Ireland and the Republic of Ireland to Great Britain) to ensure we comply with the new legislation.

Since 1 October 2015 the UK market aligned to the EU standard gas day of 5am to 5am. This facilitated the operation of the BAL and CAM codes from 1 October 2015 and 1 November 2015 respectively. Elements of the INT code were also implemented from 1 October 2015.

In early 2016 we met with adjacent TSOs at Bacton and Moffat to discuss, analyse and agree the amount of available capacity at Interconnection Points (IP) that would be offered in the annual yearly capacity auction held in March 2016. This was in accordance with article 6 of CAM and we will continue to meet at least once a year for this purpose.

From 7 April 2016, National Grid began reporting information on nominations and primary capacity allocations for the GB system in accordance with the requirements of the Implementating Regulation for the Regulation on Wholesale Market Integrity and Transparency (REMIT).

On 1 May 2016 a programme of IT system changes was delivered. This was partly to complete implementation of the INT code, which included:

- Change to Gemini system following Modification 0519 (manage the impact for shipper nominations and allocations at Bacton).
- A new data exchange solution in line with the INT Code requirements to enable shippers to submit nominations and receive confirmed quantities at interconnection points in the Edigas format over the internet.
- Disapplication of scheduling charges in respect of interconnection points as implemented by Modification 0510V.
- Additional transparency requirements in respect of capacity data and hourly flow at interconnection points.
- Amendments to the functionality in the Gemini system to allow it to send within-day capacity and tariff values to the European gas capacity trading platform PRISMA.

Appendix 6 **EU activity**

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

- **a** 0449 (Introduction of Interconnection Points and new processes and transparency requirements to facilitate compliance with the EU Congestion Management Procedures). Implemented with effect from 6:00am on 1 October 2013; it is superseded by text introduced under 0500.
- **b** 0461 (Changing the UNC Gas Day to Align with Gas Day under EU Network Codes). Implemented with effect from 5:00am on 1 October 2015.
- **c** 0485 (Introduction of Long-term use-it-or-lose-it mechanism to facilitate compliance with EU Congestion Management Procedures). Implemented with effect from 6:00am on 30 September 2014; it is superseded by text introduced under 0500.
- **d** 0489 (EU Gas Balancing Code – Information Provision changes required to align the UNC with the EU Code). Implemented with effect from 5:00am on 1 October 2015.
- **e** 0493 (EU Gas Balancing Code Daily Nominations at Interconnection Points (IP)). Implemented with effect from 6:00am on 19 June 2015.
- **f** 0494 (Imbalance Charge amendments required to align the UNC with the Network Code on Gas Balancing of Transmission Networks). Implemented with effect from 5:00am on 1 October 2015.
- **g** 0500 (EU Capacity Regulations Capacity Allocation Mechanisms with Congestion Management Procedures). Implemented with effect from 6:00am on 19 June 2015.
- **h** 0501V (Treatment of Existing Entry Capacity Rights at the Bacton ASEP to comply with EU Capacity Regulations). Implemented with effect from 6:00am on 21 July 2015. The process established by this modification (for allocation of capacity held by shippers between the new ASEPs at Bacton) was completed on 28 August 2015.
- **i** 0510V (Reform of Gas Allocation Regime at GB Interconnection Points). Implemented with effect from 5:00am on 1 October 2015.
- **j** 0519 (Harmonisation of Reference Conditions at Interconnection Points). Implemented with effect from 5:00am on 1 October 2015.
- **k** 0525 (Enabling EU-compliant Interconnection Agreements). Implemented with effect from 5:00am on 1 October 2015.
- **l** 0546S (Reduction of the Minimum Eligible Quantity (100,000kWh) for European IP capacity).
- **m** 0547S (Corrections to the EID arising from implementation of Modifications 0493/0500).

