Chapter two

- Network Development Inputs
- Customer Requirements
- Future Energy Scenarios
- Legislative Change
- Asset Health

Trigger

A change in the network, legislation, market or customer requirements.

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 messages

Customer requirements

- We are reviewing our connections processes to improve the customer experience and to help facilitate unconventional gas sources
- 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
- Customers want higher ramp rates and shorter notice periods, particularly in response to changes in the electricity market
- Distribution Network Operators (DNO) want National Transmission System (NTS) flexibility to meet their customers' requirements
- Long-term auctions no longer indicate a shipper's intention to flow. Diversity and extent of supplies can mean great variation of flow on the NTS from one day to the next
- Some contracts for gas-fired generation were issued after the first round of electricity Capacity Market auctions. We are talking to developers so we are ready for the second round of auctions
- We have commissioned the GasFlexTool in response to our customers' changing needs and their impact on NTS System Flexibility.

Future Energy Scenarios

- Sources of gas supply have changed since the 2000s
- Import dependency has grown considerably since the early 2000s and could reach 90% by 2035
- Peak supply capacity is now much higher than peak demand
- Other than the 'Gone Green' scenario, annual UK gas demand is expected to hold broadly steady with residential demand decreasing slightly due to higher efficiencies
- The 'Gone Green' scenario shows a marked decline in annual demand due to more electric heating and less use of combined cycle gas turbines (CCGT)
- Daily peaks will be similar or higher until 2020 and beyond, with more generation by CCGTs rather than coal.

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 eight of our 24 compressor sites
- LCP affects 17 of our compressor units.
- When it's finalised the Medium Combustion Plant Directive (MCP) will also form part of IED
- The draft MCP affects 26 of our compressor units.

Asset health

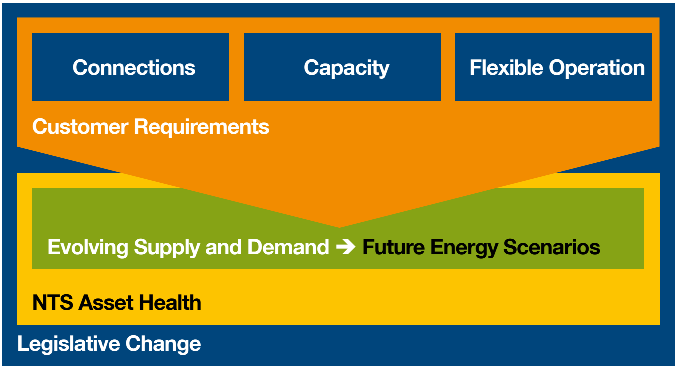
- We have developed a programme of works to resolve known asset health issues as a result of the ageing NTS. This programme of works will take us to 2021
- We will deliver 370 Network Output Measures (NOMs) during this performance year; however as these are legacy projects they will not follow the NDP
- Approximately 3,500 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.

2.1 Introduction

As we outlined in Chapter 1, our Network Development Process (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 Future Energy Scenarios (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 recently 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.

Our customers' changing behaviours mean that within-day supply and demand patterns are very different from those envisaged when the National Transmission System (NTS) was designed. These changing patterns mean that our system must be flexible enough to meet our customers' needs. This chapter explains what we mean by System Flexibility and how it is affected by changing customer behaviour.

Future Energy Scenarios

Our Future Energy Scenarios (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 Industrial Emissions Directive (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 Network Development Process (NDP). We have provided information on customer connections, entry capacity, exit capacity, and system flexibility.

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

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

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 – Sections 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) B4:B9 Rights to offtake gas from the system	✔	✗	✔	✔	✔	✔
Customers New Site Developers (that are not signatory to the UNC) and or currently connected customers. Both new and currently connected customers have Capacity Rights to flow gas onto and offtake gas from the system.	✔	✗	✗	✗	✗	✔

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 Network Development Process (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:

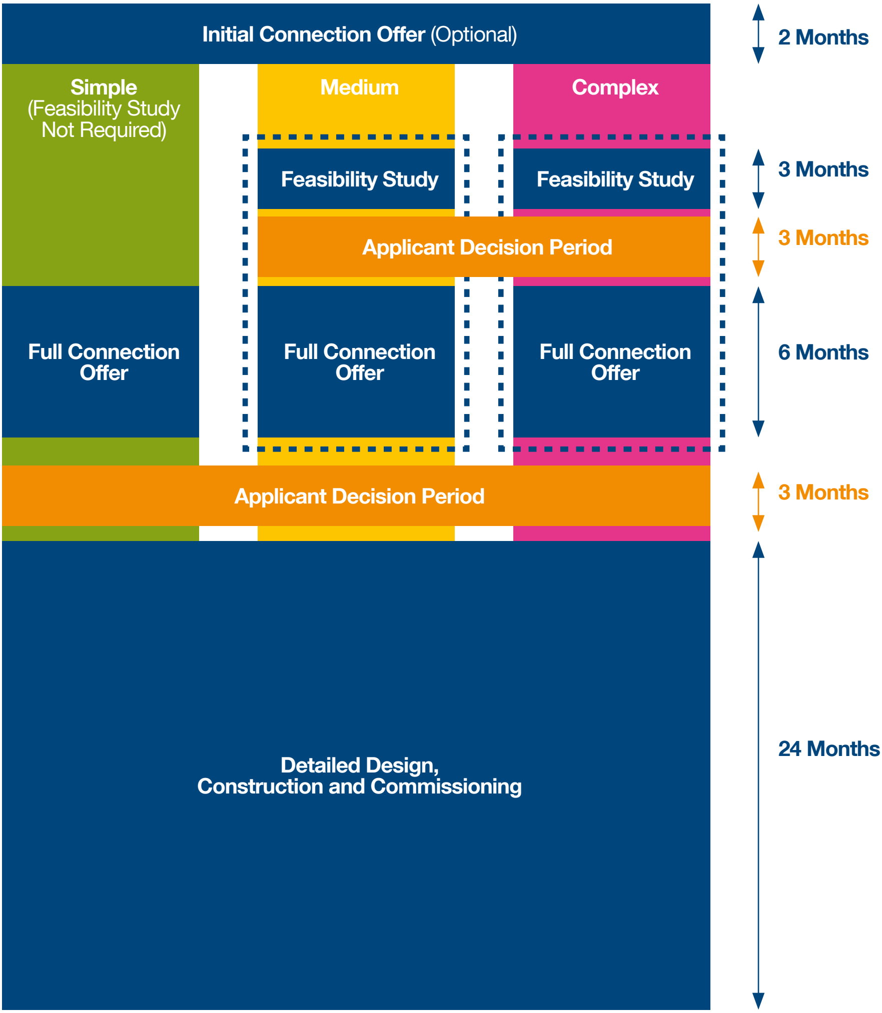
- a formal connection application template for customers to complete
- definition of the content of an initial connection offer
- definition of the content of a full connection offer
- how to request a modification to a full connection offer
- timescales for National Grid to produce a connection offer:
  – 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 £2m 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 as our customer. 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 Uniform Network Code Section J 2.2.

