# 2013 Gas Ten Year Statement

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[1] 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.

Front cover image: Churchover Compressor Station

Welcome to the 2013 edition of the Gas Ten Year Statement (GTYS). I hope that you find it an informative and useful document. The purpose of this document is to set out our assessment of the future demand and supply position for natural gas in Great Britain, the consequences for operation of the Gas Transmission Network and system capability requirements to meet this assessment.

**The production of the Gas Ten Year Statement is the conclusion to the planning process for the current cycle. It follows the publication of our Future Energy Scenarios document in July 2013. Some of the detail behind our scenarios sits within the Future Energy Scenarios document, allowing the Gas Ten Year Statement to focus on the implications of the scenarios for the development of the gas network.**

The statement explains our latest volume forecasts, system reinforcement projects and investment plans. It has been published at the end of the 2013 planning process following a re-appraisal of our analysis of the market and expands on the work in our **Future Energy Scenarios** document published in July 2013. The statement forms the basis of our industry wide revised consultation process, Future Energy Scenarios, due to restart in the new year, and is the first element of our 2014 planning process.

In response to stakeholder feedback, within this year's GTYS we have made some improvements to increase transparency of the need case for future capability requirements. In addition, in order to better inform our customer and stakeholder decision making processes we have included further information regarding the lead time for providing NTS Entry and Exit Capacity across different geographical zones as an indicative guide for customers.

During 2014, we will engage with our customers and stakeholders on how we can improve the transparency of our network capability requirements and the decision making in response to these requirements (i.e. investment or commercial solutions). We see this engagement as being increasingly important with considerable future uncertainties as detailed in our Future Energy Scenarios.

Your input is of great importance to us and I encourage you to read the Way Forward chapter of this document for further information on our 2014 GTYS consultation process. I also encourage you to tell us what you think by writing to us at **Box.SystemOperator.GTYS@nationalgrid.com**, engaging us at future stakeholder events or meet with us face to face.

I hope that you find this an informative and useful document and look forward to receiving your feedback.

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# Contents

# Executive Summary

## The purpose of Gas Ten Year Statement is to illustrate the future development of the National Transmission System (NTS) under a range of plausible energy scenarios and to provide information to assist customers in identifying opportunities to connect to the NTS.

The key information that underpins development in our network is the understanding of how supply and demand on our network could evolve over time and how our customers wish to use our system in the future.

The UK energy sector has the challenge of providing safe, reliable and secure energy as part of a sustainable, decarbonised and affordable future. There is considerable uncertainty when talking about the future, therefore National Grid develops energy scenarios to help us visualise it and plan. The scenarios consider a range of potential drivers that might have an impact on the future of energy. When planning the gas transmission system, we know:

- There is considerable uncertainty in the future supplies of gas, where it is possible that supplies could be either LNG (e.g. Milford Haven or Isle of Grain) or Continental gas (e.g. via IUK)
- The credible range of supply patterns to meet demand at any level that need to be considered is increasingly wide ranging
- Peak gas demand could remain relatively stable even with falling annual demands
- The intermittency of power generation is anticipated to increase over time as renewable generation grows which increases the requirement for gas-fired power generation to act as a back-up, operating with low load factors. This requirement will increase over time as more renewable generation comes online and other forms of conventional generation (e.g. coal) are retired.

Customer requirements from the NTS continue to change and evolve beyond that which has been traditionally seen. We continue to see an increased distribution network flex capacity requirement against a background of reduced distribution network flat capacity requirements.

The pace of development of the NTS, when judged by customer signals for incremental capacity, has slowed in recent years. Looking forward, as wider energy market processes move towards conclusion, in particular the Electricity Market Reform process, we are seeing indications of an upcoming period of renewed development activity.

In response to stakeholder feedback, we have included information regarding the lead time for providing entry and exit capacity across different geographical zones. We hope that this will help inform discussions with customers, to guide them in deciding where they may be able to site their projects.

Our current business plan has a total level of investment in the range £1.1bn to £2.2bn (2009/10 prices). This variation is largely due to the range of potential incremental entry or incremental exit capacity signals we may see in the next ten years. To provide more certainty in this area, National Grid has proposed an amendment to the contractual frameworks, known as the Planning and Advanced Reservation of Capacity Agreement (PARCA). The PARCA arrangements would enable customer and National Grid timelines to be aligned, with connections and capacity being delivered together. This process aims to provide more certainty to project developers, with transparency of all the process steps and deliverables required from both parties and sets out a timeline from initial contact through to capacity release whilst also allowing the review, discussion and potential revision of that timeline and break-out points.

A further major component of our business plan is a programme of investment to ensure that our compressor fleet remains compliant with European emissions legislation. We have already seen some key changes to the capability requirements of the compressor fleet. Some compressors are now required to support network flows in a reversed direction from their original design; some compressors have become increasingly important across a large demand range; and some only at peak demand conditions or certain supply patterns in order to avoid significant constraints. Looking forward, changing capability requirements will inevitably influence investment decisions.

The trend of increased within day variability over recent years is leading to greater operational challenges, manifesting itself particularly with respect to difficulties in the management of within-day system storage capability and ensuring that NTS pressures remain within obligated operational and safety tolerances. The changing nature of supply patterns from day to day also provides challenges to ensure the system is configured to provide maximum capability. Our challenge as the System Operator is to anticipate how these uncertainties can be managed to provide the system capability that our customers need and want into the future, economically, efficiently, safely and reliably.

To meet this challenge, we are undertaking a project to review the future requirements for the system. We are considering how different events or factors across gas days and within day might affect the way that the system is managed and possible asset, commercial and operability options that could be progressed to deliver more capability in this area.

We intend to start engagement with the industry on our future network capability requirements with respect to compressors and network flexibility from Q2 2014. This engagement will start with quantifying the need case for future network capability requirements and then consider the solutions to meet this.

We are committed to ensuring that the Gas Ten Year Statement continues to evolve and that each year our stakeholders have the opportunity to shape the development of this document. We would welcome any views on the content and scope of year's document and whether you would like to see any changes made to future versions of this document. We are happy to receive engagement of any kind through the following means and of course at any other opportunities we get to meet:

- At customer seminars
- At operational forums
- Through responses to the GTYS email **Box.systemoperator.gtys@nationalgrid.com**
- Bilateral stakeholder meetings

# Chapter One
# Introduction

The Gas Ten Year Statement (GTYS) illustrates the potential future development of the National Transmission System (NTS). It helps existing and future customers to identify connection opportunities on the gas transmission system. This introductory chapter outlines the approach we have undertaken and sets out the scope of the GTYS.

# 1.1
# Background

The GTYS is produced for you, our stakeholders, and we want to ensure it develops as a result of what you have told us.

The document forms part of a suite of publications which is underpinned by our Future Energy Scenarios. This enables the analysis in both the GTYS and its sister publication – the Electricity Ten Year Statement (ETYS) – to have a consistent base when assessing the potential future development of both the gas and electricity transmission networks.

We have received feedback, through face to face meetings at the gas customer seminar and also through our written consultation on how you would like to see the GTYS developed.

The feedback received is included in Chapter 6, Way Forward. Following the publication of this edition of the document, we will gather views from you to enable us to continually evolve the document and incorporate your views. Section 1.5 outlines how we aim to embed your views into the development of the document to a greater degree.

# 1.2
# Overview of Network Development Process

The production of the Gas Ten Year Statement is the conclusion to the Network Development Process for the current planning cycle. This document uses energy scenarios detailed within our 2013 Future Energy Scenarios publication.

## Future Energy Scenarios

This Gas Ten Year Statement covers the future design and development implications on the gas network. It is shaped by the two scenarios detailed in National Grid's Future Energy Scenarios document, which can also be found on our website. These scenarios are:

- **Slow Progression** – developments in renewable and low carbon energy are relatively slow in comparison to Gone Green and the renewable energy target for 2020 is not met until some time between 2020 and 2025. The carbon reduction target for 2020 is achieved but not the indicative target for 2030.
- **Gone Green** – Gone Green sees the renewable target for 2020 and the emissions targets for 2020, 2030 and 2050 all met.

An overview of these scenarios and how we utilise them as inputs for our wider system planning, can also be found in Chapter 2.

## Transmission Planning Code

The Gas Ten Year Statement concentrates on the implications of the scenarios for the development of the gas network. This sits alongside our **Transmission Planning Code** which describes the methodology used to determine the physical capability of the system, to inform parties wishing to connect to and use the NTS, of the key factors affecting the planning and development of the UK Gas Transmission System.

# 1.3
# Navigation through the document

The form of the document has been changed this year as we have responded directly to what you have told us. The changes to the document will hopefully bring further clarity to drivers for new capability on the system and also to provide transparency on where additional capacity is available at short lead times.

**Network Development Inputs** – This chapter describes the key inputs to the development of the network. This section sets out our previously published view of gas supply and demand in the Slow Progression and Gone Green scenarios, with the key similarities and differences between the two scenarios highlighted.

**System Operation** – This chapter provides an updated view of some of the major factors impacting our operations against future supply and demand patterns on the system and what we intend to do to meet future system operator challenges.

**Customer Requirements** – This chapter sets out details around exit and entry capacity availability and lead times. It also details user commitments with regards to capacity on the network from the recent entry capacity auctions and exit commitments.

**Meeting Future Capability Requirements** – Set out in this chapter are the currently sanctioned NTS reinforcement projects, those that are presently under construction for 2014 and indicative investment options for later years, assessed against the scenarios and sensitivities detailed in the Future Energy Scenarios document and signals received in the recent entry capacity auctions and exit commitments.

**Way Forward** – We are committed to ensuring that the GTYS continues to evolve and that each year our stakeholders have the opportunity to shape the development of this document. This chapter details the engagement process which will run in 2014.

**Appendices** – The appendices provide details of the methodologies used to produce the demand and supply scenarios, the latest demand and supply scenarios themselves, actual gas flow data, system maps and connection specifications (including gas quality). The appendices also contain a section on industry terminology and a conversion matrix.

The key demand and supply data shown in this year's document can be found in an Excel spreadsheet file on our website.

# 1.4
# Other Publications

This document details the implications of gas transmission investment from our demand and supply scenarios. There are a suite of other documents relating to scenarios and energy investment. These include:

### 1.4.1 Distribution Network Long Term Development Statements

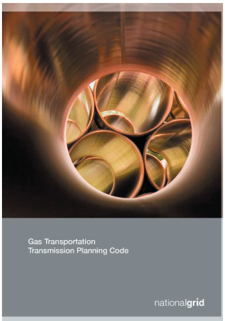
The Gas Ten Year Statement concentrates solely on the gas transmission network. Information relating to the Distribution Networks can be found in the Long Term Development Statements / Plans which can be accessed via the links across:

*National Grid UK Distribution Long Term Development Plan*

*Northern Gas Networks Long Term Development Statement*

*Scotia Gas Networks Long Term Development Statement*

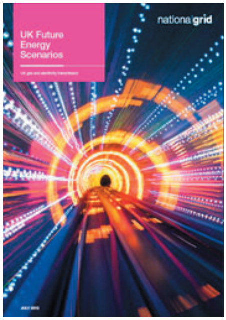
*Wales & the West Utilities Long Term Development Statement*




### 1.4.2 Gas Transportation Transmission Planning Code

This document 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

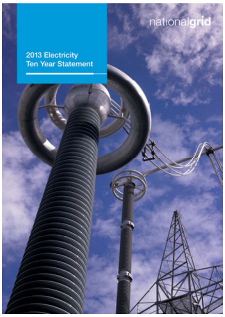
National Grid must comply with the Transmission Planning Code in planning and developing the NTS. National Grid must also review the Transmission Planning Code at least every two years, after consultation with the gas industry. Modifications to this code must be approved by the Gas and Electricity Markets Authority (GEMA) before they may be implemented.




### 1.4.3 Future Energy Scenarios Document

The UK energy sector has the challenge of providing safe, reliable and secure energy as part of a sustainable, decarbonised and affordable future. There is considerable uncertainty when talking about the future, therefore National Grid develops energy scenarios to help us visualise it and plan. The scenarios consider a range of potential drivers that might have an impact on the future of energy.

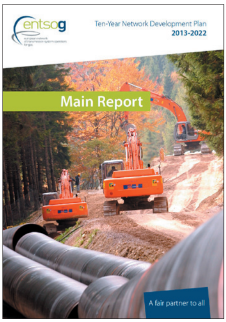
The latest Future Energy Scenarios document was launched at a one-day conference in July 2013 attended by a wide range of industry and other stakeholders. Feedback gathered from the event, from a series of workshops and from meetings with our stakeholders will be used in the development of the next set of scenarios, due for publication in 2014.




### 1.4.4 Electricity Ten Year Statement

Last year the Electricity Ten Year Statement (ETYS) replaced the Seven Year Statement (SYS) and the Offshore Development Information Statement (ODIS), harmonising their outputs and ensuring consistency in their assumptions with those in our Future Energy Scenarios.

The aims of the Electricity Ten Year Statement publication are to illustrate the potential future development of the GB Transmission System and to help existing and future customers to identify connection opportunities on both the onshore and offshore transmission system.




### 1.4.5 Ten Year Network Development Plan (TYNDP)

The TYNDP is a European development plan regarding the investments in gas transmission systems which are required on a pan-European basis and to support decision-making processes at regional and European level.


### 1.4.6. UK Transmission Customer Commitment

To continue being successful, we know that we need to operate differently. The world around us is changing, so we want to be part of that change and to help drive it.

From feedback that we have received we know that our customers are starting to experience the focus that we are putting on our customer service. We'll keep checking to make sure that we continue to improve your customer experience and deliver the levels of service you need from National Grid.

# 1.5 Stakeholder Engagement

We are committed to Stakeholder Engagement and ensuring your views are central to the development of this document. This year we have embedded this Stakeholder Engagement throughout the document.

Throughout the document you will see key areas we believe further engagement and industry experience could further enhance this statement. However, feedback is not limited to those questions we would be delighted to receive feedback of any nature, by any means appropriate. We are also keen to know how you wish to engage with us on the development of the GTYS.