6.2
Our future activity

A number of codes/changes are currently going through the comitology[4] process involving EU Member States and the Commission. We expect these to come into force in 2017. We anticipate that a number of changes to GB arrangements will be required to deliver these codes/changes between 2017 and 2019. Once the codes/changes and timelines have been confirmed under the EU processes we will confirm our delivery plans.

6.2.1
2017 onwards

Based on our current understanding the codes/changes to be implemented are as follows:

- An EU-wide Network Code on Harmonised Transmission Tariff Structures for Gas which we anticipate needing to be implemented by end 2018/early 2019 for use in 2019. This code will include rules for the application of a reference price methodology for the calculation of reserve prices for standard capacity products, as well as the associated consultation and publication requirements.
- An amendment proposal to the Network Code on Capacity Allocation Mechanisms (CAM). This will be an amendment to Commission Regulation (EU) No 984/2013 which aims to introduce a process for the release of incremental capacity at interconnection points. Some other (non-incremental) changes are also proposed as part of the amendment e.g. rules affecting the release of interruptible capacity at IPs. We anticipate the CAM amendments to come into effect from April 2017, although some changes have implementation timeframes that go beyond 2017.
- Transparency: additional transparency requirements need to be published throughout this period.

[4] Comitology refers to a set of procedures through which EU countries control how the European Commission implements EU law.

Appendix 7
Network Development Process

The following table outlines the criteria we use to prioritise all of the options considered as part of our Network Development Process (NDP). The scoring from the Whole Life Prioritisation Model aids our decision-making process and allows us to discount unsuitable options at an early stage of the NDP.

We use the Whole Life Prioritisation Model twice: once during the Need Case stage and then again at the end of the Establish Portfolio stage of our NDP. The model is used to rank the wide range of options identified during the Need Case process. At the end of this ranking process we have a narrower range of options to investigate in more detail during the Establish Portfolio stage. We use the model criteria again to rank the narrower range of options once more detailed costs and other information is available.

Criteria	Description	
Does this option allow National Grid to meet future flexibility requirements?	Reduces system flexibility and will impact users' current requirements.	Reduces system flexibility and may impact users' future requirements.
Does this option remove barrier for encouraging new investment?	Will reduce network capability and how the NTS is currently used and will create a barrier to new investment.	Will reduce network capability and may create a barrier to new investment.
Does this option have a negligible impact on customer charges?	The cost is in excess of £100 million.	The cost is between £50–£100 million.
Is this option future proof? (flexibility is covered above so this deals with legislation i.e. BREF and MCP)	When future legislation is implemented will need to revisit.	It is likely that when future legislation is implemented will need to revisit.
Can National Grid meet Exit Capacity obligations considering this option?	Existing obligations that users currently require will not be able to be met.	Existing obligations that users may require to use in the future will not be met.
Does this option allow National Grid to retain current capability?	Will reduce capability and impact how the NTS is currently used.	Capability reduced to a level insufficient to meet sold capacity and /or FES levels.
Does this option represent an appropriate level of resilience on the network?	Does not provide resilience for the loss of the largest credible unit(s) at the station.	Reduces resilience considering the loss of units at interacting stations, where the affected units are currently next in line.
Can National Grid meet Entry Capacity obligations considering this option?	Existing obligations that users currently require will not be able to be met.	Existing obligations that users may require to use in the future will not be met.
Does this option allow the network to be operated in sensitivities beyond FES?	FES cannot be met.	Significantly reduces capability to exceed FES.

The criteria included in the model help us to determine which option is the most robust and should be taken forward to the next stages of our NDP – Select Option, Develop and Sanction. The definition of current capability now references sold and FES levels and assesses each option against the ability to meet these.