General connection pressure information

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

[4] 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 50 MW/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 up to 25%, up to 50% and greater than 50% of maximum offtake rate. These notice periods are required to ensure that pressures can be maintained at times of system stress including high demand. Notice periods will only be enforced in these circumstances when system flexibility is limited. More detail regarding access to system flexibility can be found on our website in the Short Term Access to System Flexibility Methodology Statement[6].

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. These projects tend to be fast to market and the NTS connection cost represents a significant proportion of the total development costs. Many of you have told us that the existing connection regime does not meet your project's requirements.

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. Our aim is to develop a low cost and timely NTS connection service for new and unconventional gas connections.

Connections and capacity

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

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

The PARCA process (see section 2.2.5) 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.

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

Customer Requirements

2.2.3 NTS entry capacity

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

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.

2015 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.

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

[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/

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 16 March 2015 and closed on Tuesday 17 March 2015. 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.

2.2.4 NTS exit capacity

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

NTS exit capacity types

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 Transporters 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 13:30 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 at 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.

Customer 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.

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 1GWh/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[10] 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.

[10] http://www2.nationalgrid.com/UK/Industry-information/Gas-capacity-methodologies/Exit-Capacity-Substitution-and-Revision-Methodology-Statement/

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, and can also be reserved through a PARCA by a developer or a User (both DNO and shipper).

Incremental capacity that cannot be provided via substitution is only guaranteed for release where a PARCA has been agreed by 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

Customer Requirements

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 required timescales, their PARCA may be cancelled and any reserved NTS capacity would either be used for another live PARCA or returned to the market. This will ensure that NTS capacity is not unnecessarily withheld from other NTS users
A PARCA customer will be required to provide financial security to reserve NTS capacity. If the customer cancels their PARCA, a termination amount will be taken from the security provided. This would be credited to other NTS users through the existing charging mechanisms
The timescales for the release of incremental NTS capacity to the PARCA applicant will be aligned to our timescales for providing increased system capability. This will take into account the Planning Act requirements for a reinforcement project. As a result, the risk of constraint management actions taking place and any costs potentially being shared with end consumers will be reduced
They are available to both UNC parties and project developers and therefore available to a wider range of customers compared to the existing annual NTS capacity auction and application processes

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

2.2.6 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 Uniform Network Code (UNC). The PARCA arrangements apply to all NTS entry and exit points, NTS storage and NTS interconnectors.

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

The PARCA framework is split into four logical phases: Phase 0 to Phase 3 (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[11].

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

Customer Requirements

2.2.7 Changing customer requirements

Our customers' requirements on the NTS are interlinked with legislative (Industrial Emissions Directive (IED)) and market (Electricity Market Reform (EMR)) changes. All of these changes impact on the wider energy industry and strongly influence how we plan and operate our system. These changes cannot be looked at in isolation.

While we predict significant change ahead, the pace of NTS development, when judged by customer signals for incremental capacity, has slowed in recent years. This trend has continued in the 2015 Quarterly System Entry Capacity (QSEC) auction and the 2015 Exit Capacity window. In contrast the number of connection enquiries we are receiving remains high.

The following summarises what we currently see:

- Increasing Distribution Network (DN) exit flexibility capacity requirements (against a background of reduced DN flat capacity requirements)
- Increasing requests for higher ramp rates and reduced flow rate change notice periods for gas power generation offtakes
- Increasing requirement for south-to-north flows as a result of declining St Fergus flows (Future Energy Scenarios (FES))
- Operationally, we are seeing an increased requirement to rapidly switch between 'west-to-east' and 'east-to-west' flow in the heart of the NTS.

We need to balance the needs of our customers with the ability of the NTS to respond and the cost to the end consumer. We need to work with our customers and stakeholders to make sure that the right operational arrangements (rules), commercial options (tools) and physical investments (assets) considered across the NTS. The way we plan and operate the NTS needs to be more flexible to allow us to more quickly adapt to our customers' changing behaviour.

2.2.8 System Flexibility

Through the RIIO process System Flexibility was defined as: *"a requirement for additional operational capability driven by changing user behaviour and explicitly not the provision of incremental entry or exit capacity".*

This is quite a broad definition and you have told us that you would like to gain a better understanding of what we mean by System Flexibility.

What is System Flexibility?
We define System Flexibility as:

- The ability of the NTS to adapt to changing daily supply and demand profiles and imbalances by varying system linepack and system pressures
- The ability of the NTS to cater for supply and demand levels which occur away from the 1-in-20 peak demand level but result in network flows in some parts of the network that are higher than would occur at the 1-in-20 demand level
- The ability of the NTS to cater for the rate of change in the geographic distribution of supply and demand levels. This results in changes in the direction and level of gas flow through pipes, compressors and multi-junctions, and may require rapid changes to the flow direction in which compressors and multi-junctions operate.

The need for System Flexibility

NTS exit (flexibility) capacity

The underlying assumption in a daily balancing regime is that a quantity of gas will be supplied to match the daily demand taken off the system and it will be delivered (ignoring entry profiles) at a flat (1/24th) rate. Flex measures how much gas is taken off the system over and above this flat entry flow and therefore how much gas is taken out of system linepack. The measurement is made at 22:00 as this is when the profiled gas demand for both DN and power generation offtakes drop below the average daily rate. The volume of flex taken reduces overall system linepack.

Distribution Network Operators (DNO) offtake gas from the NTS to meet their consumers' gas requirements. DNOs tell us that they book NTS exit 'flat' (end-of-day quantity) and flex (profile) capacity, to comply with their 1-in-20 NTS Security Standard as well as to meet their diurnal storage requirements.

The DNOs can agree assured pressures as pressure can provide an alternative to flex. The reason for this is that the DNOs can use higher pressures to store more gas in their own systems in the form of linepack. They can then use more of their own linepack to meet their diurnal storage requirements i.e. offset the difference between flows from the NTS and the profiles of their customers.

DNO flexibility at a Local Distribution Zone (LDZ) (aggregate offtake rate) level is limited by the two-hour 5% rule. This limits the change in offtake rate for any hour bar to a 5% change with two hours' notice given. This rule is more onerous at lower demands as a lower demand change would represent a 5% increase. This rule has been subject to a recent UNC modification proposal which was approved on the basis that the rule would only be applied when required and hence was effectively 'off by default'.

On low demand days, defined as being when the first LDZ demand forecast on the preceding gas day is less than 50% of the 1-in-20 peak day forecast, we have the right under the UNC to require that the aggregate LDZ NTS Exit (Flexibility) capacity utilised is not greater than zero.