We will be looking to engage with stakeholders:

- At consultation events and as part of the customer seminars
- Through responses to the GTYS email link as below
- By organising bilateral stakeholder meetings depending on the feedback

In preparation for next year's statement a Way Forward section, Chapter 6, is included at the end of this document that summarises our next steps in the engagement process for the GTYS 2014.

This Stakeholder Engagement provides an opportunity for us to understand your views. We would very much like to understand how this document is used by the industry and how our work affects others with a view to incorporating these views into our decision making processes.

**Should you wish to provide us feedback on any of the content of this document we would ask you to submit it to: Box.SystemOperator.GTYS@nationalgrid.com, catch up with us at one of our consultation events or arrange a face to face meeting.**

# 1.6
# Introducing the Transmission Network Strategy Teams

We would like to take this opportunity to introduce the Gas Network Development Team and the Transmission Strategy Team.

The Gas Network Development Team is responsible for defining the future gas system capability needs against customer requirements, Future Energy Scenarios and operability requirements. It responsible for defining the most economic solutions to meet the future capability needs.

The Transmission Strategy Team considers and directs strategic and policy options that will maintain and enhance our current system operator and transmission owner roles for both gas and electricity, whilst working with a broad spectrum of stakeholders.

It is the purpose of the Gas Ten Year Statement to engage with our stakeholders on the future development of the gas system. We would very much appreciate your suggestions and feedback.

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# 1.7 Introducing the Transmission Gas Customer Service Team

We would like to take this opportunity to introduce the Transmission Gas Customer Service Team and let you know what we have been doing and plan to do to help improve your experience with National Grid. Based on your feedback we aim to improve the way we engage with you by organising ourselves better and focusing on dedicated workshops and face-to-face engagement, where appropriate, to reduce the burden on you. We will continue to engage with you as we work together in shaping the future.

We have been listening and you told us that the connections process should be a key priority for us and that it needs to be improved and simplified. We are committed to improving the services we provide to you, as well as ensuring everything we do provides value for money. We will continue to work with you to improve the processes and frameworks that underpin the services we provide and strive to ensure they work within the commercial and regulatory environment in which we all operate.

- Throughout 2013/14 we will engage with you on the development of new capacity and connection arrangements, with the aim to have these in place in April 2014
- In July 2013 we introduced gas customer seminars, to give you a forum to engage with us on a variety of connection-related issues
- We will meet our obligations to deliver timely offers for connections to our network and work to ensure (where possible) that we can meet your desired connection date and explain to you the reasons why we can't
- We will continue to work with you to improve engagement throughout the lifetime of your project and reconcile any charges within the agreed time scale.

We have appointed Customer Account Managers to ensure you have a point of entry into our organisation, this ensures our people are accessible to you and we respond to your queries in a timely manner. We will provide an acknowledgement of any complaint within 2 working days of receipt and provide a full response within 20 working days of receipt.

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Chapter Two

# Network Development Inputs

This chapter describes the key inputs to the development of the network. It sets out our previously published view of gas supply and demand in the Slow Progression and Gone Green scenarios, with the key similarities and differences between the two scenarios highlighted.

### Key messages in this chapter

**Demand**

- Peak gas demand could remain relatively stable even with falling annual demands.
- The intermittency of power generation is anticipated to increase over time as renewable generation grows which increases the requirement for gas-fired power generation to act as a backup, operating with low load factors. The requirement will increase over time as more renewable generation comes online and other forms of conventional generation (e.g. coal) are retired.

**Supply**

- There is considerable uncertainty in the future supplies of gas, where it is possible that supplies could be either LNG (e.g. Milford Haven or Isle of Grain) or Continental gas (e.g. via IUK).
- The credible range of supply patterns to meet demand at any level that need to be considered is increasingly wide ranging.

# 2.1
# Overview

Our 2013 scenarios make extensive use of axioms[1] to intentionally create scenarios which encompass a wide range of possible future developments. These axioms mainly impact on the level of annual gas demand, which is anticipated to reduce in both scenarios. The intermittency of power generation is anticipated to increase over time as renewable generation grows. It is anticipated that gas-fired power generation will play an important role in helping to support the decarbonisation of electricity, as this type of generation will help to manage this intermittency. Peak gas demand could therefore remain relatively stable even with falling annual demands.

Appendix 2 of our Future Energy Scenarios document contains the full set of axioms used in creating our 2013 scenarios; Table 2.1A shows some of those most relevant to gas supply and demand.

There are four key drivers for capability in the gas transportation infrastructure:

- The level of 1 in 20 peak day gas demand
- Entry requirements for supplies including imports and storage
- The range of credible supply and demand patterns, both daily and within day patterns
- The resilience of the gas transportation infrastructure against credible planned and unplanned events (e.g. supply loss, outages or transportation infrastructure failure).

[1] An axiom is a premise or starting point of reasoning.

*Table 2.1A*
*Gas Supply and Demand Axioms*[2]
*Source: National Grid*

| | Slow Progression | Gone Green |
|---|---|---|
| Targets | UK 2020 renewable target is missed. Pathway to 2050 falls short of carbon targets and 4th carbon budget. Pressure for UK carbon targets to be abandoned. | Targets met. Scenario based on meeting targets. Balanced approach across all market sectors, no carbon trading. No change to EU and UK policies. |
| CCGT | There is limited new build in the very near term and existing CCGTs and OCGTs stay open longer. Gas CCGT is default option for longer term. | CCGTs are run more flexibly to provide backup to variable generation. No unabated CCGTs post 2030. |
| Economic Outlook | Low economic growth. | Moderate economic growth. |
| Domestic Energy Efficiency | Lower drive for energy efficiency. Green Deal domestic energy efficiency improvements are limited. | Drive for energy efficiency. Green Deal domestic energy efficiency improvements are significant. |
| Commercial Energy Efficiency | Historical rates of energy efficiency improvements continue. | Carbon Reduction Commitment Energy Efficiency Scheme and fuel prices drive energy efficiency above historic levels. |
| Heat | Replacement of conventional boilers with condensing boilers continues at current rates. | Many properties replace gas boiler for electric heat pump. Replacement of conventional boilers with condensing boilers continues in properties unsuitable for heat pumps. |
| Energy User Behaviour | High behaviour inertia. | Drive towards demand reduction / shifting. |
| Global Gas Markets | Gas becomes increasingly important as the lowest carbon fossil fuel. Gas demand in China and other emerging markets increases significantly. Uncertainty in supply sources to meet this demand leads to an uncertainty in global LNG trade and therefore LNG and Continental imports to the UK.<br><br>NTS exports are subject to balance of LNG imports. | The role of gas in power generation and heat is diminished due to increased deployment of lower carbon technologies.<br><br>Future gas developments are held back due to uncertainty in the future market for gas, leading to uncertainty in global LNG trade and therefore LNG and Continental imports to the UK.<br><br>NTS exports subject to balance of LNG imports. |
| Gas Supply (UKCS) | Further development of smaller fields drives higher UKCS supply and lower rate of decline than compared to Gone Green. | Limited development of smaller fields leads to lower UKCS supply and more acute decline than in Slow Progression. |
| Gas Supply (Norway) | Higher Norwegian production. | Lower Norwegian production. |
| Gas Supply (LNG) | Increased global liquefaction production facilities (from Australia, USA, East Africa, Israel etc). | Lower level of global LNG production facilities. |

[2] This list is non exhaustive; other axioms in the Future Energy Scenarios document are also relevant to gas supply and demand.

| | Slow Progression | Gone Green |
|---|---|---|
| Gas Supply (Continent) | Increased gas supplies to Europe via numerous routes (mainly through increased Russian gas to Europe). | Decreased gas supplies to Europe. |
| Shale Gas, Coal Bed Methane, Biogas | UK shale gas extraction (increase from 2012 analysis) favoured over biogas. | Biogas production favoured over UK shale gas extraction. |
| Gas Storage | Security of supply and Government gas storage strategy drives increased seasonal storage. | Lower gas demand and access to European storage sites drives increase use of fast cycling flexible storage sites. |

# 2.2
# Demand

This chapter covers our assessment of annual and peak demand and the key drivers associated with these demands.

Gas demand described here is highlighted in further detail in the National Grid publication Future Energy Scenarios.

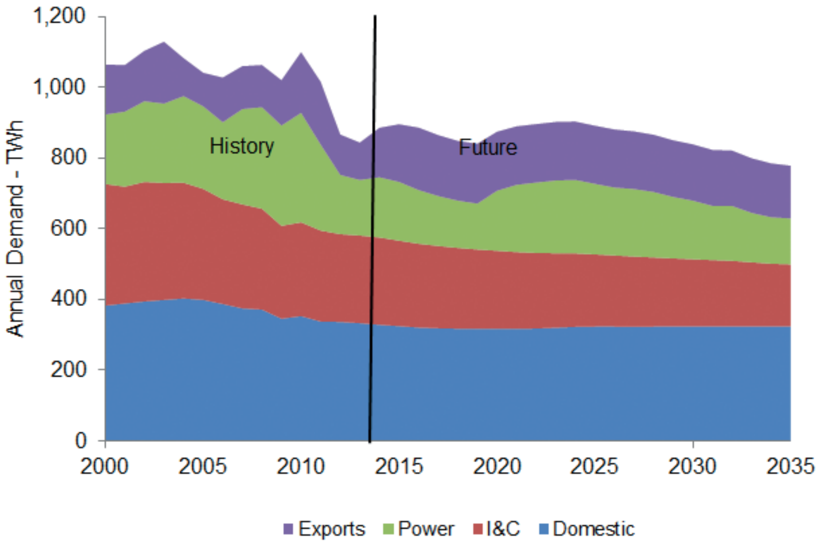
The main drivers of gas demand are:

- Fuel prices;
- Economy;
- Energy efficiency;
- Electrification of heat;
- Sites opening / closing;
- Power generation requirements and associated power generation mix; and
- Gas exports to the continent and Ireland.

These factors vary between scenarios due to the axioms that underpin them.

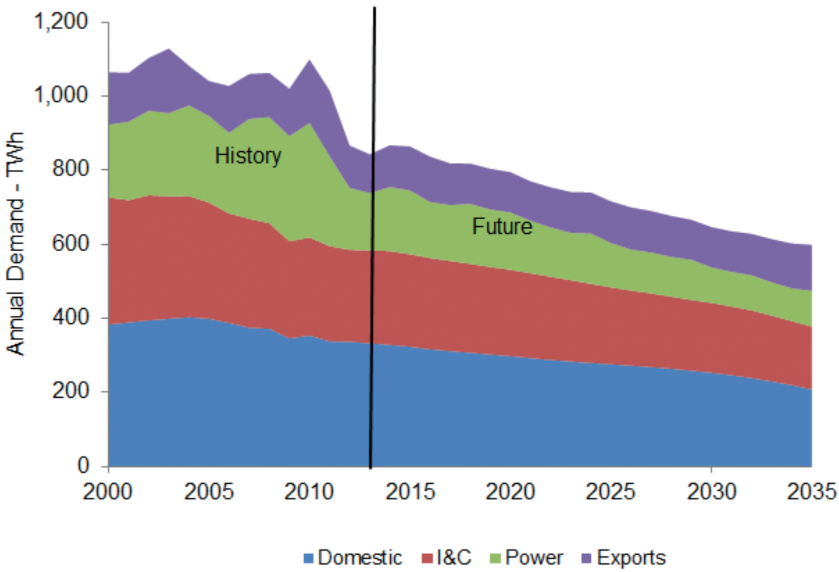
The two scenarios show very different outcomes for gas demand, due predominantly to the changes in demand for power generation and domestic sectors.

*Figure 2.2A*
*Annual Gas Demand Scenarios including history – Slow Progression*
*Source: National Grid*




Our Slow Progression scenario has a fairly flat view of annual demand over the scenario period. There is a further decrease in demand from 2012 due to a slower economy. Total demand then remains broadly flat, until the mid 2020s when total demand starts to decrease predominantly due to the changes in power generation demand.

*Figure 2.2B*
*Annual Gas Demand Scenarios including history – Gone Green*
*Source: National Grid*




In the Gone Green scenario, there is a continual reduction in annual gas demand throughout the scenario period. This is due to a combined influence of further efficiency savings, a transition to alternative sources of energy in our Gone Green scenario, and power generation being maintained as marginal plant for electricity balancing and reserve.

# 2.3
# Peak Gas Demand

Our peak gas demand scenarios are aligned to our annual gas demand scenarios.

Figure 2.3A shows the peak demand for both scenarios. The similar peaks for both scenarios up to 2018/19 reflect the similarity between annual demands over the same period.

From 2020 the differences in peaks reflect the differences in domestic gas demand and gas demand for power generation.

*Figure 2.3A*
*Peak Gas Demand; both scenarios, GWh/d*
*Source: National Grid*

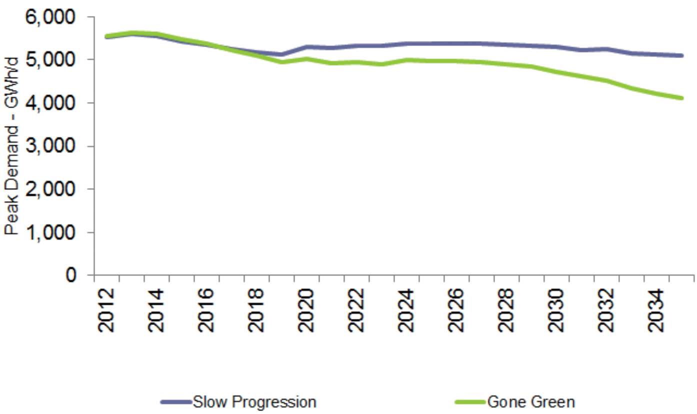



Figure 2.3A also shows that in both scenarios the peak gas demand trend is flatter than the corresponding annual gas demand. The relationship between total annual demand and peak will change as the market mix changes. The variation between peaks and annuals can be understood by splitting the total peak gas demand into domestic, industry, commercial and power generation components – this breakdown will be discussed in the subsequent sections.