Reduces system flexibility, but this is unlikely to affect users' future requirements.	Provides similar level of system flexibility as the existing situation.	Increases the system flexibility to assist in meeting users' future requirements.
Will reduce network capability, but unlikely to be a barrier to new investment.	Maintains network capability – no impact on new investment.	Increases network capability, facilitating new investment.
The cost is between £20–£50 million.	The cost is between £10–£20 million.	The cost is <£10 million.
May need to be revisited when future legislation is implemented.	Although there is some interaction with future legislation should not require revisiting.	Ability to respond to future legislation.
Existing obligations that users are unlikely to use in the future will not be met.	The ability to meet existing obligations is maintained.	Increases the ability to meet existing obligations.
Capability reduced to potentially be insufficient to meet sold capacity and/or FES levels.	Sufficient capability to meet sold capacity and /or FES levels.	Increased capability to meet sold capacity and/or FES levels.
Reduces resilience for the loss of units at interacting stations, where the affected units are not currently first in line.	Provides similar level of resilience as the existing situation.	Increases the resilience of the network.
Existing obligations that users are unlikely to use in the future will not be met.	Ability to meet existing obligations is maintained.	Increases the ability to meet existing obligations.
Reduces capability to exceed FES.	Provides similar capability as the existing situation to exceed FES.	Enhances the ability over the existing situation to exceed FES.

Appendix 8
Conversion matrix

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

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

Note: all volume to energy conversions assume a calorific value (CV) of 39.6 MJ/m^3

GWh = Gigawatt hours
mcm = Million cubic metres
Thousand toe = Thousand tonne of oil equivalent
MJ/m^3 = One million joules per metre cubed

Appendix 9
Glossary

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

Appendix 9
Glossary

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

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

Appendix 9
Glossary

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

Acronym	Term	Definition
IPPC	Integrated Pollution Prevention & Control Directive 1999	Emissions from our installations are subject to EU wide legislation; the predominant legislation is the Integrated Pollution Prevention & Control (IPPC) Directive 1999, the Large Combustion Plant Directive (LCPD) 2001 and the Industrial Emissions Directive (IED) 2010. The requirements of these directives have now been incorporated into the Environmental Permitting (England and Wales) (Amendment) Regulations 2013 (with similar regulations applying in Scotland). IPPC aims to reduce emissions from industrial installations and contributes to meeting various environment policy targets and compliance with EU directives. Since 31 October 2000, new installations are required to apply for an IPPC permit. Existing installations were required to apply for an IPPC permit over a phased timetable until October 2007.
IUK	Interconnector (UK)	A bi-directional gas pipeline between Bacton in the UK and Zeebrugge Belgium. **http://www.interconnector.com**
KWh	Kilowatt hour	A unit of energy used by the gas industry. Approximately equal to 0.0341 therms. One Megawatt hour (MWh) equals 1000 kWh, one Gigawatt hour (GWh) equals 1000 MWh, and one Terawatt hour (TWh) equals 1000 GWh.
LCP	Large Combustion Plant (Directive)	The Large Combustion Plant (LCP) directive is a European Union Directive which introduced measures to control the emissions of sulphur dioxide, oxides of nitrogen and dust from large combustion plant, including power stations.
LDZ	Local Distribution Zone	A gas distribution zone connecting end users to the (gas) National Transmission System.
	Linepack	The volume of gas within the National or Local Transmission System at any time. (See Also: PCLP)
LNG	Liquefied natural gas	LNG is formed by chilling gas to -161˚C so that it occupies 600 times less space than in its gaseous form. **www2.nationalgrid.com/uk/Services/Grain-lng/what-is-lng/**
	Load Duration Curve (1-in-50 Severe)	The 1 in 50 severe load duration curve is that curve which, in a long series of years, with connected load held at the levels appropriate to the year in question, would be such that the volume of demand above any given demand threshold (represented by the area under the curve and above the threshold) would be exceeded in one out of fifty years.
	Load Duration Curve (Average)	The average load duration curve is that curve which, in a long series of winters, with connected load held at the levels appropriate to the year in question, the average volume of demand above any given threshold, is represented by the area under the curve and above the threshold.
LRS	Long-range storage or seasonal storage	There is one long-range storage site on the national transmission system: Rough, situated off the Yorkshire coast. Rough is owned by Centrica and mainly puts gas into storage (called ‘injection’) in the summer and takes gas out of storage in the winter. **http://www2.nationalgrid.com/UK/Our-company/Gas/Gas-Storage/**
LTS	Local Transmission System	A pipeline system operating at >7 barg that transports gas from NTS/LDZ offtakes to distribution system low pressure pipelines. Some large users may take their gas direct from the LTS.
LTSEC	Long-Term System Entry Capacity (LTSEC)	NTS Entry Capacity available on a long-term basis (up to 17 years into the future) via an auction process. This is also known as Quarterly System Entry Capacity (QSEC).
m^3	Cubic metre	The unit of volume, expressed under standard conditions of temperature and pressure, approximately equal to 35.37 cubic feet. One million cubic metres (mcm) are equal to 106 cubic metres, one billion cubic metres (bcm) equals 109 cubic metres.
mcm	Million cubic metres	Unit or measurement of volume, used in the gas industry. 1 mcm = 1,000,000 cubic metres
	Margins Notice	The purpose of the Margins Notice is to provide the industry with a day-ahead signal that there may be the need for a market response to a potential physical supply/demand imbalance.
MCP	Medium Combustion Plant (Directive)	The Medium Combustion Plant (MCP) directive will apply limits on emissions to air from sites below 50 MW thermal input. MCP is likely to come into force by 2020.