Direct Connect profiling

Shippers at Directly Connected (DC) offtakes are not required to book NTS Exit (Flexibility) Capacity. The impact of their gas offtake profiles is broadly the same as for DN offtakes. There are a number of key differences between DC offtakes and DN offtakes. While DNOs can trade off flex and pressure, additional pressure at a DC offtake has no impact on the required offtake (flex) profile. DNOs book flex capacity to meet the 1-in-20 NTS Security Standard and this provides a key input to the NTS planning process. DC profiling is not limited by flex bookings but power generation offtakes are limited by the electricity supply profile and hence further 'booked' capacity may not be of value.

Directly Connected (DC) offtakes have ramp rate and notice period restrictions. Typically a ramp rate (the rate at which the offtake of gas can be increased at the offtake) of 50 MW/minute is offered but increasingly higher ramp rates are being requested and agreed where they can be facilitated. Notice periods are written into the NExAs and are defined as the number of hours' notice for increases of up to 25%, up to 50% and greater than 50% of maximum offtake rate.

Forecast error and market behaviour

Within-day changes in demand with a delayed supply response are met through system linepack and consequently require system flexibility. Within-day demand changes will result in either an increase or decrease in flow rate at relevant supply points, once the demand change has been identified, as a result of shipper / market behaviour and/or balancing actions.

This behaviour is replicated when market behaviour results in supply flows starting the day at a rate that is less than the daily demand. The difference in flow rate and the period over which the imbalance persists will create a within-day imbalance requiring system linepack and flexibility.

Adherence to offtake rate change notice periods reduces the impact of within-day demand changes, and hence within-day imbalances. Notices of rate changes are required through NExAs and as a result of the DN two-hour 5% rule.

Customer Requirements

Flows at bi-directional system points (storage and interconnectors) and other system entry points are influenced by shipper behaviour. Shippers balance their portfolios taking into account their expected end-of-day demand and supply allocations at all their exit and entry points. As demand changes within-day, shippers may not immediately make supply re-nominations to balance their portfolios as they may use gas trades first. This way they can make use of NTS within-day flexibility to manage within-day imbalances. Within-day imbalances may also occur due to supply losses and, again, these may not be addressed immediately as gas trades may be carried out first.

Unexpected supply losses
Unexpected supply losses occur when offshore or delivery facilities have technical problems or failures. These supply losses will result in either an increase in flow rate at the relevant point once the problem has been rectified, or an increase in flow rate at an alternative point (as a result of shipper/market behaviour and/or balancing actions) if the problem cannot be rectified. There can be a delay between a supply loss and the market response.

Quantification of flexibility
In Chapter 3 we explain how we are seeking to quantify flexibility requirements.

Customer and stakeholder feedback

Our discussions, in customer seminars and stakeholder engagement events, have highlighted that System Flexibility is important to the wider industry. You have told us that our current analysis does not provide enough information on this area. We have developed a new tool to look specifically at System Flexibility called the GasFlexTool. We discuss the tool development and its outputs in more detail in Chapter 3. This tool will help us to clarify what effect restricted NTS Flexibility could have on the way we plan and operate the network.

We are reviewing the future flexibility requirements for the system. We are considering how different events or factors across gas days and within-day might affect the way the system is managed. This work may lead to changes in the planning processes and may require asset, commercial and operability solutions to be progressed to deliver more capability.

The categories we are considering include supply-side behaviour (e.g. supply shocks, supply profiling in response to market behaviour), demand-side behaviour (e.g. the impact of wind intermittency on CCGT use, demand profiling, ramp rates and notice periods, pressure commitments) and network flow direction changes (e.g. changes from east–west to west–east flow patterns over a short timescale, storage and interconnector behaviour). In parallel, we are also considering how our design and security standards are applied in our planning and operational processes and whether these are appropriate for supply and demand patterns and behaviour we may see in the future. More information on the work we have done so far is provided in Chapter 3.

You have told us that you would also like more information on the asset and non-asset options to address greater requirements for System Flexibility. We discuss these options in more detail in chapters 4 and 5.

System Flexibility and our NDP

There is no existing NDP trigger mechanism to enhance system capability in response to changing and/or reducing flows of gas in the network, i.e. the net impact of a number of different customers changing their use of the NTS. The current regime is based on the concept of user commitment to provide incremental capacity; however, this cannot always be the case when the way that capacity is used changes.

2.2.9 Gas System Operability Framework

To address future system operability challenges such as System Flexibility, we are considering the possibility of introducing a Gas System Operability Framework (GSOF). This will highlight how we identify current and future operability challenges. We will initially use the GTYS to document the outputs.

The SOF is a concept used by National Grid electricity transmission. The electricity SOF was first published in 2014. It draws on real-time experience on the electricity system, combined with FES, to infer potential challenges to operability of the electricity transmission system out to 2035. The electricity SOF identifies and quantifies future system challenges so that a range of mitigation measures can be developed and economically assessed.

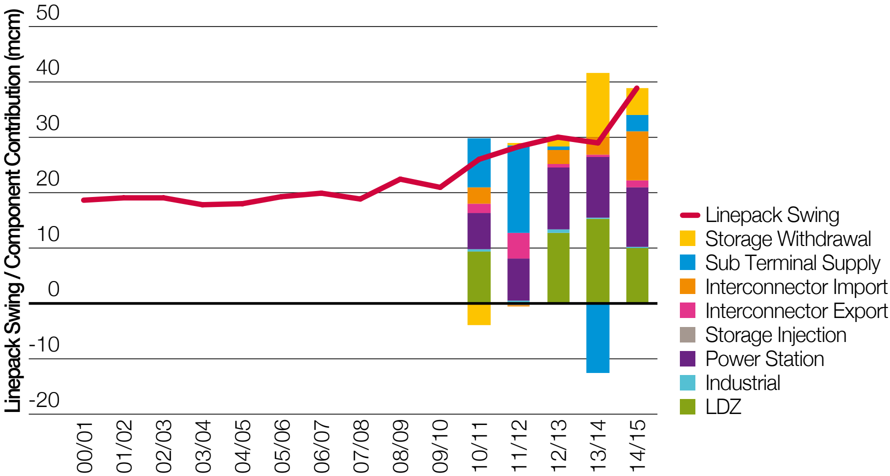
Our aim is to operate a safe, efficient, economical and commercially viable gas system for our customers. There are a number of factors that could make this more challenging for us in the future:

- increase in supply swings at beach terminals
- increased use of linepack by the LDZs
- increased opportunities for arbitrage between Great Britain and Europe through the Bacton–Zeebrugge interconnector
- spot and forward spreads across the Bacton–Zeebrugge interconnector
- increase in use of arbitrage by CCGTs between the gas and electricity markets
- increases in exit profiling within-day by combined cycle gas turbines (CCGTs)
- gas/coal forward spread
- changes in UK installed gas generation capacity
- changes in patterns of gas use in Ireland
- available information on reliability of offshore infrastructure
- within-day swing on a sector-by-sector basis (including at the beach, LDZs and by CCGTs)
- correlation of effects across sectors.