Peak gas-fired electricity generation is less related to weather and more dependent on generation availability and the position of gas power stations in the generation merit order. It is predominantly this change that drives any differences in peak day forecast year on year. Unlike annual gas demand for the sector which is expected to decline, peak gas-fired electricity generation will remain broadly as it is today, due to the increasing requirement for gas-fired power generation to act as a back-up for renewable generation. This requirement will increase over time as more renewable generation comes online and other forms of conventional generation (e.g. coal) are retired.

We are presently analysing the future role of gas generation and the impact on gas demand, in particular, the within day variation in demands, and consequential impact on the capability of the gas transmission system. We expect to complete this analysis early next year and we will share our analysis with stakeholders.

# 2.4 Domestic Demand

The changes in domestic gas demand are mainly due to the following:

- Behaviour change (comfort levels)
- Extra demand from new houses
- Energy efficiency in the existing housing stock
- Electric heat pumps replacing gas boilers in the existing housing stock.

This is covered in further detail in section 4.3.1 of the Future Energy Scenarios document.

*Figure 2.4A*
*Domestic Gas annual demand in both scenarios*
*Source: National Grid*

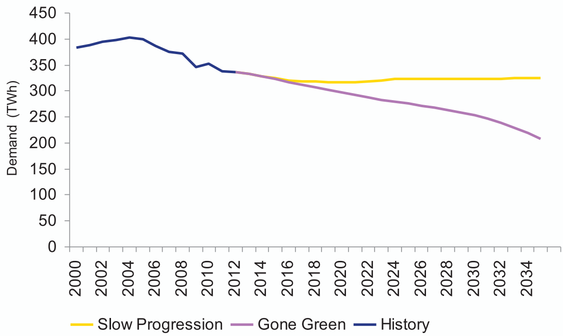



*Figure 2.4B*
*Domestic Gas peak demand in both scenarios*
*Source: National Grid*

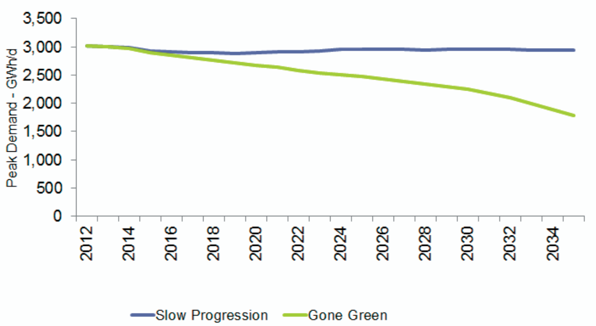


Figure 2.4A shows domestic gas demand in the context of history. After years of steady domestic gas demand growth, demand started decreasing from 2005, due to a combination of behaviour change and increasing energy efficiency in the sector. Slow Progression shows the effect of behaviour change slowly reverting to previous levels (with relatively small amounts of extra energy efficiency), whereas Gone Green shows a continuation of the behaviour of lowering household temperatures combined with high levels of insulation. As previously mentioned, Gone Green has some electrification of houses currently heated by gas, with a material effect from mid / late 2020s.

Figure 2.4B shows the peak domestic gas demand in both scenarios. The peak domestic trend generally follows the annual trend in both scenarios.

### 2.4.1. Industrial and Commercial Demand

This market sector has less variability between scenarios than other sectors for two reasons:

- Many elements of the sector have a particularly consistent gas demand – especially larger large loads; and
- The interaction of axioms pulling in opposite directions mitigating material differences.

History shows a general steady annual decline in this sector as a result of a transition in the manufacturing sector towards less energy intensive production. Our scenarios show a continuation of this trend with some large loads reducing their demand or stopping taking gas in Slow Progression due to slower economic activity, whereas in Gone Green other sites convert to biomass. This leads to Slow Progression showing lower gas usage than Gone Green out to 2028, as site closures and usage reductions depress demand further than the increases in efficiency shown in Gone Green. The Service sector has underpinned economic growth and is expected to drive the UK back to long term recovery in both scenarios. However, Slow Progression has a slower return to growth and Gone Green includes similar electrification assumptions to the domestic sector, offsetting increasing demand from new office and retail buildings.

Peak demands decline consistent with the annual demand in these sectors.

*Figure 2.4C*
*Industrial and Commercial Gas annual demand in both scenarios*
*Source: National Grid*

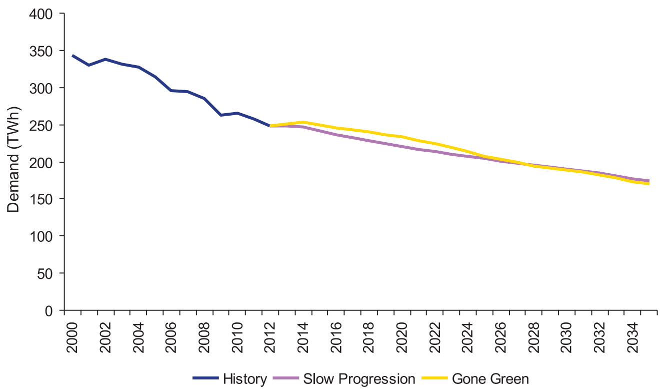
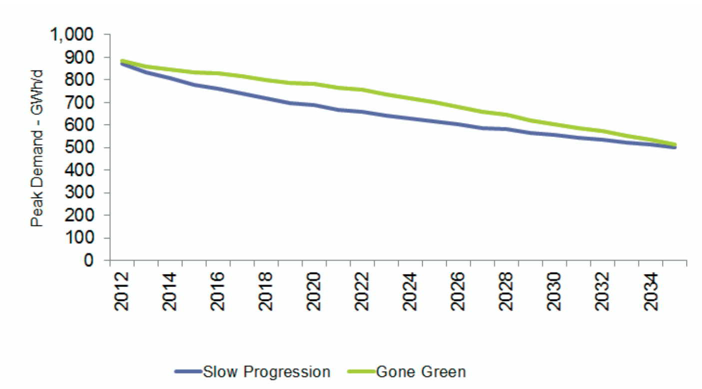



*Figure 2.4D*
*Industrial and Commercial Gas peak demand in both scenarios*
*Source: National Grid*



### 2.4.2. Power Generation

Across both 2013 scenarios the level of installed gas generation capacity is lower than in the 2012 scenarios. This is primarily driven by a reduced need brought about by lower Average Cold Spell (ACS) peak demands in the 2013 scenarios and also, in Gone Green, by increased levels of biomass plant conversions.

Gas demand for generation increases by over 10% in the 2013 scenarios relative to the 2012 scenarios as a result of earlier Large Combustion Plant Directive (LCPD) related coal and oil plant closures. In the short term, Gone Green has a higher annual and peak demand for gas generation due to higher carbon prices adding costs to coal generation.

By 2020/21 the Industrial Emissions Directive further restrict coal plant capacity leading to a step increase in peak demand, with Slow Progression also showing a marked increase in annual gas demand due to lower levels of renewable generation. However, longer term both scenarios continue to have declining demand.

Both scenarios end up with a peak demand at similar level to 2012/13, due to the influences of declining annual gas demand and increased use of gas-fired generation for balancing purposes.

*Figure 2.4E*
*Power Generation Gas annual demand in both scenarios*
*Source: National Grid*

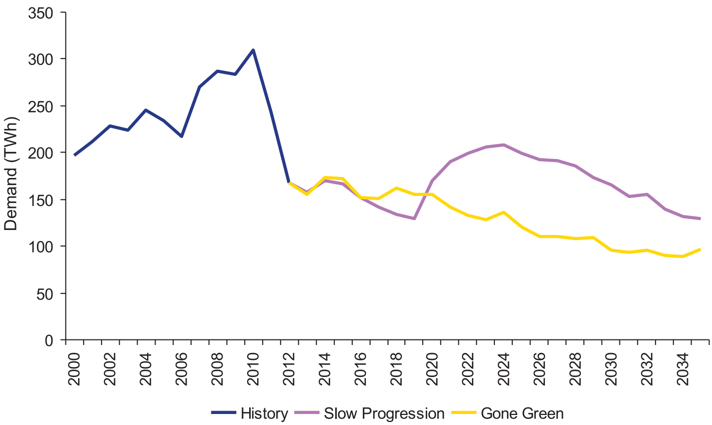


*Figure 2.4F*
*Power Generation Gas peak demand in both scenarios*
*Source: National Grid*

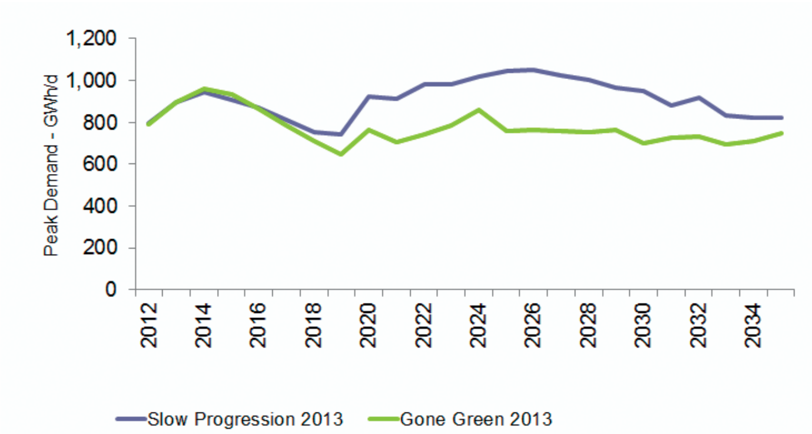
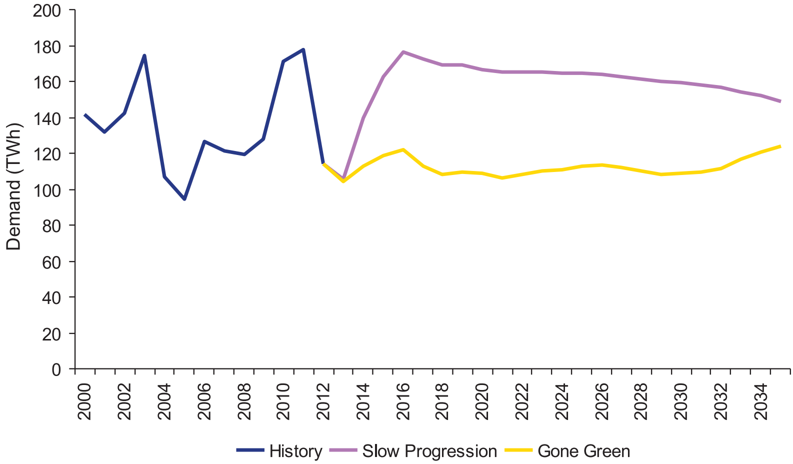


*Figure 2.4G*
*Exports demand in both scenarios*
*Source: National Grid*




### 2.4.3 Exports

The predicted level of gas exports to Ireland is heavily influenced by the development of indigenous Irish gas supplies via the Corrib gas field and the prospects regarding Irish gas demand. For each scenario we assume Irish supplies from Corrib post-2016/17, no developments of LNG projects and new Irish storage projects in the mid-2020s to meet peak gas demand. On the demand side we assume similar energy trends in Ireland to that in the UK for each scenario; hence Irish demand is essentially flat in each scenario until the early 2020s when demand increases from power generation.

Exports to (and indeed imports from) Europe via Interconnector UK (IUK) are highly sensitive to both the overall UK supply / demand balance and Continental gas markets, for this reason both the levels of imports and exports flowing through IUK are subject to a great deal of uncertainty. The level of imports from the Continent and LNG are interrelated and subject to uncertainty in both scenarios, this is covered further in the supply section.

IUK exports are higher in Slow Progression than in Gone Green. This is due to the assumptions regarding the overall supply availability to the UK from other supply sources. This is further described in Section 4.4 of the Future Energy Scenarios 2013 document.

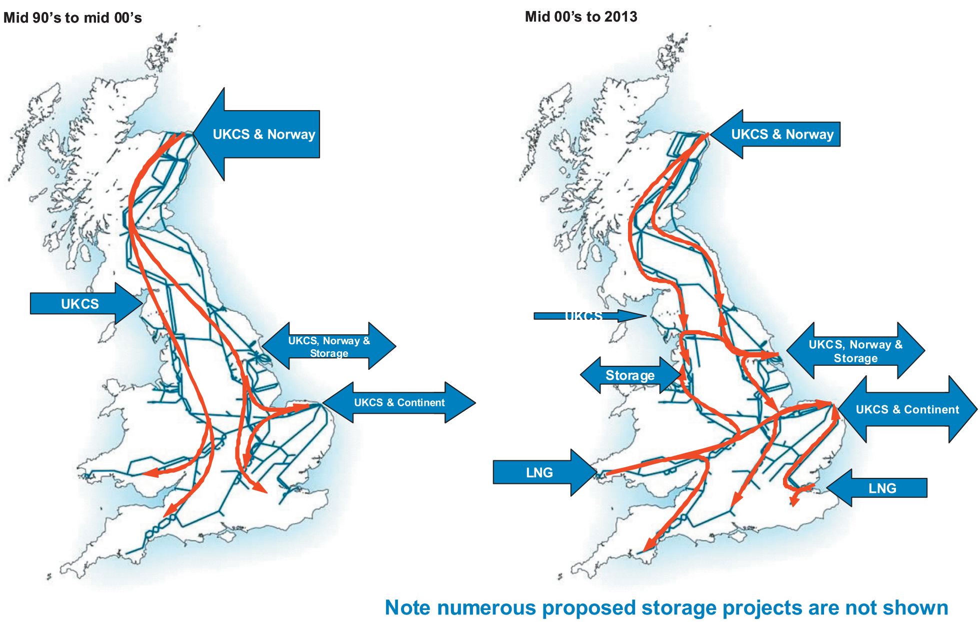
### 2.5.1 Supply Overview

National Grid's UK Future Energy Scenarios publication examines the gas supply components behind the two scenarios – Slow Progression and Gone Green. Rather than replicate this information, the supply section of the 2013 Ten Year Statement contains the information related to Gas Transmission capability planning:

- Charts showing annual and peak supplies for the two scenarios;
- Chapter 3 also details some background on the historic changes of gas supply; including historical evidence on the winter variation between winter maximum and minimum;

We have highlighted in recent years how supply patterns on the NTS are changing and are anticipated to become more uncertain into the future. Figure 2.5A represents some of the changes we have seen in flows on the system from the mid 1990's to today.