Appendix 9
Glossary

Acronym	Term	Definition
MRS	Medium-Range Storage	Typically, these storage facilities have very fast injection and withdrawal rates that lend themselves to fast day to day turn rounds as market prices and demand dictate.
MWh	Megawatt hour	1,000,000 watts, a measure of power usage or consumption in 1 hour.
NBP	National balancing point	The wholesale gas market in Britain has one price for gas irrespective of where the gas comes from. This is called the national balancing point (NBP) price of gas and is usually quoted in price per therm of gas.
NCS	Norwegian Continental Shelf	The Norwegian Continental Shelf (NCS) comprises those areas of the sea bed and subsoil beyond the territorial sea over which Norway exercises rights of exploration and exploitation of natural resources. NCS gas comes into the UK via St Fergus and Easington terminals.
NDM	Non-daily metered	A meter that is read monthly or at longer intervals. For the purposes of daily balancing, the consumption is apportioned, using an agreed formula, and for supply points consuming more than 73.2 MWh pa, reconciled individually when the meter is read.
NDP	Network Development Process	NDP defines the method for decision making, optioneering, development, sanction, delivery and closure for all National Grid gas projects. The aim of the NDP is to deliver projects that have the lowest whole-life cost, are fit for purpose and meet stakeholder and RIIO requirements.
NEA	Network Entry Agreement	A NEA is signed by the gas shipper prior to any gas flowing on to the system. Within the NEA the gas transporter sets out the technical and operational conditions of the connection such as the gas quality requirements, the maximum permitted flow rate and ongoing charges.
NExA	Network Exit Agreement	A NExA is signed by a gas shipper or Distribution Network Operator prior to any gas being taken off the system. Within the NExA the gas transporter sets out the technical and operational conditions of the offtake such as the maximum permitted flow rate, the assured offtake pressure and ongoing charges.
NGGT	National Grid Gas Transmission	NGGT refers to teams within both the SO and TO areas of National Grid, involved in gas transmission activities.
NGSE	Network Gas Supply Emergency	A NGSE occurs when National Grid is unable to maintain a supply–demand balance on the NTS using its normal system balancing tools. A NGSE could be caused by a major loss of supplies to the system as a result of the failure of a gas terminal or as the result of damage to a NTS pipeline affecting the ability of the system to transport gas to consumers. In such an event the Network Emergency Coordinator (NEC) would be requested to declare a NGSE. This would enable National Grid to use additional balancing tools to restore a supply–demand balance. Options include requesting additional gas supplies be delivered to the NTS or requiring gas consumers, starting with the largest industrial consumers, to stop using gas. These tools will be used, under the authorisation of the NEC, to try to maintain supplies as long as possible to domestic gas consumers.
NOM	Network Output Measure	RIIO has introduced Network Output Measures (NOMs) (previously Network Replacement Outputs) as a proxy for measuring the health and thus level of risk on the gas network. There are specific targets which are related to the condition of the NTS which must be met. Asset health is a key RIIO measure in terms of allowances and output. The targets cover an eight-year period from 2013 to 2021.
NOx	Nitrous Oxide	A group of chemical compounds, some of which are contributors to pollution, acid rain or are classified as greenhouse gases.
NTS	National Transmission System	A high-pressure gas transportation system consisting of compressor stations, pipelines, multijunction sites and offtakes. NTS pipelines transport gas from terminals to NTS offtakes and are designed to operate up to pressures of 94 bar(g).
	National Transmission System Offtake	An installation defining the boundary between NTS and LTS or a very large consumer. The offtake installation includes equipment for metering, pressure regulation, odourisation equipment etc.
NWE	North West European (Hub)	The wholesale gas market in North West Europe has one price for gas irrespective of where the gas comes from. This is called the North West European (NWE) hub price of gas and is usually quoted in price per therm of gas.