Linepack swing is a growing trend on the NTS. This is making the safe and reliable operation of the NTS more challenging. There are a number of other potential developments that could adversely impact system operability. These include Gas Quality and new sources of gas (e.g. biomethane and shale). Figure 2.4 shows the highest linepack swing levels for each year since 2000, as well as component contributions to the swings for the past five years.

Customer Requirements

Figure 2.4
Maximum linepack swing by gas year



We are in the process of establishing a mechanism for identifying planning data to reflect anticipated within-day supply and demand variation, alongside the FES process (see Chapter 3 for more detail). GSOF could be used to address this requirement, as well as other future system operation requirements.

We would like to seek your views on whether a GSOF would be useful for planning the gas NTS. Please send any comments through to our GTYS mailbox: **Box.SystemOperator.GTYS@nationalgrid.com** or speak to us at customer/stakeholder events.

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. Our stakeholders provided positive feedback on our 2014 scenarios and suggested evolutionary, rather than revolutionary, improvements for this year. In response, we kept our 2015 scenarios based on the energy trilemma (security of supply, sustainability and affordability). There is also a new scenario called Consumer Power, replacing the 2014 Low Carbon Life scenario, which you told us lacked clarity.

In Chapter 1 (Figure 1.2), we showed the political, economic, social, technological and environmental factors accounted for in our four 2015 Future Energy Scenarios. For more detailed information on each of our scenarios please read our Future Energy Scenarios 2015 publication[12].

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 National Transmission System (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
In the decade prior to 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 has remained marginal within the UK power generation market ever since.

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.

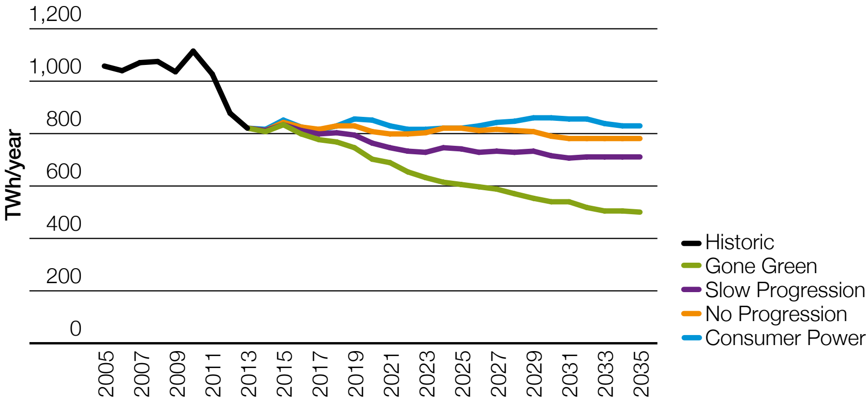
In our FES, the Slow Progression and Gone Green scenarios show that the historical decline in gas demand in the UK will continue as more household efficiency improvements are made and alternative heating appliances are installed. Consumer Power and No Progression show increased demand as a result of lower energy efficiency uptake, combined with growth in the gas power station and distributed gas combined heat and power (CHP) sectors (Figure 2.5).

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

Chapter two

Future Energy Scenarios

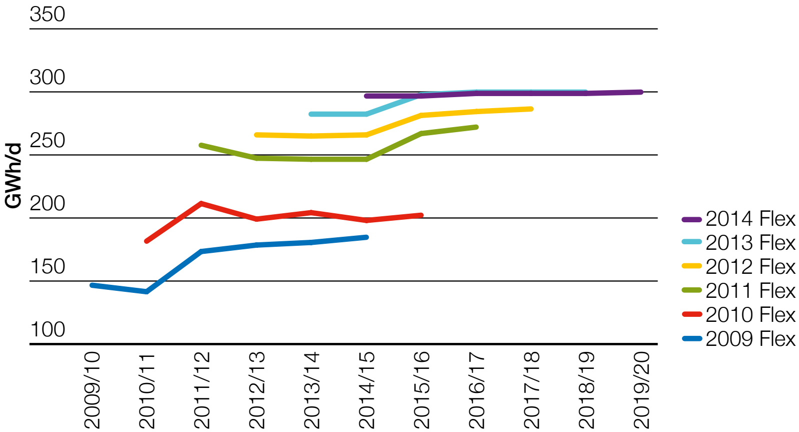
Figure 2.5
Total gas demand under our four scenarios



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 Section 2.2.7 and 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

Electricity generation from gas-fired plant has become increasingly marginal in recent years as coal prices have fallen significantly, making it a more favourable fuel.

The development of unconventional gas sources such as shale in the US has reduced worldwide demand for coal, which has driven the price down. Other forms of energy generation such as coal, wind, solar and nuclear generally have lower operating costs. This makes them more likely to be used for generation in preference to gas.

The role of combined cycle gas turbine (CCGT) power stations has evolved. We are seeing more variable demand from CCGTs connected to the NTS, both day-to-day and within-day. Instead of providing baseline generation, CCGTs now provide energy to cover the variable output from renewable generation on the electricity system. This means that within-day CCGT demand profiles have become more difficult to forecast.

CCGTs play an important role in balancing the electricity system alongside other balancing tools (interconnection, storage, other generation and demand-side response) which 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.

As a result of EU environmental directives, such as the Industrial Emissions Directive (IED), coal power stations are being retired. 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 become an even 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.

Chapter two

Future Energy Scenarios

Figure 2.7
Forecast levels of coal, wind and solar capacity

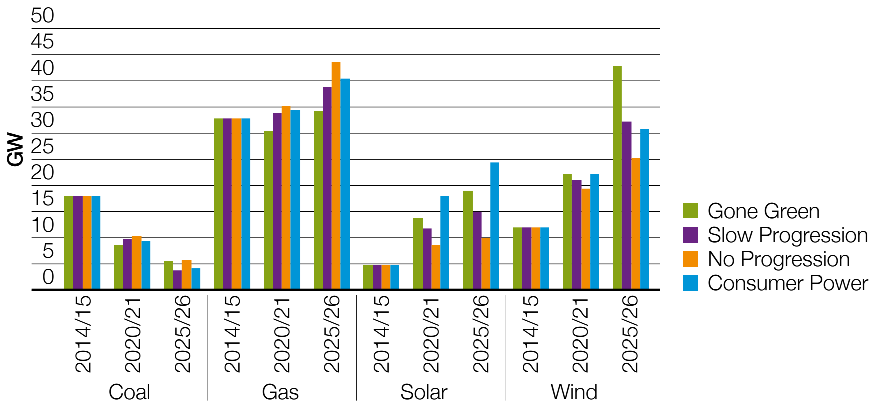
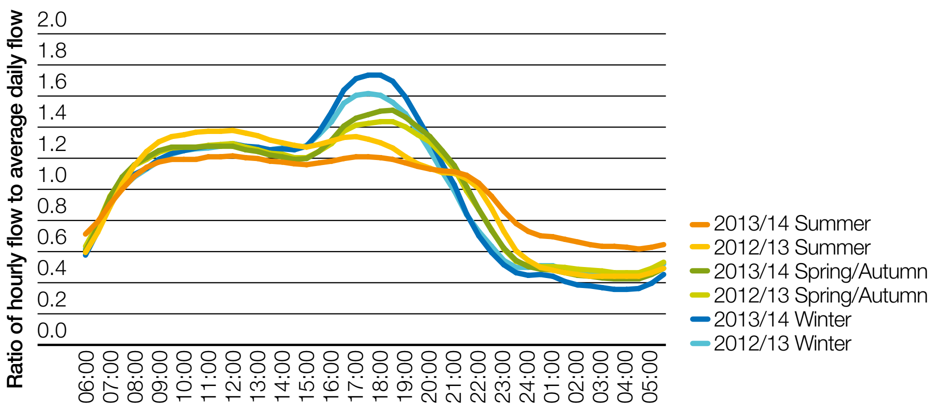