*Figure 2.5A*



In the mid 1990's to the mid 2000's, supply levels were relatively easy to predict as they were dominated by flows from the UKCS, mainly entering at terminals on the east coast and travelling through the system in a general north-south flow pattern.

The UK became a net importer of gas for the first time in 2004 due to the decline in UKCS gas production.

A positive consequence of this supply transition has meant that there are more supply points onto the NTS and they are much more distributed around the UK and the average distance for transporting gas from supplies to demands has reduced. Supply capacity in relation to peak demand has also grown from ~105% in 2005 to ~140% in 2013. These factors have helped security of supply and the management of compressor fuel usage.

However, this increased supply capacity over peak demand also drives complexity to planning the capability on the Gas Transmission System. The credible range of supply patterns to meet demand at any level that need to be considered is increasingly wide ranging due to:

- The uncertainty of worldwide gas markets and the impact of this on gas imports from Norway, LNG and from the continent via the interconnectors
- The development of a number of fast-cycle storage sites.

As an example of the impact this can have on planning; if we have high Milford Haven flows then there is a large amount of exit capacity in South Wales whereas if we have low Milford Haven flows then exit capacity is limited.

The following two charts (figures 2.5B and 2.5C) show the annual supply scenarios for Slow Progression and Gone Green. (Peak demand scenarios can be found in Appendix 2).

*Figure 2.5B*
*2013 Annual Supply - Slow Progression*
*Source: National Grid*

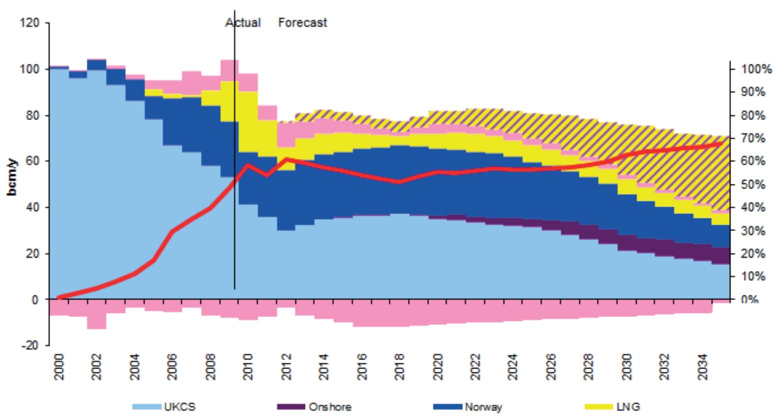


*Figure 2.5C*
*2013 Annual Supply – Gone Green*
*Source: National Grid*

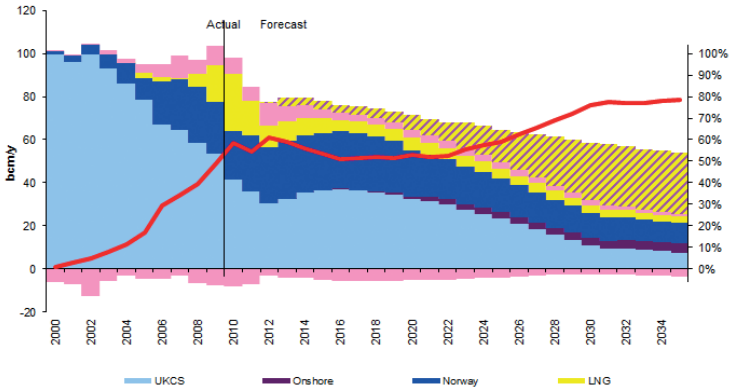
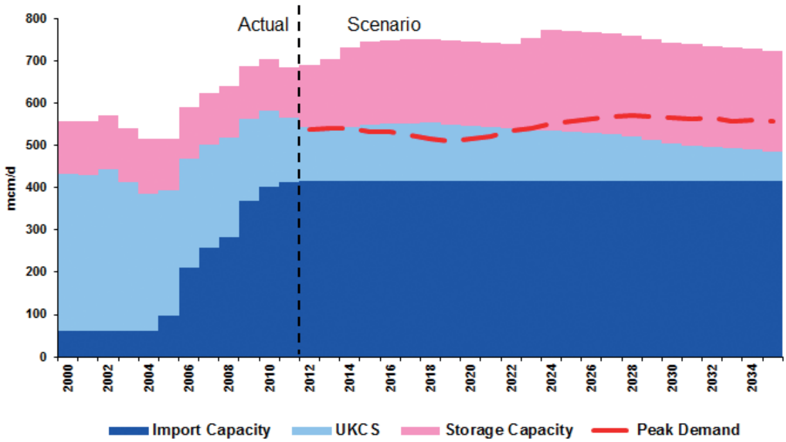


*Figure 2.5D*
*2013 Peak Supply - Slow Progression*
*Source: National Grid*

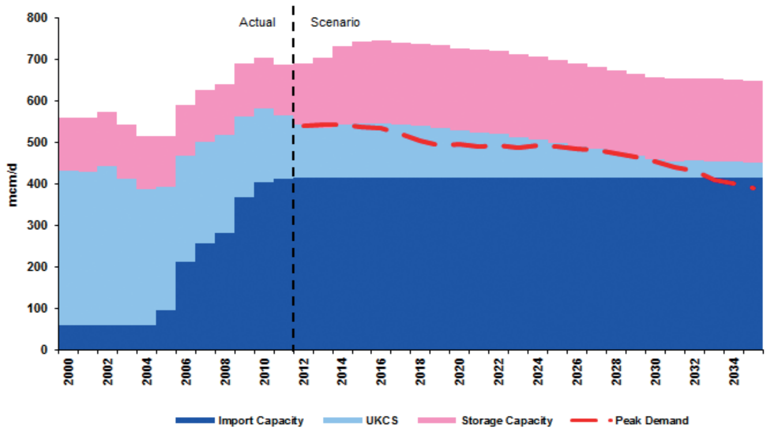



The charts show the considerable difference in gas demand between the two scenarios, peaking at just over 17 bcm/yr by 2030 by which time demand in the Slow Progression scenario is 30% higher than in the Gone Green scenario. The charts also illustrate the considerable uncertainty in supply patterns within each scenario. The hatched area marked as 'Import Generic' represents uncertainty in the supply of imported gas, where it is possible that supplies could be either LNG (e.g. Milford Haven or Isle of Grain) or Continental gas (e.g. via IUK). This uncertainty is described further in the Future Energy Scenarios.

Figures 2.5D and 2.5E show the peak supply for Slow Progression and Gone Green. These are illustrated by showing an aggregated stack of import capacity, UKCS production (including onshore) and peak storage capacity, the charts also show peak demand for both scenarios. The historic data reflects the capacity for imports and storage and the highest aggregated flows for UKCS by terminal. The future data reflects the peak supply for both scenarios namely capacity for imports and storage and future peak UKCS production.

The charts show that the peak supply capacity has increased since 2000 from about 550 mcm/d to a current level of about 700 mcm/d, despite a significant decline in the peak supply from the UKCS. During this period peak demands have been relatively static at about 500 mcm/d. The primary driver behind the increase in peak supply during this period has been the increase in import capacity and recently an increase in storage capacity.

*Figure 2.5E*
*2012 Peak Supply – Gone Green*
*Source: National Grid*




In our forward looking scenarios there is an assumption of no increase in projected import capacity. This is primarily due to our assumption of static or declining peak demand. Whilst no increase in import capacity is shown in the scenarios there are numerous drivers that could lead to new import capacity and hence this sensitivity should to be considered. In the near term both scenarios show an increase in storage capacity and over time a further decline in the peak supply from the UKCS.

# 2.6
# Stakeholder Engagement

Below we have detailed some of the specific areas that would like to hear your feedback in relation to this chapter, although we would welcome feedback and views on any area. We intend to engage further in these areas during the first half of 2014. We are happy to receive engagement of any kind through the following means and of course at any other opportunities we get to meet:

- At consultation events as part of the customer seminars
- At operational forums
- Through responses to the GTYS email **Box.systemoperator.gtys@nationalgrid.com**
- Organising bilateral stakeholder meetings

You can find a full set of the questions in word format for each chapter on our website.

We have described how supply and demand scenarios produced through the Future Energy Scenarios consultations are used in developing the gas transmission network. How well do you understand the link between FES and our long term network planning?

What further information could we share that would improve the transparency around this area?

How can we improve the way we use information you might have on future supply and demand on our system to better define what network capability you need in the future?

# Chapter Three
# System Operator

## This chapter provides an updated view of some of the major factors impacting our operations against future supply and demand patterns on the system and what we intend to do to meet future System Operator challenges.

**Key messages in this chapter**

- Supply Capacity exceeds peak demand by one third; this provides our customers with significant flexibility in how they meet demand. Our system needs to be capable of managing supplies from many different geographical locations
- Within day demand levels are increasingly variable, driven both by distribution network and gas generation requirements. In recent years, we have seen an increased requirement from distribution networks for demand flexibility from the transmission network as their storage capability reduces with the gas holder closure program. The intermittency of gas generation is anticipated to increase over time as renewable generation grows which increases the requirement for gas-fired power generation to act as a back-up, operating with low load factors
- The system has within day storage capability, known as linepack; we are seeing a step change in utilisation of this capability due to the factors above. This trend of increased within day variability over recent years is leading to greater operational challenges, manifesting itself particularly with respect to difficulties in the management of within-day linepack and ensuring that NTS pressures remain within obligated operational and safety tolerances
- The changing nature of supply patterns from day to day provides challenges to ensure the system is configured to provide maximum capability
- We are undertaking a project to review the future requirements for the system. We are considering how different events or factors across gas days and within day might affect the way that the system is managed and possible asset, commercial and operability options that could be progressed to deliver more capability in this area
- We intend to start engagement with the industry on these areas from Q2 2014. This engagement will start with quantifying the impact that these issues will have on customers if no action is taken. This engagement will also include the requirements with respect to compressors captured by the Industrial Emissions Directive (IED) limits as detailed in Chapter 5.

# 3.1 Overview

Our primary responsibility as System Operator is to transport gas from NTS supply points to NTS offtakes, on behalf of our customers, but in doing this we have a number of overriding obligations that affect how we operate the system. The key elements related to NTS operation are:

Safety and System Resilience

- Maintaining NTS pressures within safe limits, such that pressure does not exceed safety limits or fall below the minimum levels
- Ensuring that the quality of gas transported through the NTS meets the criteria defined within the Gas Safety (Management) Regulations.
- Ensuring that capabilities, processes and products are in place to effectively manage / mitigate a Network Gas Supply Emergency.

Environment

- Ensuring our compressor sites are operated within specific environmental permits
- Minimising our environmental impact (which is measured through specific environmental incentives).

Facilitating efficient market operation

- Optimising the utilisation of NTS infrastructure
- Providing customers with the information and data they need to allow them to make effective and efficient decisions
- Making entry and exit capacity available in line with obligations and contractual rights
- Taking commercial actions in the event that system capability is less than contractual rights
- Meeting the pressures contractually agreed with our customers
- Managing gas quality (Calorific Value) at a zonal level to ensure consumers are fairly billed for the gas they use.

In the following sections we provide an updated view of some of the major factors impacting our operations against future supply and demand patterns on the system and what we intend to do to meet future System Operator challenges.

# 3.2
# Evolution of Gas Supplies

The changing nature of gas supplies to the UK since 2000 provides an indication of how future supply patterns may develop. Until 2003/04 the UK was a net exporter of gas; since then the level of imports has progressively increased as UK Continental Shelf (UKCS) supplies have declined. Besides the need for increased imports, recent history has provided a further understanding of the potential behaviour of imports and the interaction of international markets and global events; for example:

- The influence of the global LNG market on UK supplies; notably increases in Japanese demand following the 2011 tsunami, and economic growth in China;
- The development of unconventional gas sources in the US; which has in turn led to reduced worldwide coal demand impacting on the electricity generation gas and coal merit orders in the UK (in favour of coal and making gas the marginal fuel), and going forward may see the US become an LNG exporter;
- The interaction of Norwegian gas supplies between the continent and the UK;
- The behaviour of the Interconnector (IUK) as a flexible supply source for the UK and Continental markets. Though not as obvious, the flow patterns through the BBL pipeline from the Netherlands have also been changing; and
- The impact of international events such as the Russia-Ukraine dispute (European supplies), nuclear power plant outages in Japan (Global LNG), and US hurricanes (pricing behaviour and Atlantic LNG).

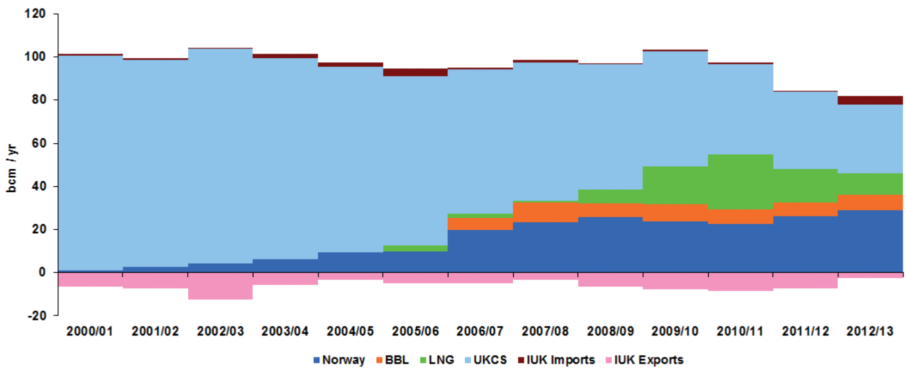
Figure 3.2A below shows the changing mix of annual gas supplies to the UK[1] since 2000, the chart also shows exports through IUK.