Acronym	Term	Definition
	Oil & Gas UK	Oil & Gas UK is a representative body for the UK offshore oil and gas industry. It is a not-for-profit organisation, established in April 2007. **http://www.oilandgasuk.co.uk**
OCGT	Open Cycle Gas Turbine	Gas turbines in which air is first compressed in the compressor element before fuel is injected and burned in the combustor. (See also CCGT)
OCM	On the Day Commodity Market	This market constitutes the balancing market for GB and enables anonymous financially cleared on the day trading between market participants.
	Odourisation	The process by which the distinctive odour is added to gas supplies to make it easier to detect leaks.
Ofgem	Office of Gas and Electricity Markets	The UK's independent National Regulatory Authority, a non-ministerial government department. Its principal objective is to protect the interests of existing and future electricity and gas consumers.
OM	Operating Margins	Gas used by National Grid Transmission to maintain system pressures under certain circumstances, including periods immediately after a supply loss or demand forecast change, before other measures become effective and in the event of plant failure, such as pipe breaks and compressor trips.
OUG	Own Use Gas	Gas used by National Grid to operate the transportation system. Includes gas used for compressor fuel, heating and venting.
pa	Per annum	Per year
PARCA	Planning and Advanced Reservation of Capacity Agreement	A solution developed in line with the enduring incremental capacity release solutions which have been developed following the implementation of the Planning Act (2008). PARCAs were implemented on 1 February 2015 and replace the functions of PCAs and ARCAs. (See also ARCA & PCA)
PCA	Planning Consent Agreement	Planning Consent Agreements were made in relation to NTS Entry and Exit Capacity requests and comprised a bilateral agreement between National Grid and developers, DNOs or Shippers whereby National Grid assessed the Need Case for NTS reinforcement and would undertake any necessary planning activities ahead of a formal capacity signal from the customer. Where a Need Case was identified, the customer would underwrite National Grid NTS to undertake the required statutory Planning Act activities such as strategic optioneering, Environmental Impact Assessment, statutory and local community consultations, preparation of the Development Consent Order (DCO) and application. This has now been replaced by the PARCA process. (See PARCA)
PCLP	Projected Closing Linepack	Linepack is the volume of gas stored within the NTS. Throughout a gas day linepack levels fluctuate due to imbalances between supply and demand over the day. National Grid, as residual balancer of the UK gas market, need to ensure an end-of-day market balance where total supply equals, or is close to, total demand. The Projected Closing Linepack (PCLP) metric is used as an indicator of end-of-day market balance. (See also Linepack)
	Peak Day Demand	The 1-in-20 peak day demand is the level of demand that, in a long series of winters, with connected load held at levels appropriate to the winter in question, would be exceeded in one out of 20 winters, with each winter counted only once.
QSEC	Quarterly System Entry Capacity	NTS entry capacity available on a long-term basis (up to 17 years into the future) via an auction process. Also known as Long-Term System Entry Capacity (LTSEC).
	RIIO-T1	RIIO relates to the current Ofgem price control period which runs from 1 April 2013 to 31 March 2021. For National Grid Transmission this is referred to as RIIO-T1.