Figure 2.8 maps how the within-day profiles of CCGTs have changed in the last two years. The profiles follow expected demand patterns, peaking at 6pm in winter periods.

Figure 2.8
Normalised CCGT profiles



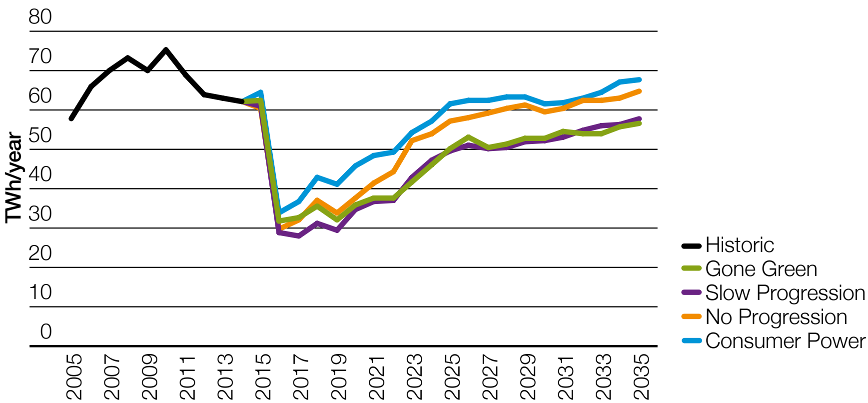
Exports

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 Europe.

The level of gas exports to Ireland is highly influenced by the timing and scale of supply from indigenous Irish supplies. In this year's FES we have assumed that the Corrib gas field will start operating in October 2015 with a step change in production rates from March 2016.

We expect that when Corrib is operational 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).

Figure 2.9
Gas demand from the NTS to Ireland



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.

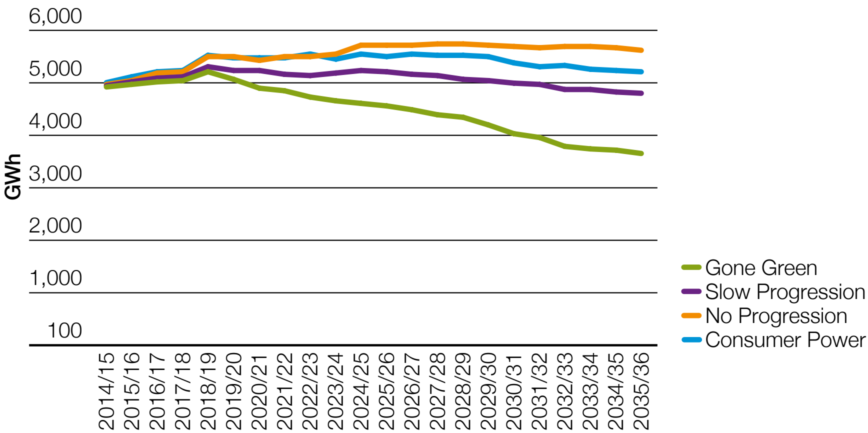
Future Energy Scenarios

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 increase in peak demand over the next five years in all four of our scenarios is the result of a short period where we expect an increase in gas-fired power generation. The peak is less related to weather and more dependent on generation availability assumptions and the position of gas-fired power generation within the merit order. Our analysis assumes a low wind load factor of 7% with gas prices more favourable to coal.

Figure 2.10
1-in-20 diversified peak demand



The relationship between demand and weather is periodically reviewed with the latest industry standard taking effect on 1 October 2015. This update followed the acceptance of Mod 330, which introduced the concept of a weather station substitution methodology, into the Uniform Network Code.

A new weather history dataset was supplied by the Met Office along with a climate change methodology. This means we can complete our analysis using weather history that is adjusted to climate conditions appropriate for the period in which the demand to weather relationship will apply (2015–2020). By using this new data our 1-in-20 diversified peak has decreased by 4.8%.

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.

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).

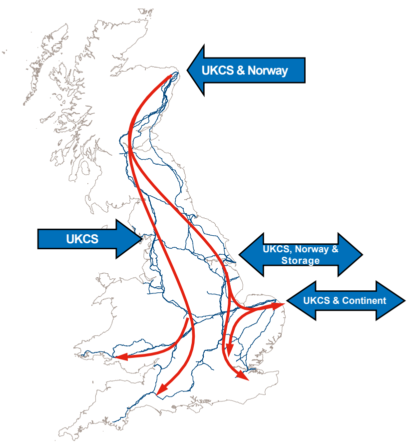
Changing GB gas supply

Our 2015 Future Energy Scenarios publication gives details of annual and peak gas supply for each of our four scenarios. The Gas Ten Year Statement (GTYS) expands on the FES by adding locational information and highlighting implications for the future planning and operation of the NTS.

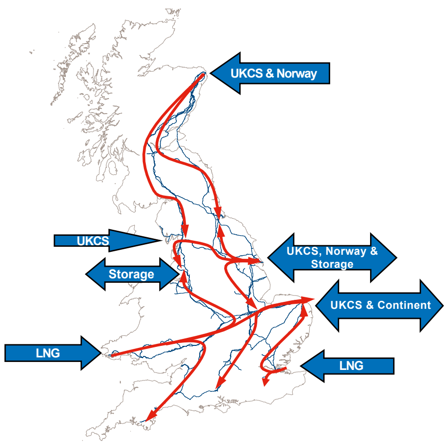
In recent years we have shown how supply patterns on the NTS are changing and how they are expected to become more uncertain in the future. Figure 2.11 shows some of the changes we have seen from the mid-1990s to today.