The chart highlights:

- UK self sufficiency followed by the decline of UKCS production. UKCS represented 43% of NTS inputs in 2011/12 and 39% in 2012/13;
- The increase in Norwegian gas supplies, notably post 2006/07 (Langeled);
- Imports through BBL from 2006/07; and
- Continued exports through the interconnector (IUK) despite increasing import dependency;
- LNG imports commencing in 2004/05 (Grain 1), with further increases in 2008/09 (Grain 2), 2009/10 (South Hook 1 & 2 and Dragon) and 2010/11 (Grain 3).

The historic peak supply capacity shown in figures 2.5D and 2.5E, highlight how peak supply capacity has increased despite the decline in UKCS production. As the UK has shifted from being self sufficient in gas to being increasingly import dependent there has been a considerable shift in how gas supplies are sourced to meet demand.

*Figure 3.2A*
*Historic annual UK Gas Supplies and IUK exports*
*Source: National Grid*

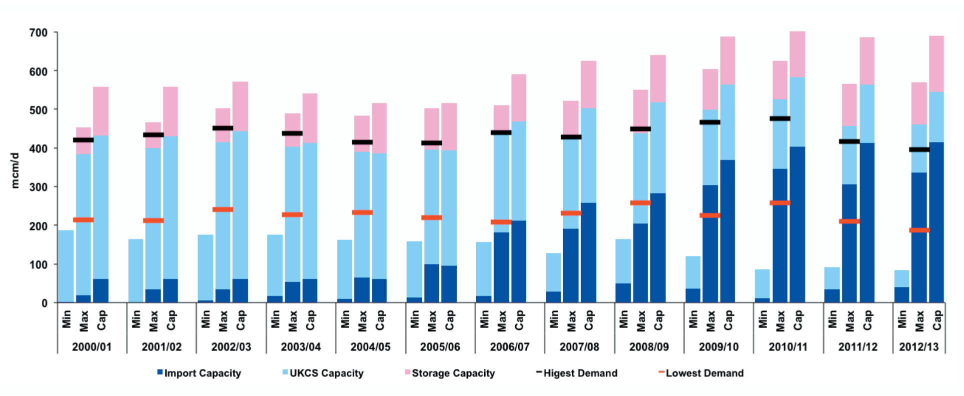



Historically demand was met by UKCS supplies and when needed, storage was used to make up for any supply shortfall. With the onset of import capacity from Norway, the Continent and LNG, the use of supply capacity, often in excess when compared to demand, has changed considerably.

This change is illustrated in figure 3.2B where each gas supply year since 2000/1 to 2012/13 is shown as three discreet stacked bars each consisting of imports, UKCS and storage. The first bar is the minimum flow experienced during the winter period for each supply source on a terminal by terminal basis. Hence for UKCS the minimum flow from Bacton, Barrow Theddlethorpe, etc is aggregated. Similarly LNG and interconnector imports are aggregated as is each storage site. The second bar shows the maximum flow across the winter period being October to March whilst the third bar shows the capacity. Also shown on the chart are the highest and lowest days of actual supply / demand for each of the years.

[1] Gas supplied to the NTS.

*Figure 3.2B*
*Historic Review of Peak Supplies*
*Source: National Grid*

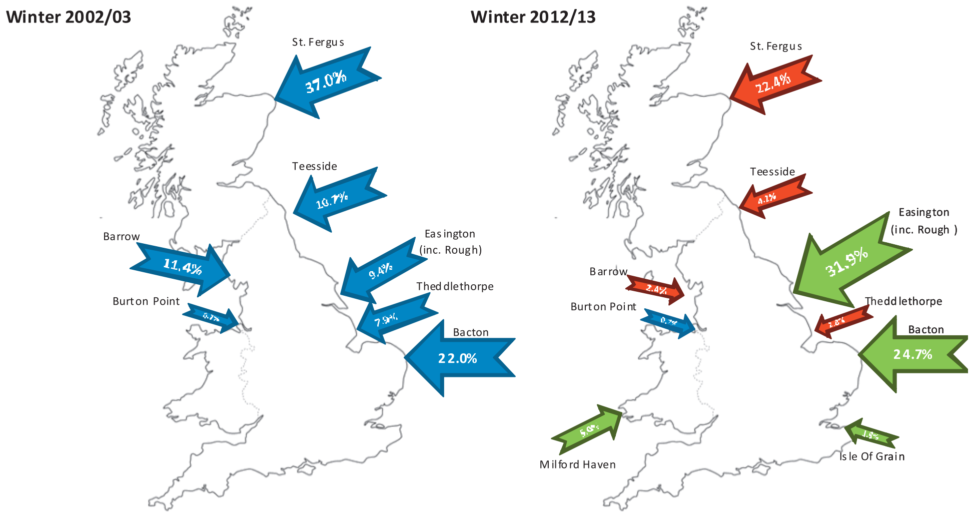



The chart highlights many interesting details in how supplies have changed over the past 13 years, whilst the highest daily demand has remained fairly static at around 400 to 450 mcm/d. There are some important factors to consider as we look forward, for example:

- Post 2005/6 there has been a significant increase in import capacity.
- The current supply capacity of nearly 700 mcm/d is far in excess of the highest demand ever experienced of 465 mcm/d and our 2013/14 peak day demand scenarios of 511 mcm/d. As supply capacity has increased, the way capacity has been utilised has changed.
  - Multiple sources of supply, including storage can now be used to meet even peak demand. In 2000/1 the headroom between maximum supply utilisation and highest demand was about 30 mcm/d. For the past 4 years the headroom has increased to an average of over 150 mcm/d.
  - Minimum supply utilisation figures have declined, because the increased supply capacity allows supplies to be used more flexibly.
  - Supply flexibility has increased the difference between maximum and minimum supply utilisation across the winter. In 2000/1 this was approximately 250 mcm/d, in recent years this has increased to about 500 mcm/d. To put this into context the within winter variation of supply (from minimum to maximum) is now comparable to 1 in 20 peak day demand. i.e the network needs to manage a very wide range of supply patterns.

To further illustrate the increasing uncertainty with respect to supply patterns, figures 3.2C and 3.2D present a snapshot of how winter supply has developed in the previous 10 years.

*Figure 3.2C*
*Winter supplies, 2002/03 and 2012/13*




The coloured arrows indicate where there has been a decline in supplies (red arrows) and indicate where there has been an increase in supplies (green arrows) between the winters of 2002/3 and 2012/13. Although the flows into Bacton have remained relatively consistent, sources of gas into this terminal have developed. In 2002/3, Bacton was supplied only by UKCS gas but by 2012/13 it was mostly continental European supplies entering the terminal through the IUK and BBL interconnectors.

In general, these changes in entry flow locations and sources of gas have an impact for the system operator in terms of the need for network capacity, flexibility and fundamentally impact how the network must be operated.

*Figure 3.2D*
*Winter supplies, 2010/11 and 2012/13*

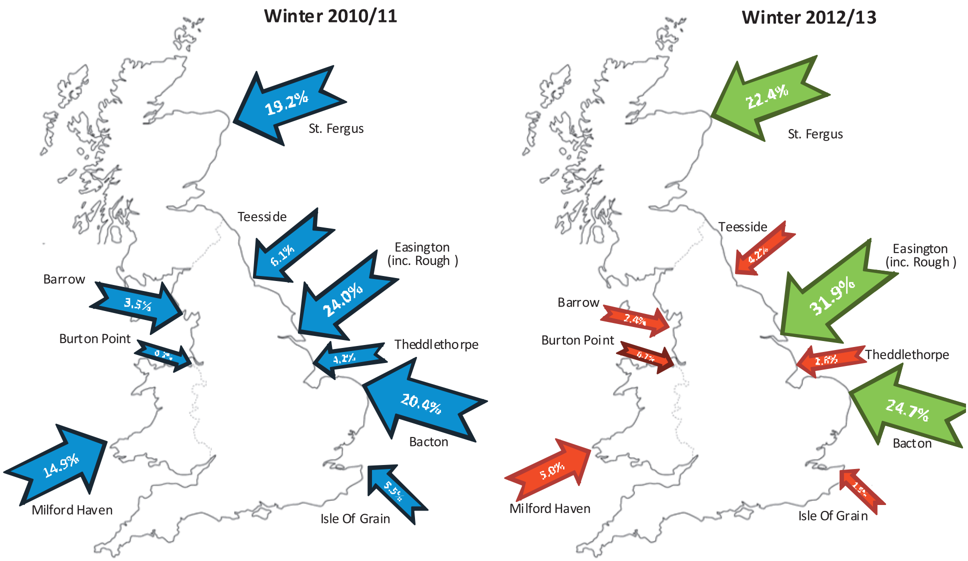



Figure 3.2D shows the supply pattern changes between winter 2010/11 and winter 2012/13, it illustrates just two of the possible supply patterns that can occur on the NTS.

Winter 2010/11 was dominated by high LNG flows through the Milford Haven and Isle of Grain terminals in contrast, winter 2012/13 saw high flows through Bacton from continental Europe and Easington from Norway, as a result of LNG being diverted to other markets in South East Asia. The reduction in supplies from the west in 2012/13 has a direct influence on the amount of exit capacity that can be offered in South Wales, the south west and West Midlands since the gas has to be transported further distances from supplies in the north and east, which in turn impacts compressor usage.

*Figure 3.2E*
*2002/03 Supply make up*

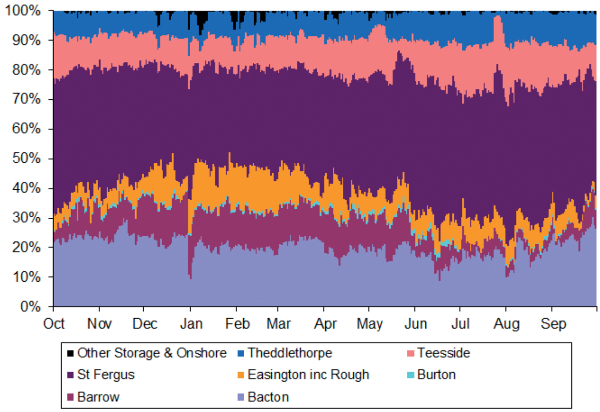
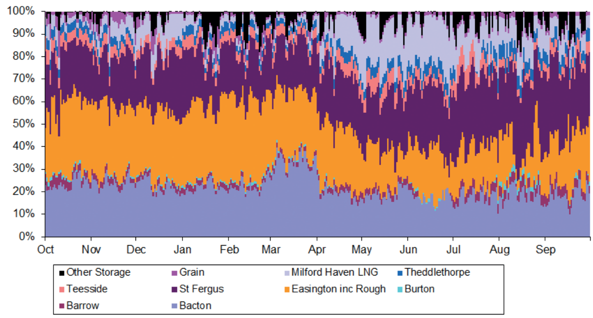



*Figure 3.2F*
*2012/13 Supply Make up*




We also see more supply variation across days than was experienced a decade ago. Figure 3.2E illustrates variation in supplies in 2002/3 compared to 2012/13 as shown in figure 3.2F.

The impact of the changing supply patterns from day to day is the need to reconfigure the system against this uncertainty. The increased volatility in daily supply patterns leads to more frequent system reconfiguration.

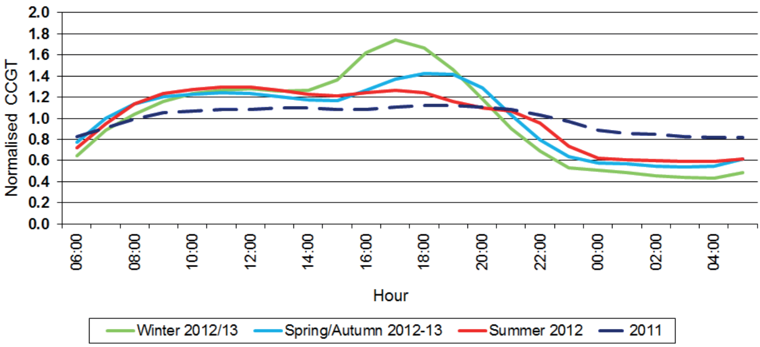
# 3.3
# Evolution of Gas Demand

Within day demand levels are becoming increasingly variable driven by:

- Distribution Networks reducing the storage capability within their networks from the holder closure programs, which in turn is seeing an increase in the NTS flexibility requirements as can be seen in section 4.3
- Demand from gas generators is becoming increasingly variable, and more importantly unpredictable as their role in providing balancing generation to cover the increasingly intermittent renewable generation on the electricity system increases

Gas generation has recently become increasingly marginal with coal prices falling in relation to gas prices The following figure 3.3A maps how CCGTs within day profiles have increased over the past two years. The profiles follow expected demand patterns peaking at 6pm in winter 2012/13.

*Figure 3.3A*
*Normalised CCGT profiles*




In the medium term with coal plant retiring, gas generating plant is likely to become the marginal plant on an enduring basis. This is due to the fact that other forms of generation (e.g. wind, nuclear) have lower operating costs and therefore will generate in preference to gas, assuming they are able to do so. With increasing levels of wind generation on the system, the role of CCGTs becomes less predictable since the CCGT requirement depends both on demand levels and wind output.

By way of an example to demonstrate the potential of this issue, looking forward to the 2020s with total wind capacity at 30 GW (from present capacity of approximately 9 GW) instantaneous output from the wind fleet could vary between 84% and 15% of installed capacity on any given day. If we assume wind output reduces from 84% to 15% of installed capacity on a day, and all the reduction in generation from wind is met by an upturn in CCGT generation, then this equates to an increase in within day gas demand of roughly 90 mcm/day. This level of demand profiling on the NTS would create challenges for the system operator to manage, in particular since this is likely to be a very short notice.