Appendix 9
Glossary

Acronym	Term	Definition
	Safety Monitors	Safety Monitors in terms of space and deliverability are minimum storage requirements determined to be necessary to protect loads that cannot be isolated from the network and also to support the process of isolating large loads from the network. The resultant storage stocks or monitors are designed to ensure that sufficient gas is held in storage to underpin the safe operation of the gas transportation system under severe conditions. There is now just a single safety monitor for space and one for deliverability. These are determined by National Grid to meet its Uniform Network Code requirements and the terms of its safety case. Total shipper gas stocks should not fall below the relevant monitor level (which declines as the winter progresses). National Grid is required to take action (which may include use of emergency procedures) in order to prevent storage stocks reducing below this level.
SEAL	Shearwater Elgin Area Line	The offshore pipeline from the Central North Sea (CNS) to Bacton.
SEPA	Scottish Environment Protection Agency	The environmental regulator for Scotland.
	Shale Gas	Shale gas is natural gas that is found in shale rock. It is extracted by injecting water, sand and chemicals into the shale rock to create cracks or fractures so that the shale gas can be extracted. **https://www.gov.uk/government/publications/about-shale-gas-and-hydraulic-fracturing-fracking**
	Shipper or Uniform Network Code (Shipper) User	A company with a Shipper Licence that is able to buy gas from a producer, sell it to a supplier and employ a GT to transport gas to consumers.
	Shrinkage	Gas that is input to the system but is not delivered to consumers or injected into storage. It is either Own Use Gas or Unaccounted for Gas.
SHQ	Supply Hourly Quantity	Supply Hourly Quantity
SNCWV	Seasonal Normal Composite Weather Variable	The seasonal normal value of the CWV is the smoothed average of the values of the applicable CWV for that day in a significant number of previous years. (See also CWV)
	System operability	The ability to maintain system stability and all of the asset ratings and operational parameters within pre-defined limits safely, economically and sustainably.
SO	System Operator	An entity entrusted with transporting energy in the form of natural gas or power on a regional or national level, using fixed infrastructure. Unlike a TSO, the SO may not necessarily own the assets concerned. For example, National Grid operates the electricity transmission system in Scotland, which is owned by Scottish Hydro Electricity Transmission and Scottish Power.
SOQ	Supply Offtake Quantity	The maximum daily consumption at a Supply Point.
SOR	Strategic Options Report	Output of the PCA, ARCA and PARCA statutory Planning Act activities reporting to the customer on the findings of optioneering analysis by National Grid in relation to the customer request for NTS Entry or Exit Capacity.
SRS	Short-Range Storage	These are commercially operated sites that have shorter injection/withdrawal times so can react more quickly to demand, injecting when demand or prices are lower and withdrawing when higher.
	Substitution	Capacity substitution is the process of moving unsold capacity from one or more system points to another, where demand for that capacity exceeds the available capacity quantities for the relevant period. This avoids the construction of new assets or material increases in operational risk.
	Supplier	A company with a supplier's licence contracts with a shipper to buy gas, which is then sold to consumers. A supplier may also be licensed as a shipper.
	Supply Point	A group of one or more meter points at a site.
	Therm	An imperial unit of energy. Largely replaced by the metric equivalent: the kilowatt hour (kWh). 1 therm equals 29.3071 kWh.