Figure 2.11
Changing flow patterns on the NTS

Mid 90s to mid 00s



Mid 00s to 2014



Future Energy Scenarios

From the mid-1990s to 2000s, supply patterns were relatively easy to predict as they were dominated by flows from the UK Continental Shelf (UKCS). Flows mainly entered the system at terminals on the east coast and travelled in a north to south pattern.

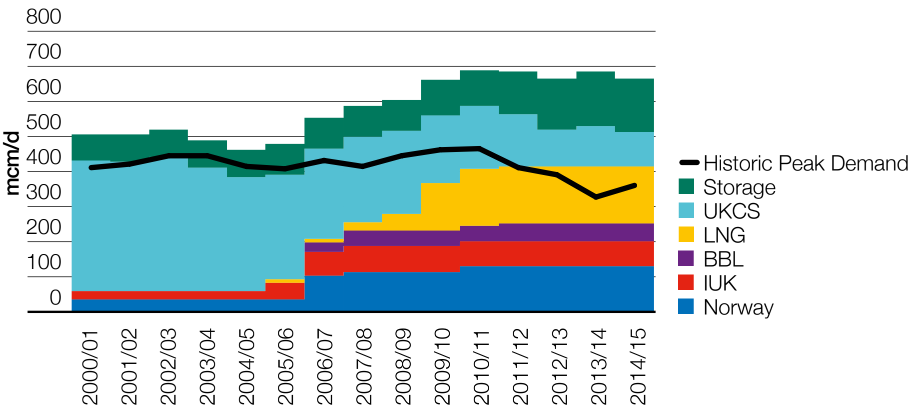
A positive consequence of this supply pattern evolution is that there are more entry points to the NTS distributed around the UK, so the average distance that gas is transported has reduced. Supply capacity in relation to peak demand has also grown significantly. These factors have helped to maintain security of supply and reduce compressor use.

The credible range of supply patterns needed to meet demand is increasing as factors such as the uncertainty in the world gas market and the development of fast cycle storage sites need to be taken into account. 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 Chapter 3 and 4.

The changing nature of gas supplies to the UK since 2000 provides an indication of how future supply patterns may develop. The UK was a net exporter of gas until 2003/04. From that point, the level of imports has progressively increased as UKCS supplies have declined. Recent history has developed our understanding of potential import behaviour and the interaction of international markets and global events, as shown in the following examples:

- The influence of the global LNG market on UK supplies. Increases in Japanese demand for gas following the 2011 tsunami and economic growth in China meant LNG shipments preferentially went to these two countries and drove LNG prices up
- The development of cheap shale gas in the US contributed to a global surplus of coal in the export market which lowered coal prices. Cheaper imported coal was used in place of gas in the GB power generation market
- The behaviour of the Interconnector (IUK) as a flexible supply source for the UK and Continental markets

Figure 2.12
Historic gas supply capacity and peak day demand



- We are more reliant on gas supplies from outside the UK and therefore more susceptible to supply shocks from global events. We have discussed the impact of supply losses in Section 2.2.8 and we outline how we plan for and develop operational strategies to deal with supply losses on the NTS in Chapters 3 and 4.

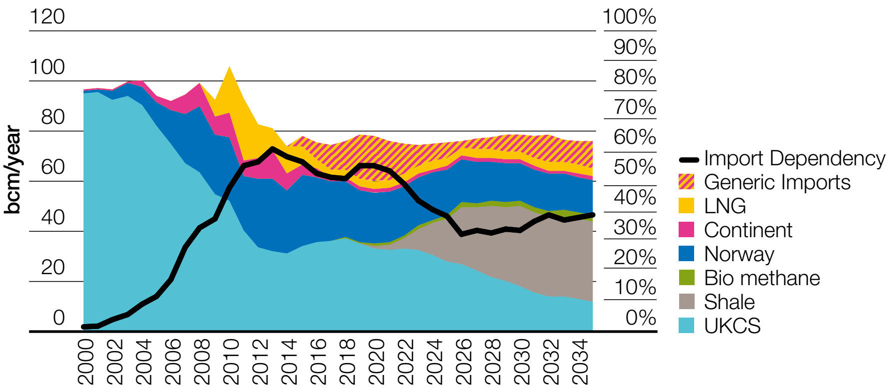
Figure 2.12 shows how peak supply capacity has increased despite the decline in UKCS production. As the UK has evolved from gas self-sufficiency to an increasing dependence on imports, there has been a considerable shift in how gas supplies are sourced to meet demand.

Historically, demand was met by UKCS supplies and, when needed, storage was used to make up for any supply shortfall. With the introduction of Norwegian imports, the Continent and LNG, the supply mix has changed considerably.

Annual and Peak Gas Supply

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

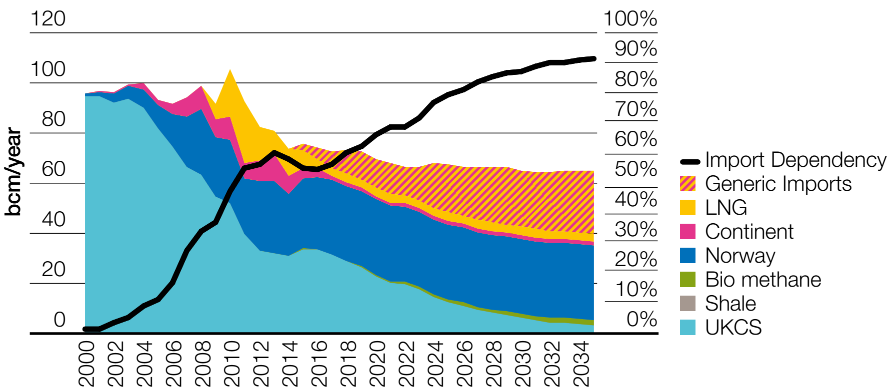
Figure 2.13
Annual gas supply for Consumer Power



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

Future Energy Scenarios

Figure 2.14
Annual gas supply for Slow Progression

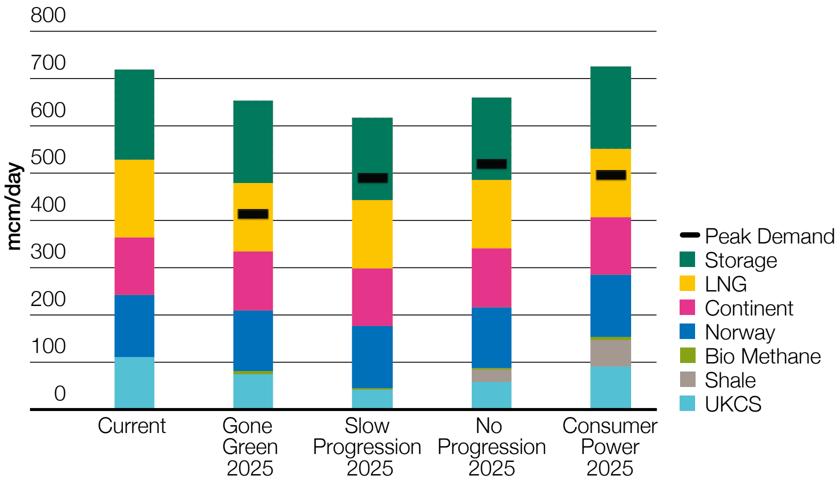


In Slow Progression, UKCS production is low and there is no shale gas, leading to much higher levels of imported gas.