# 3.4
# Impact of the Evolution of Within Day Supply and Demand Patterns on the System

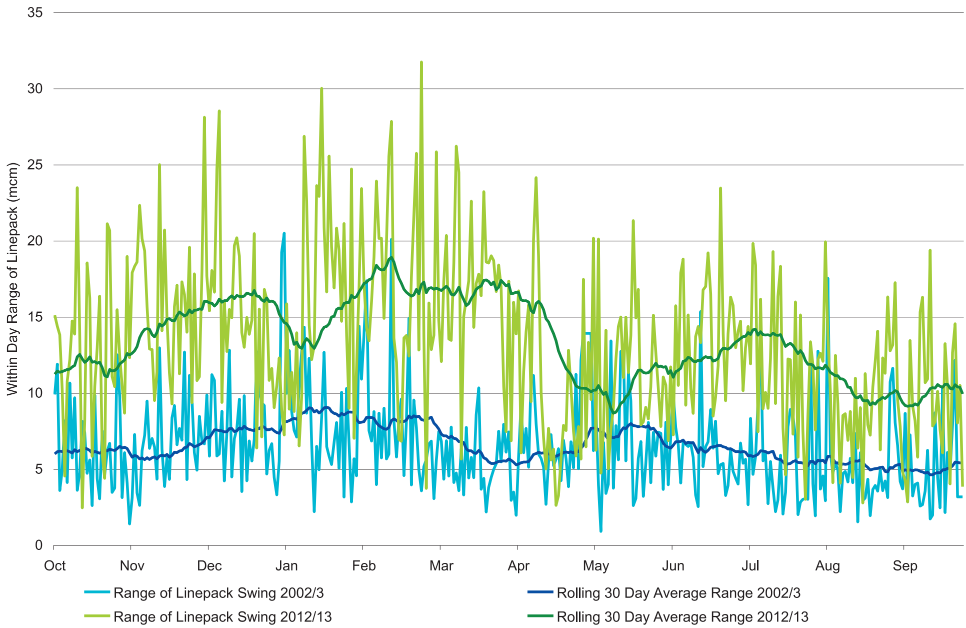
To ensure that NTS pressures remain within obligated operational and safety tolerances at any point in time a volume of gas can be stored within the National Transmission System, this is known as linepack. If supply exceeds demand, then linepack can be increased and vice versa. There are limitations to the linepack capability both nationally and locationally which is determined by the minimum and maximum pressures on the system.

Changing supply and demand flows on the system impact on our ability to manage linepack within the NTS to manage the imbalance between supply and demand at any point in the gas day.

Large linepack changes are caused when the demand from the network exceeds the rate of supply entering the network and vice versa. Figure 3.4A shows how these imbalances a reflected in linepack swings on the NTS. The 2002/3 and 2012/13 gas years are presented to illustrate the differences we have observed.

*Figure 3.4A*

Comparison of Within Day Max-Min Range of NTS Linepack (mcm)

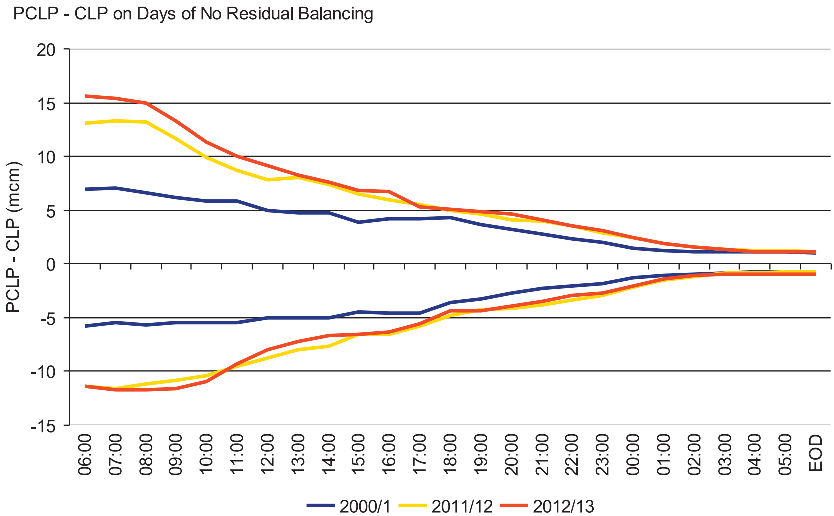


The data clearly shows the increased frequency and magnitude of linepack variations between those seen in 2002/2003 to those seen in 2012/2013, with linepack volatility at certain times of the year up to three times the level seen a decade ago. This trend of increased linepack volatility has been seen over recent years and is leading to greater operational challenges, manifesting particularly with respect to the management of within-day linepack and ensuring that NTS pressures remain within obligated operational and safety tolerances.

This linepack volatility is being driven by; an increasing within day demand volatility; an increase in supply profiling and; relatively frequent and rapid storage site transitions between injection and withdrawal in response to within day gas wholesale price variation.

Alongside the increase in linepack volatility, an associated trend can be seen in figure 3.4B, which shows the aggregated network user notifications (this is the physical delivery information provided by interconnectors, DNs, storage facilities, terminals, CCGTs, etc) that feed into the end-of-day market indicator of Projected Closing Linepack (PCLP), with the chart showing the underlying market imbalance at the start of the gas day and the time taken for the network to balance. PCLP is a key piece of data used by National Grid in its role as residual balancer.

*Figure 3.4B*




The trend highlighted last year has continued with the expected imbalance at the start of the gas day increasing with changing physical flows during the latter part of day seeing a balance by the end of the gas day. It shows on average the PCLP at the start of the gas day is around twice as far out of balance compared to 2000/01, with 2012/13 being slightly worse than last year. We believe this is a developing story of how users are changing the way that they use the network, including a notable trend towards later reconciliations of daily balance, with the start of day offtake and flow notifications provided being less reflective of outturn flows.

# 3.5 Meeting the Future System Operator Challenges

The decline in UKCS supplies and subsequent increase in import capacity has materially changed the UK's gas supply landscape. Indeed, the resulting high capacity of importation sources has fundamentally changed the dynamics of supply from that of near predictability to considerable uncertainty.

This uncertainty could be compounded by increased within-day demand variation as a result of the effects of increasing renewable energy driving dynamic operation of CCGTs.

Over the last couple of years we have discussed in detail the changing operational environment in the UK and the potential impact this would have on delivering against our obligations. The key operational challenges for us are managing day to day supply uncertainties, unplanned events (e.g. supply losses) and the resulting larger within day linepack variation, also a consequence of the unpredictable demand environment. We expect this trend of increasing uncertainty to continue, bringing various challenges in our ability to manage the network in the future.

### 3.5.1 Safety and System Resilience

We anticipate that less predictable flows into the future will increase the use of tools within the commercial regime in order to manage the system pressures within safe limits. The current commercial regime allows us to take certain measures to manage the system safely however, we may need to revisit these tools in light of the changing commercial environments we are now operating in. In addition, it may also become necessary to increase the resilience of the network through physical solutions should certain infrastructure become more critical.

### 3.5.2 Environment

As discussed in section 3.2, supplies are generally more distributed around the system today than in previous years. This tends to help security of supply and reduce the average distances gas is transported in the NTS from supply to demand. Less predictable flow patterns are impacting the way that we use compression, as sites are required to operate at shorter notice in a more dynamic way. This can lead to an increased requirement to operate sites at short standby. We are continually evolving our compressor strategy, and defining our future capability requirements, to ensure the most efficient operation possible.

### 3.5.3 Facilitating Efficient Market Operation

The system has been designed against a background of supply certainty to meet peak demand. Going forward the increased supply variation and uncertainty at any demand level is likely to lead to increased capability requirements. We are developing our tools to both model and manage this requirement going forward.

We would also expect changing supply patterns to increasingly impact on exit capability available on any day and in some cases pressures that customers can expect. We will look to review the information we provide to customers to ensure they can assess this. We will also continue to review the future system capability needs. Further information on this work and our plans to engage customers and stakeholders is detailed below.

## Defining the future network flexibility capability requirements

As highlighted in this section we are already seeing a significant change in customer requirements from the NTS, resulting in very different gas flow patterns than those for which the network was originally designed. The current regime is based on the concept of user commitment to support the provision of incremental capacity. There is no existing mechanism to trigger the enhancement of system capability required specifically 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.

Our planning analysis has identified projects to improve network capability to meet these changing flow requirements, categorised as 'Network Flexibility' in our RIIO-T1 submission. These mainly comprised modifications to existing compressors and the installation of flow control valves to enable greater control and configuration of the NTS to meet emerging customer requirements from the system. These projects can increase the resilience of the network to meet variations in supply and demand patterns, including response to unforeseen events such as major supply outages. They provide the system operator with enhanced capability to operate the network in the flexible manner which customers are indicating that they require.

Our discussions with our customers and stakeholders through the RIIO Talking Networks events and through more recent forums have highlighted that our analysis and plans in this area do not provide enough information.

In particular, we understand that we need to better describe what could happen, under a range of credible scenarios, if no action were taken and the status quo prevailed in terms of the current commercial arrangements governing system management. Customers and stakeholders also would like more information on non-asset solutions which might prove more economical to implement.

As a result of this, we are undertaking a project to review the future requirements for a more flexible system. We are considering how different events or factors across gas days and within day might affect the way that the system is managed and possible asset, commercial and operability options that could be progressed to deliver more capability in this area.

The categories we are considering include supply-side behaviour (e.g supply shocks, supply profiling), 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 standard and security standard is applied in our planning and operational processes and whether these are appropriate for supply and demand patterns we may see in the future.

We intend to start engagement with the industry on these areas from Q2 2014. This engagement will start with quantifying the impact that these issues will have on customers if no action is taken. This engagement will also include the requirements with respect to compressors captured by the Industrial Emissions Directive (IED) limits as detailed in Chapter 5.

# 3.6
# Stakeholder Engagement

Below we have detailed some of the specific areas that would like to hear your feedback in relation to this chapter, although we would welcome feedback and views on any area. We intend to engage further in these areas during the first half of 2014. We are happy to receive engagement of any kind through the following means and of course at any other opportunities we get to meet:

- At consultation events as part of the customer seminars
- At operational forums
- Through responses to the GTYS email **Box.systemoperator.gtys@nationalgrid.com**
- Organising bilateral stakeholder meetings

You can find a full set of the questions in word format for each chapter on our website.

We have described at a high level in this document the types of operational challenges we see in the future. How well do you understand the operational impacts of changing supply and demand patterns within and across gas days on the NTS?

What further information could we share to help you understand this area?

We have described how we think customer requirements for using our system might change. How do you think customers may want to operate their facilities connected to the NTS into the future?

How can we help you meet your future operational challenges?

Do you have any views on the level of system resilience needed now or in the future?

How would it impact your business or organisation if the system became more constrained in the future and more commercial measures needed to be taken?

# Chapter Four
# **Customer Requirements**

This chapter sets out details around exit and entry capacity availability and lead times. It also details user commitments with regards to capacity on the network from the recent entry capacity auctions and exit commitments.

**Key messages in this chapter**

- Whilst we predict significant change in the period ahead, the pace of development of the NTS, when judged by customer signals from incremental capacity, has slowed in recent years
- Looking forward, as wider energy market processes move towards conclusion, in particular the Electricity Market Reform process, we are seeing indications of an upcoming period of renewed development activity
- Customer requirements from the NTS continue to change and evolve beyond that which has been traditionally seen. We continue to see an increased distribution network flex capacity requirement against a background of reduced distribution network flat capacity requirements
- In response to stakeholder feedback, we have included information regarding the lead time for providing NTS Entry and Exit Capacity across different geographical zones as an indicative guide for customers.

# 4.1
# Entry and Exit Capacity

NTS user requirements continue to evolve and both environmental legislation and market reforms such as the Electricity Market Reform (EMR) will impact on future system operation. This section outlines the upcoming period of significant changing needs of the National Transmission System (NTS).

Whilst we predict significant change in the period ahead, the pace of development of the NTS, when judged by customer signals for incremental capacity, has slowed in recent years, with this trend continuing in the 2013 Quarterly System Entry Capacity (QSEC) auction. In contrast to the level of signals, however, the number of connection enquiries we are receiving remains far higher than in the past.

It is also notable that customer requirements from the NTS continue to change and evolve beyond that which has been traditionally seen. We continue to see:

*Increased Distribution Network (DN) flex capacity requirement (against a background of reduced DN flat capacity requirements)*

*Our Future Energy Scenarios are highlighting an increased requirement for south to north flows as a result of declining St. Fergus flows*

*Operationally we are seeing an increased requirement to rapidly switch between 'West-to-East' and 'East-to-West' flow directions in the heart of the network.*

Through our RIIO Talking Networks Stakeholder Engagement, we have discussed with the industry whether these changes (and others) merit re-examining the existing design standards against which we plan the network. With the Transmission Planning Code updated during 2012 and planned to undergo further review in light of the RIIO-T1 outcome, this is an important opportunity to continue this discussion.

Looking forward, as wider energy market processes move towards conclusion, (in particular the Electricity Market Reform process) and more stringent environmental legislation is introduced, we are seeing strong indications of an upcoming period of significant change and renewed development activity.

This likely activity makes it even more important that we work together with our stakeholders and customers to ensure that the right combination of commercial options (rules), operational arrangements (tools) and physical investments (assets) are available to us in order to determine the most efficient overall solution.

## NTS Capacity and Connections Process ("Cap/Con")

The Planning Act (2008) introduced a new process for planning decisions for Nationally Significant Infrastructure Projects (NSIPs), which is applicable to gas infrastructure projects. For NSIPs, the new planning process requires extensive optioneering and consultation with the community prior to the consideration of the application by the Planning Inspectorate and decision by the Secretary of State. This is likely to increase lead-times for complex construction projects up to an estimated 72 to 96 months from the point of a formal capacity signal to delivery of that capacity; however, the default lead-times contained within National Grid's Transporter Licence places an obligation on National Grid to deliver Incremental Entry and Exit NTS capacity to a 42- and 36-month lead-time respectively.