Acronym	Term	Definition
TO	Transmission Owner	National Grid owns the gas National Transmission System (NTS) in Great Britain. As the TO National Grid must make sure all assets on the NTS are fit for purpose and safe to operate. Effective maintenance plans and asset replacement schedules are developed and implemented to keep the gas flowing.
TPC	Transmission Planning Code	The Transmission Planning Code describes National Grid's approach to planning and developing the NTS in accordance with its duties as a gas transporter and other statutory obligations relating to safety and environmental matters. The document is subject to approval by the Gas and Electricity Markets Authority (GEMA).
TSO	Transmission System Operator	Operator of a Gas Transmission Network under licence issued by the Gas and Electricity Markets Authority (GEMA) and regulated by Ofgem.
TWh	Terawatt hour	1,000,000,000,000 watt hours, a unit of energy.
UAG	Unaccounted for Gas	Gas "lost" during transportation. Includes leakage, theft and losses due to the method of calculating the Calorific Value.
UK	United Kingdom of Great Britain and Northern Ireland	A geographical, social and economic grouping of countries that contains England, Scotland, Wales and Northern Ireland.
UKCS	United Kingdom Continental Shelf	The UK Continental Shelf (UKCS) comprises those areas of the sea bed and subsoil beyond the territorial sea over which the UK exercises sovereign rights of exploration and exploitation of natural resources.
UNC	Uniform Network Code	The Uniform Network Code is the legal and commercial framework that governs the arrangements between the Gas Transporters and Shippers operating in the UK gas market. The UNC comprises different documents including the Transportation Principal Document (TPD) and Offtake Arrangements Document (OAD).
VSD	Variable Speed Drives	Compressor technology where the drive speed can be varied with changes in capacity requirement. Variable speed drive compressors compared to constant speed compressors are more energy efficient and operate more quietly by varying speed to match the workload.
	Weather corrected	The actual demand figure that has been adjusted to take account of the difference between the actual weather and the seasonal normal weather.
WLP	Whole Life Prioritisation	The WLP provides the criteria used to prioritise all of the options considered as part of the Network Development Process (NDP). The scoring from the WLP Model aids the decision-making process by discounting unsuitable options at an early stage of the NDP.

Disclaimer

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

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

National Grid would wish to emphasise that the information must be considered as illustrative only and no warranty can be or is made as to the accuracy and completeness of the information contained within the Document. Neither National Grid Electricity Transmission, National Grid Gas nor the other companies within the National Grid group, nor the directors, nor the employees of any such company shall be under any liability for any error or misstatement or opinion on which the recipient of this Document relies or seeks to rely other than fraudulent misstatement or fraudulent misrepresentation and does not accept any responsibility for any use which is made of the information or Document which or (to the extent permitted by law) for any damages or losses incurred.

[3] Special Condition 7A requires the Ten Year Statement, published annually, shall provide a ten-year forecast of transportation system usage and likely system developments that can be used by companies, who are contemplating connecting to our system or entering into transport arrangements, to identify and evaluate opportunities.

Continuing the conversation

Join our mailing list to receive email updates for GTYS or any of our Future of Energy documents.
http://www.nationalgrid.com/updates

Email us with your views on GTYS at:
transmission.gtys@nationalgrid.com
and we will get in touch.

Access our current and past GTYS documents and data at:
http://www.nationalgrid.com/gtys

Keep up to date on key issues relating to National Grid via our Connecting website:
www.nationalgridconnecting.com

You can write to us at:
Gas Network Development
National Grid House
Warwick Technology Park
Gallows Hill
Warwick
CV34 6DA

YouTube National Grid UK

@nationalgriduk

LinkedIn National Grid

NationalGridUK

National Grid plc
National Grid House,
Warwick Technology Park,
Gallows Hill, Warwick.
CV34 6DA United Kingdom
Registered in England and Wales
No. 4031152

www.nationalgrid.com