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 3bcm up to 22bcm, dependent on how much of the generic import is LNG.

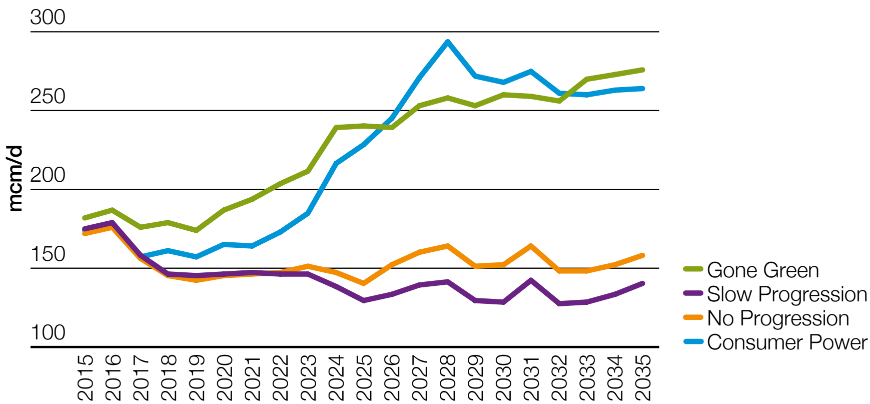
In our 2015 FES the current level of physical supply capability is more than enough to satisfy peak gas demand in all our scenarios. Figure 2.15 shows the current peak supply capability along with the peak supply capability at 2025 in the four scenarios and the peak demands in each. The chart shows that in all years the peak demand can be met by the existing supply infrastructure.

Figure 2.15
Peak supply capacity and demand



In all scenarios and all years there is at least 100 mcm/d supply capability over peak demands as shown in Figure 2.16.

Figure 2.16
Excess of supply capacity over peak demand



Future Energy Scenarios

Supply infrastructure

The peak supply chart in 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 a power 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 proposals for 7 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. We have highlighted the loss of Avonmouth from 2016.

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. These tables show the removal of the Teesport LNG terminal this year from Teesside.

Legislative Change

2.4
Legislative change

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

2.4.1 Industrial Emissions Directive (IED)

The European Union (EU) has agreed targets and directives that determine how we should control emissions from all industrial activity. The Industrial Emissions Directive[13] (IED) is the biggest change to environmental legislation in over a decade, with implications for everyone who relies on the NTS.

The IED came into force on 6 January 2013. 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 overleaf, summarises the key features of IED.

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 Combined Cycle Gas Turbine (CCGT) 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 Section 2.2.7 and Chapter 3).

The IPPC impacts 8 of our 24 NTS compressor sites. The LCP directive impacts 16 of our 64 compressor units. Details of what we are doing to adapt our sites to comply with this legislation are outlined in Chapter 5.

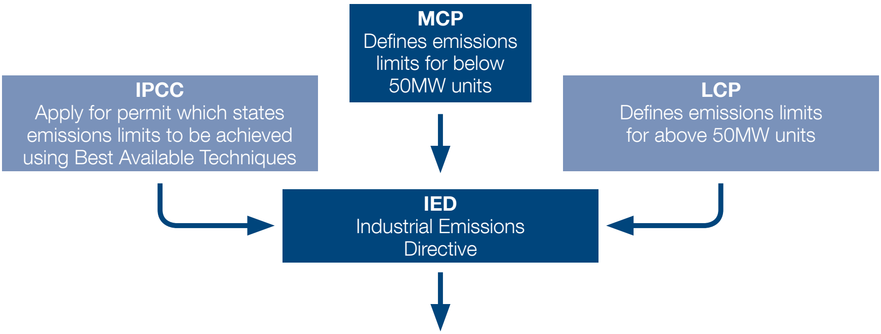
The Medium Combustion Plant (MCP) Directive is currently draft legislation, but is expected to be incorporated into IED within the next year. Based on the current draft legislation we anticipate this will impact a further 26 of our compressor units.

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

[13] A copy of the Industrial Emissions Directive can be found here: http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2010:334:0017:0119:EN:PDF

Legislative Change

Figure 2.17
IED key features



IED Key Features					
Below 50MW	Installations must be operated with a permit	Permits specify the 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 is likely to be finalised in mid-2016	MCP will be finalised before the end of 2015 with compliance required by 2025
Above 50MW	Set new ELV for carbon monoxide 100mg/Nm³ for new and existing plant Set new ELV for nitrogen oxide 50mg/Nm³ new plant; 75mg/Nm³ for existing plant	All our gas-driven compressors that produce emissions above the threshold set by the Industrial Emissions Directive (IED) must be compliant with new limits by 31 December 2023	Compressors not meeting new ELVs have to stop operating by 31 December 2015 unless a Limited Lifetime Derogation is applied for or the unit is 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 which 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.

Integrated Pollution Prevention and Control (IPPC) Directive

The IPPC[14], 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 units have a permit which specifies the maximum Emission Limit Values (ELVs) to the air for each unit.

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

BAT Reference (BREF)

BREF[15] 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 2016. From the date of finalisation we will have four years to implement the conclusions.

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

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

Legislative Change

Large Combustion Plant (LCP) Directive

The LCP[16], 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 above 50MW 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. However, we still have the option to opt out prior to January 2016 if through our IED submission to Ofgem[17] in May 2015 (see Chapters 3 and 5 for more information) an alternative way of compliance (either emergency use provision, decommissioning or replacement) is agreed.

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.

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

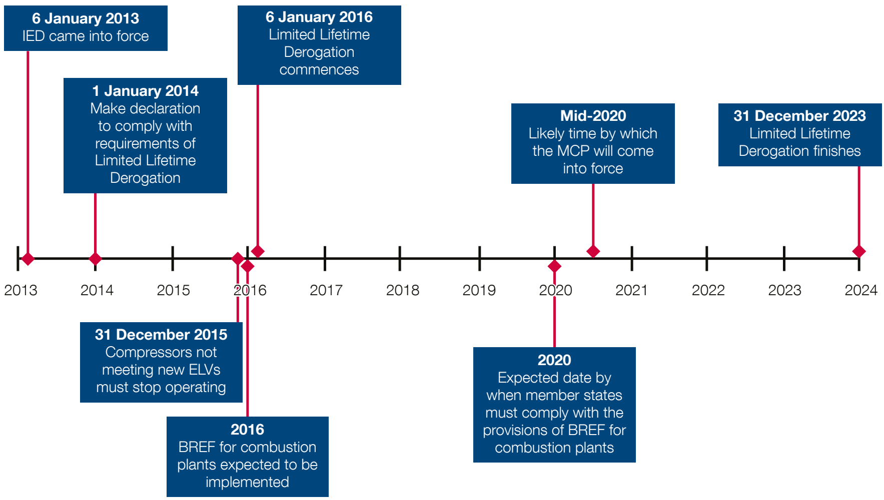
[17] http://consense.opendebate.co.uk/files/nationalgrid/transmission/IED_Investments_Ofgem_Submission_FINAL_REDACTED.pdf

Medium Combustion Plant (MCP) Directive

The MCP is expected to be implemented in 2020. It will apply limits on emissions to air for all combustion plant with a thermal input of less than 50MW. It is expected that this legislation will introduce different ELVs based on the plant's age, capacity and type of installation.