In response to the changes introduced by the Planning Act, National Grid has developed a generic multi-stage timeline, which has been shared with the industry, to illustrate the planning process stages leading up to a submission to the Planning Inspectorate. It is important to note that this is a generic timeline, and the actual duration of each stage will be dependent on the nature and complexity of each construction project.

| | Planning Stage | Activity | Duration |
|---|---|---|---|
| 1a | Strategic Optioneering | Establish the need case and identify technical options | Up to 6 months |
| 1b | | Develop Strategic Options Report (SOR) | Up to 6 months |
| 2 | Outline Routing and Siting | Identify Preferred Route Corridor / Siting Studies | Up to 15 months |
| 3 | Detailed Routing and Siting | Undertake Environmental Impact Assessment (EIA) & detailed design | Up to 24 months |
| 4 | Development Consent Order (DCO) Application Preparation | Formal consultation, finalising project, preparation of application documentation | Up to 6 months |
| 5 | DCO Application, Hearings and Decision | Submission and examination | Up to 15 Months |
| 6 | | Approval process | |

Through our Talking Networks events, we highlighted that the impact of the Planning Act (2008) meant that the current obligated lead-times applicable to incremental entry and exit capacity were not achievable where significant network investment would be required. Releasing incremental NTS capacity to these obligated lead-times could result in considerable constraint management costs to the industry. Simply increasing these lead-times was not deemed to be a viable solution as it would require customers to commit to capacity with lead-times that were not consistent with their own project investment decision timescales.

National Grid's March 2012 RIIO-T1 business plan submission included a number of proposals that could address this issue whilst facilitating the overarching objective of delivering connections and capacity together, in the most efficient lead- time and in a transparent manner. Following this, National Grid and the industry have been working together in order to further develop potential solutions to modify and align the NTS capacity and connections processes more effectively.

The proposed solution involves the introduction of a bi-lateral contract, the Planning and Advanced Reservation of Capacity Agreement (PARCA), for parties wishing to signal incremental capacity. The PARCA arrangements would enable customer and National Grid timelines to be aligned, with connections and capacity being delivered together. This process aims to provide more certainty to project developers, with transparency of all the process steps and deliverables required from both parties and sets out a timeline from initial contact through to capacity release whilst also allowing the review, discussion and potential revision of that timeline and break-out points. The timelines will be developed in conjunction with our customers and will be assessed on a site-by-site / project-by-project basis and as a result lead-times may be variable. This would be accompanied by a phased user commitment that would ramp up in line with progression through the process, culminating in full user commitment once a formal capacity signal is received in line with the current UNC and licence principles.

The PARCA approach was developed at the monthly Transmission Workgroup Meetings leading to UNC modification proposals and the development of the associated changes to our Gas Transporters Licence and Methodology Statements, and the PARCA contract. Each aspect of the solution was discussed at Transmission Workgroup meetings, allowing the industry to participate in shaping the final solution. Two alternative options have been developed for the initial user commitment; one based on location specific capacity prices and one based on average entry or exit prices.

The proposal develops the long-term NTS Entry and Exit Capacity release mechanisms and extends the current UNC ad hoc application provisions that allow Users to reserve Enduring NTS Exit Capacity to allow the reservation of both NTS Exit and Entry Capacity. The proposed PARCA arrangements are based upon the existing Advanced Reservation of Capacity Agreement (ARCA) for NTS Exit Capacity which is currently available to developers, and the Planning Consent Agreement (PCA) for both NTS Entry and Exit Capacity, which is currently available to developers and users (both DNO and Shipper). Incremental NTS Capacity, which cannot be provided via substitution, is only guaranteed to be released where a PARCA has been agreed by National Grid and a Developer or a User (both DNO and Shipper). Baseline NTS Capacity, Non-obligated Incremental NTS Capacity and Incremental NTS Capacity that can be provided via substitution will be made available through Annual Quarterly System Entry Capacity auctions and Annual Enduring Annual NTS Exit (Flat) Capacity processes but can also be reserved through a PARCA by a developer or a user (both DNO and Shipper).

### Further detail on the solution can be found below:

A PARCA is a multi-phased bilateral contract, between National Grid and a customer, which, would allow Firm Quarterly System Entry Capacity and / or Firm Enduring Annual NTS Exit (Flat) Capacity to be reserved for that customer, whilst they develop the initial phases of their own project. Any NTS Capacity initially reserved via a PARCA would, subject to the need case for that capacity being sufficiently demonstrated and any necessary planning permissions being received, be allocated exclusively to the PARCA applicant, or, where the PARCA applicant is not a UNC party, a NTS user(s) nominated by the PARCA applicant. The features of the overall PARCA proposal provide a number of benefits for customers who would wish to use a PARCA, other customers and ourselves.

### Customers who wish to use a PARCA

- A PARCA would facilitate customers approaching National Grid early in the development of their own project in order to reserve NTS Entry and / or Exit Capacity without the need to fully financially commit to the formal capacity booking at that stage, thereby reducing a potential barrier to participation
- Reserved NTS Capacity would be exclusive to the PARCA applicant (or their nominated NTS user) and therefore unavailable to other NTS users though other auction / application mechanisms
- A PARCA would provide the customer with greater certainty, earlier in their own project timescales, of when National Grid can provide their capacity requirements, should their project progress to completion

- A PARCA would facilitate the customer and National Grid being able to align project timelines and planning requirements in order that projects can progress together, should the customer deem this to be of benefit. A PARCA would also allow the customer to align the NTS Capacity process with the equivalent NTS Connection process, should this be of benefit to them
- The PARCA processes would be flexible, with logical "drop out points" ahead of capacity allocation. Capacity allocation would occur closer to the customer's first gas day, than under current arrangements. As a result the customer would be able to take advantage of these "drop out points", should their project become uncertain
- PARCAs would be available to both UNC parties and project developers and therefore available to a wider range of customers when compared to the existing annual NTS Capacity Auction and Application processes.

### Other Customers

- Throughout the lifecycle of a PARCA, we would publish increased levels of information, when compared to the existing auction / application mechanisms, thereby increasing transparency for other NTS users
- The PARCA Entry Capacity process would include an ad-hoc QSEC Auction mechanism to allow other NTS users to compete for unsold Quarterly System Entry Capacity prior to it being reserved through a PARCA
- The PARCA process also includes a PARCA Application Window where other NTS users can approach us to sign a PARCA. This provides a focal point for customers considering entering into a PARCA and would allow multiple PARCAs to be considered together. Therefore National Grid could make best use of unsold levels of NTS Capacity and existing system capability when determining how to meet our customers' requirements, enabling that the most economic and efficient investment decisions could be made
- Throughout the lifecycle of a PARCA, the customer would be required to regularly provide information to National Grid, demonstrating the progression of their project. Should a customer fail to provide the required information by in the required timescales, this may result in the termination of their PARCA and any reserved NTS Capacity would either be used for another live PARCA or returned to the market and made available for sale in the next applicable release process. This would ensure that NTS Capacity is not unduly held away from other NTS users
- A customer would be required to provide financial security under a PARCA as a commitment to the reserved NTS Capacity, and, in the case of that customer cancelling their PARCA, a termination amount would be derived from the level of security provided. This would then be credited to other NTS users through the existing charging mechanisms
- The timescales for the release of Incremental NTS Capacity to the PARCA applicant would be aligned to National Grid's timescales for providing increased system capability under the Planning Act, if required. As a result, the risk of constraint management actions being undertaken and any costs being potentially shared with end consumers would be reduced.

### National Grid

- Throughout the lifecycle of a PARCA, the customer would be required to regularly provide information to National Grid, demonstrating the progression of their project. This would allow our need case for any required investment to be based upon clear, demonstrable customer requirements. Also, we would not begin construction on any investment projects until the customer had received full planning permission for their project, enabling economic and efficient NTS investment.

# 4.2
# NTS Exit Capacity Maps and Lead-Times

The following section provides information regarding the lead-time for providing NTS Exit Capacity as an indicative guide for shippers, distribution network operators and developers. If unsold NTS Exit Capacity is available at an existing exit point then it can be accessed via the July application process for the following winter. If unsold NTS Entry Capacity is available at an existing ASEP then it can be accessed via the auction processes.

The Obligated Capacity Level, less any already sold, is the quantity 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.

- In some areas, capacity can be made available without investment including by capacity substitution ***~ Lead-time <36 months***
- In some areas, capacity can be made available with simple medium-term works ***~ Lead-time 36 months***
- In some areas, capacity requires long lead-times associated with more significant reinforcement works including new pipelines and compression ***~ Lead-time >>36 months***
- If we receive an application for exit capacity above the obligated capacity level at an offtake we will first consider whether capacity can be made available without any reinforcement works and without increasing operational risk. This can be the case for exit capacity close to large reliable supplies.

If reinforcement works or increased operational risk is identified, we investigate substituting unsold capacity i.e. moving our obligation to make capacity available from one system point to another, to avoid reinforcement work. An exchange rate is calculated which means more or less than one unit of capacity might be substituted to make a new unit of capacity available. Sometime substitution is not possible due to local constraints.

If substitution is not feasible, we will consider reinforcement works and contractual solutions. Works on our existing sites such as modification of compressors and above ground installations may not require planning permission and hence may have shorter lead-times. Significant new pipelines require a Development Consent Order (DCO) to be obtained, as a consequence of The Planning Act (2008), and this can result in capacity lead times of 60 to 84 months. Construction of new compressor stations may also require DCOs if a new HV electricity connection is required and, subject to local planning requirements, may require similar timescales to pipeline projects.

## Introduction of a Long Term Non-Firm Capacity Product

National Grid NTS believes that there would be benefits to the industry in providing additional flexibility for the release of NTS Entry and Exit Capacity which would help to meet customer expectations where the project timelines are not aligned.

National Grid NTS has therefore developed proposals to allow NTS users access to the NTS prior to the release of the firm incremental capacity signalled by those same NTS users.

The proposed solution is to introduce a long term non-firm capacity product that is exclusively available to a user who has provided an incremental capacity signal, which has subsequently been allocated (or as the case may be reserved). This change would allow a user to hold capacity ahead of the effective date of the Quarterly NTS Entry Capacity / Enduring Annual NTS Exit (Flat) Capacity allocated to or reserved by that same user. Any long term non-firm capacity released would be in the form of firm NTS Entry / Exit Capacity with an associated Buy Back Option Agreement for all days on which the long-term non firm capacity is held.

For the avoidance of doubt, long term non-firm NTS Entry / Exit Capacity is envisaged as a non-firm product which we are using existing firm capacity and buyback option products to facilitate.

### 4.2.1 NTS Exit Capacity Map

The following map divides the NTS into regions based on key multijunctions including compressor stations and multijunctions which separate sections of the NTS with different pressure ratings. A description is then given regarding potential capacity lead times in each region including identified sensitivity areas. This information is indicative and actual capacity availability will depend on the quantity of capacity requested from all customers within a region and interacting regions. This information is provided recognising the impact EMR may have on interest in NTS connections and capacity.

### 4.2.2 Available (Unsold) NTS Exit (Flat) Capacity

The following table indicates the quantities of unsold NTS Exit (Flat) Capacity within each region that could be used to make capacity available at other offtakes via exit capacity substitution.

| Region | Obligated | Unsold | |
|---|---|---|---|
| | (GWh/d) | (GWh/d) | % |
| Scotland & the North | 718 | 49 | 7% |
| The North West | 1110 | 245 | 22% |
| North Wales & Cheshire | 315 | 184 | 58% |
| The North East, Yorkshire & Lincolnshire | 1570 | 294 | 19% |
| South Wales & West Midlands | 570 | 50 | 9% |
| Central & East Midlands | 281 | 63 | 22% |
| Peterborough to Aylesbury | 126 | 25 | 20% |
| Norfolk | 360 | 86 | 24% |
| South West | 461 | 63 | 14% |
| Southern | 526 | 194 | 37% |
| London Suffolk & The South - East | 1512 | 313 | 21% |

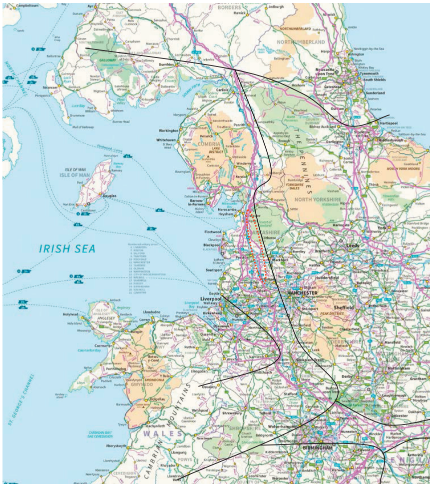
### Regional 1 – Scotland and the North

**NTS Location:** North of Longtown and Bishop Auckland

**NTS / DN Exit Zones:** SC1,2,3,4, NO1,2

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

### Region 2 – The North West towards West Midlands

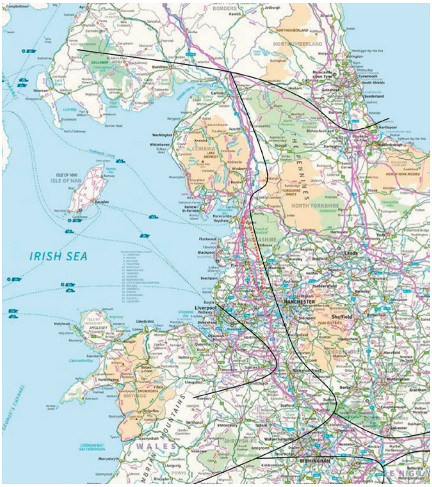



**NTS Location:** South of Longtown, north of Alrewas and east of Elworth

**NTS / DN Exit Zones:** NW1, WM1

The quantity of unsold capacity within the region indicates that there is a good probability that capacity could be made available by exit capacity substitution. Capacity is likely to be available on main feeder sections between Carnforth and Alrewas. The region is highly sensitive to national supply pattern and use of storage; this area was historically supplied by gas from the north but increasingly receives gas from the south and from the east across the Pennines. Potential Non-Planning Act reinforcements could release capacity but then significant pipeline reinforcement would be required, particularly in the sensitivity region around Samlesbury and Blackrod (North Lancashire and Greater Manchester).

### Region 2.1 – The North West towards North Wales




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

**NTS / DN Exit Zones:** NW2, WA1

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 quantities of additional capacity but then significant pipeline reinforcement would be required resulting in long (Planning Act) timescales. This is an extremity of the system with limited local supplies (Burton Point) but a significant number of storage facilities.