Based on the draft legislation there will be a long transition period for existing plant, up to 2025 for the larger plant (5–50MW) and up to 2030 for the smaller plant (less than 5MW). It is expected that we will have to comply with this legislation by 2025 (Figure 2.18).

Figure 2.18
Excess of supply capacity over peak demand



Legislative Change

2.4.2 Other legislation

European Union Third Package
One of the most important pieces of recent 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 introduces 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 applies in Great Britain from 1 October 2015

(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. Implementation is required by 1 May 2016.

For more information on our activity to date and our future activity to comply with this new 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[18] 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.

Ofgem has asked us to proceed with the development of a centralised demand-side response mechanism. This will allow our large gas customers to reduce demand voluntarily ahead of an emergency. This could help to reduce the likelihood, severity and/or duration of a gas emergency. The demand-side response mechanism is expected to be in place by October 2016.

[18] 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 National Transmission System (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) (previously Network Replacement Outputs) as a proxy for measuring the health and thus level of risk on the network. We must meet specific targets which 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. We have plans in place to meet these targets by the end of the eight-year period.

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.

2.5.1 Asset maintenance

We have a large number of asset types on the NTS. At a high level maintenance approaches are set by asset type however the amount and type of maintenance required can differ both by and within asset types.

For example, two of our asset types are valves and pipelines; we adopt a different overall approach to maintaining valves than we do to pipelines, however the maintenance required by an individual valve within the broader valve asset type will differ depending on the make and model of valve, its location on the network and its age and existing condition.

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.

The following asset types require different approaches to maintenance:

- Pipelines – Risk-based inspection
- Instrumentation – Criticality-based, intelligent condition monitoring
- Electrical – Scheduled inspections and failure-finding functional checks
- Compressors – Condition monitoring, functional checks, scheduled inspections, and usage-based inspections
- Valves – Criticality based intervals
- Above Ground Installations (AGIs) – Functional checks.

We record issues relating to the operational status of assets by giving them a priority score. The issues identified could highlight a requirement for asset repair, failure mitigation or any other work that is deemed necessary to maintain the safe operation of an asset. Issues are scored based on a number of independent parameters with a higher weighting given to problems that have a high impact on the safe operation of the NTS.

The assets score is then used to prioritise replacement or repair of the asset. We use a Replacement Priority Matrix which is based on condition versus criticality, shown in Figure 2.19.

Asset Health

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

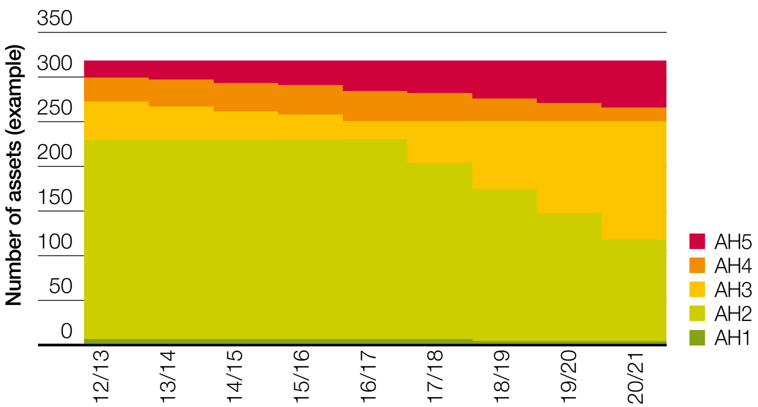
C1	Very High
C2	High
C3	Medium
C4	Low

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

As an asset ages we would expect its condition to deteriorate. Depending on the age of the asset the level of deterioration will vary. Figure 2.20 outlines an example of expected asset health condition decline over a nine-year period. The Asset Ageing Model is based on the Asset Health Scores defined in Figure 2.19 for assets ranging from new to end of life.

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



During 2014/15 we have invested £57m towards maintaining the health of our assets. We have delivered over 2,000 asset health improvements which have contributed approximately 150 NOMs towards our NOMs targets.

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).

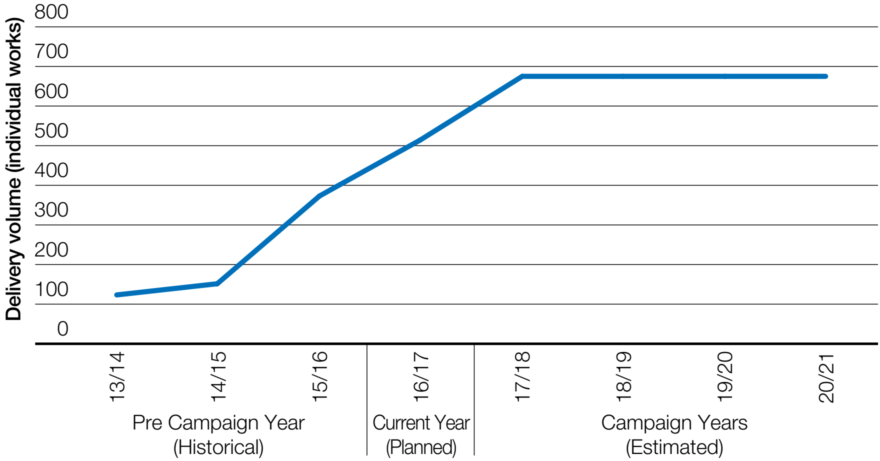
Campaign delivery

The campaign will bundle maintenance work by geographical area, tackling all issues in a particular location at once to minimise costs and provide an operational focal point.

In terms of operational delivery the NTS is split into three areas: Scotland, West and East. These three areas are then divided into zones, with four zones in the West and Scotland and five zones in the East. This approach to zonal planning has been successfully used for feeder outages.

The focused campaign approach was developed to address the growing number of asset health issues that we have identified over the next five years. Figure 2.21 shows the estimated NOM deliveries as part of the campaign.

Figure 2.21
Asset NOM delivery volumes



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.

Asset Health

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 of Energy & Climate Change (DECC).

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 zonal 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 for you.