### Region 3 – The North East and Northern East Midlands


**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

The quantity of unsold capacity within the region indicates a very good probability that capacity could be made available via exit capacity substitution. There should be further capacity available without requiring reinforcement within this region assuming stable north-east supplies; however, this may be limited on smaller diameter spurs including Brigg. Non-planning act reinforcements including compressor modifications could then be carried out to make additional capacity available. There are a significant number of power stations in this region and this may impact on future agreement of ramp rates (the ramp rate is the rate at which flows can increase at an offtake as set out in the Network Exit Agreement ~ NExA).

## Region 4 – The West Midlands towards South Wales


**NTS Location:** West of Churchover

**NTS / DN Exit Zones:** WM3, SW1, WA2

The quantity of unsold capacity within the region indicates a limited quantity of capacity could be substituted. Exit Capacity availability within this region is highly sensitive to Milford Haven flows. Low Milford Haven flows result in reduced South Wales pressures which limit capacity. High Milford Haven flows result in reduced pressures in the West Midlands which may limit capacity. Potential Non-Planning Act reinforcements could release small quantities of capacity, but then significant pipeline reinforcement would be required with the area south of Cilfrew a sensitivity due to the different pressure ratings.

## Region 5 – Central West Midlands and East Midlands


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

**NTS / DN Exit Zones:** EM3,4, WM2

The quantity of unsold capacity indicates a limited scope that capacity could be substituted. Potential Non-Planning Act reinforcements could be carried out to release a small quantity of capacity, but then significant pipeline reinforcement would be required, in particular for the sensitivity area (Austrey to Shustoke).

### Region 6 – Peterborough to Aylesbury

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

**NTS / DN Exit Zones:** EA6, 7

The quantity of unsold capacity within the region indicates a limited scope for exit capacity substitution from the single offtake within the region but there may be scope for substitution from the downstream southern region. Capacity availability is sensitive to demand increases downstream in the south west region. Potential Non-Planning Act reinforcements could be carried out to release capacity.

### Region 7 – Norfolk

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

**NTS / DN Exit Zones:** EA1, 2, 3

The quantity of unsold capacity indicates a good probability that capacity could be substituted. Additional capacity could be made available, without reinforcement works, assuming stable Bacton supplies. The region is sensitive to south east demand; if demand increases in the south east then capacity may become more constrained.

### Region 8 – The South West

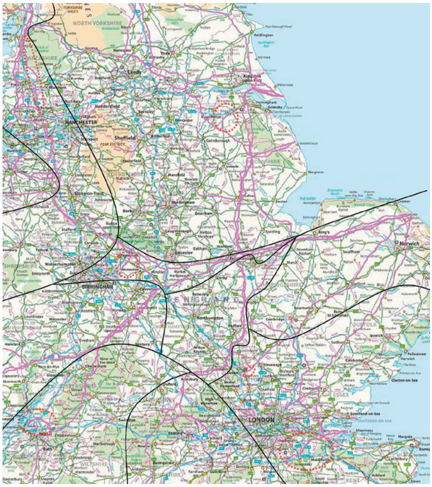

**NTS Location:** South of Wormington and Lockerley

**NTS / DN Exit Zones:** SW2, 3

The quantity of unsold capacity in this region indicates a limited scope that capacity could be made available via exit capacity substitution and exchange rates may be high due to small diameter pipelines.

Potential Non-Planning Act reinforcements could release small quantities of additional capacity but then significant pipeline reinforcement would be required resulting in long (Planning Act) timescales particularly in the sensitivity area (west of Pucklechurch on the feeder 14 spur) due to small diameter pipelines. There is some sensitivity to low Milford Haven flows.

### Region 9 – Suffolk, North Thames & The South East



**NTS Location:** South Diss, Cambridge, east of Huntingdon and Whitwell

**NTS / DN Exit Zones:** EA4, 5, NT1, 2, 3, SE1, 2

The quantity of unsold capacity within the region indicates a good chance that capacity could be made available via exit capacity substitution; however, exchange rates may vary dependent on location. Potential Non-Planning Act reinforcements could be carried out to release small quantities of additional capacity but then significant pipeline reinforcement would be required.

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

## Region 10 – Southern


**NTS Location:** South of Aylesbury and north of Lockerley

**NTS / DN Exit Zones:** SO1, 2

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

### 4.2.3 NTS / DN Exit Zones

The following map indicates the distribution network zones which are used to identify which NTS / DN offtakes provide capacity within the distribution networks and helps to indicate the extent of the zones that form the NTS Exit Capacity map.

# 4.3
# Exit Capacity – User Commitment Summary

Aggregate NTS Exit (Flat) Capacity allocations have decreased by approximately 3% compared to levels previously signalled and there has been a small increase in aggregate NTS Exit (Flex) Capacity.

Figures 4.3A and 4.3B detail the year on year change between Exit Capacity allocated to DN customers from the 2009 to 2013 Exit Capacity Allocation Processes.

*Figure 4.3A*
*DN Exit Flat Capacity Bookings*

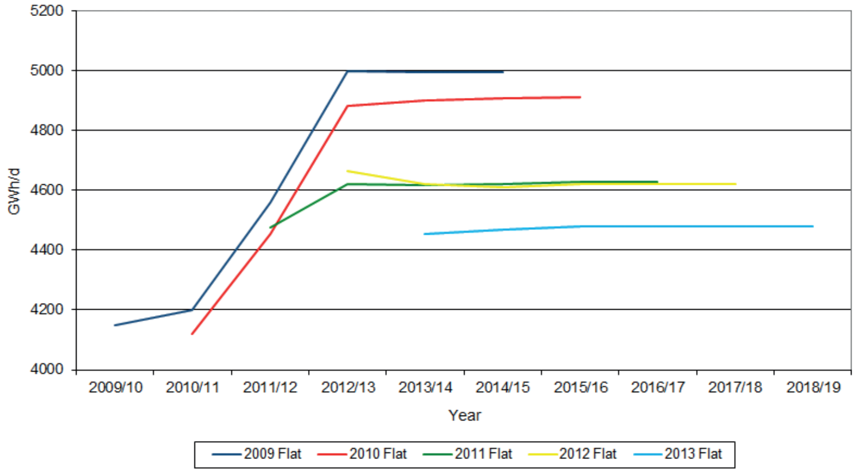
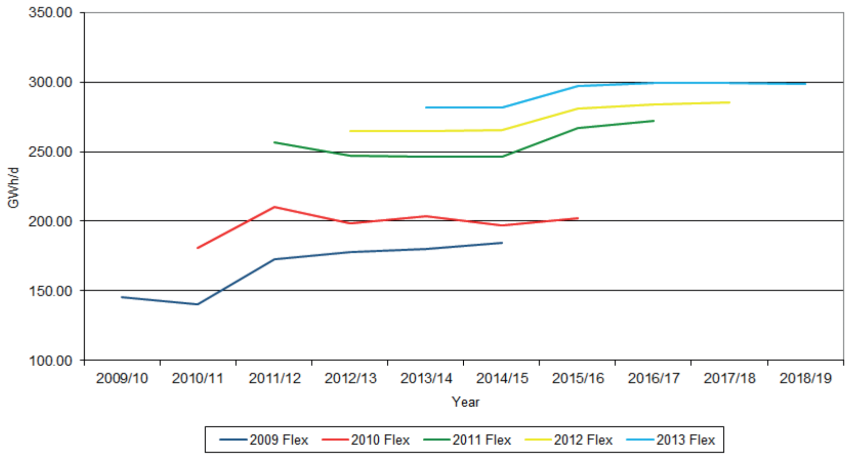



*Figure 4.3B*
*Exit Flex Capacity Bookings*



All obligated NTS Exit (Flat) Capacity requests from DNs have been allocated in full. Requested increases in non-obligated NTS Exit (Flat) Capacity and NTS Exit (Flexibility) Capacity were rejected if they could not be accommodated within the capability of the system whilst maintaining existing entry and exit commitments, or if the release would significantly increase operational costs (for example use of shrinkage gas).

The graphs (4.3A & 4.3B) clearly demonstrate an ongoing trend in flat capacity reductions year on year at the same time as significant increases in flex capacity requests. DN flex capacity requirements can be seen to have nearly doubled over the last 5 years of bookings.

### 4.3.1 NTS Pressure Agreements

Figure 4.5A shows the main exit pressure agreements, both obligated and advisory, that National Grid has in place.

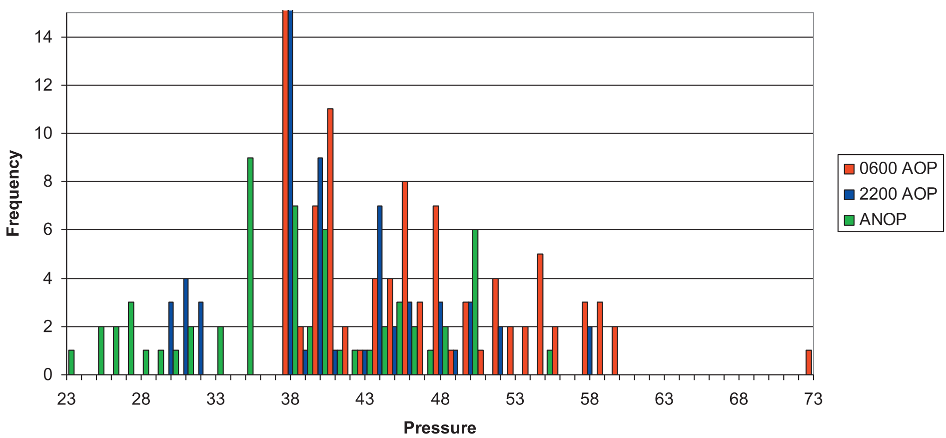
There are 2 primary types of pressures on the NTS:

- Assured Offtake Pressures (AOPs) as defined in the UNC, these are a minimum pressure requirement to maintain security of supply to DN customers.
- Anticipated Normal Operating Pressures (ANOPs) these are advisory pressures and indicate to directly connected customers the minimum pressure likely to be available on the NTS, in the vicinity of their connection, under normal operation.

**AOPs** – All DN offtakes have Assured Offtake Pressures, covering both 06:00 ('Start of Day') pressures and 22:00 ('End of Day') pressures and are defined in the UNC. These are pressure obligations, primarily around winter capacity requirements, that National Grid is required to maintain to ensure security of supply to DN users. A significant number of these assured pressures (approximately 1/3 of 06:00 and 2/3 of 22:00, extending beyond the limits of the graph) are set at 38 barg; the anticipated minimum pressure in most sections of the NTS under normal operating conditions. 06:00 pressures enable DN operators to build linepack within their own systems overnight, potentially reducing their flex capacity requirements. 22:00 pressures are the minimum pressures that must be maintained on the NTS, other than with prior agreement. These pressure agreements, which are in place to maintain supplies to customers within the distribution networks, can lead to transportation and within day capability restrictions on the NTS.

**Anticipated Normal Operating Pressures** – The, typically lower, Anticipated Normal Operating Pressures (ANOPs) are provided at other NTS exit locations, and represent National Grid's best view of the minimum pressure likely to be seen at each exit point within the envelope of normal operations. These are predominantly in place to advise the customer of the minimum pressures they could see at their offtake to enable efficient plant design. If NTS capability analysis shows an increasing likelihood that these pressures may not be met under normal operation, the customer will be notified at least 36 months ahead to advise of the revised ANOP.

*Figure 4.3C*



## Impact of EMR Capacity

The EMR capacity market is being developed to ensure that there are sufficient quantities of flexible generation available to supply electricity demand for periods with low renewable generation. Both existing and new generation will be able to participate in the capacity market. The capacity is expected to go live in 2014 with delivery of the first new capacity expected in 2018. One of the aims of the capacity market is to incentivise new generation to connect and so, if new gas fired generation is successful in the capacity auction, these new gas fired power stations will require additional gas capacity prior to 2018 to allow them to meet their EMR capacity contract.

It is anticipated that the EMR capacity market will result in a number of new gas fired power stations being built that have secured capacity contracts; therefore, we believe that there will be a number of new connection applications post the 2014 EMR auction process. In addition, existing gas-fired power stations may delay their decommissioning date dependent on successful contracts and may require additional firm capacity.

To better align transmission system developments to the development of projects that would like to connect to the transmission system, we are developing proposals that aim to provide industry parties with additional tools to better manage their longer term capacity arrangements.

The development of Long Term Non-Firm Capacity (UNC Modification 0454) and the PARCA (UNC Modification 0452) seek to introduce arrangements to improve the certainty, flexibility and transparency of the long term capacity requirements for our customers.

In addition, EMR capacity market will incentivise generators with a capacity contract to produce electricity at times of forecast scarcity. If they are not producing electricity during these times, it is proposed that they will be subject to a maximum penalty of £17,000 / MWh. It is not yet known what impact such an incentive will have on the gas network or the interaction of the gas and electricity market. However, there is the potential for the electricity incentives to feed through into the gas market.

# 4.4
# NTS Entry Capacity Availability and Capacity Lead-Times

The following section provides information regarding the lead time for providing NTS Entry Capacity as an indicative guide for shippers and developers. If unsold NTS Entry Capacity is available at an existing ASEP then it can be accessed via the daily, monthly and annual entry capacity auction processes. If unsold capacity is not available through this process, including new entry points, the lead-times may be longer. The information should inform the likely lead time associated with new entry points; however, new entry points can typically result in significant changes to network flow patterns and we encourage customers to approach our customer team to discuss specific requirements. This information is indicative and actual capacity availability will depend on the quantity of capacity requested from all customers at an ASEP and interacting ASEPs.

### 4.4.1 Entry Planning Scenarios

Chapter 3 discussed the uncertainties in the future supply mix that arise from both existing supplies and potential new developments, and that are in aggregate capable of exceeding most peak demand scenarios. These uncertainties are exacerbated by Gas Transporters Licence requirements for National Grid to make obligated capacity available to shippers up to and including the gas flow day. This creates a situation where National Grid is unable to take long-term auctions as the definitive signal from shippers about their intentions to flow gas on any particular day. National Grid continues to develop its processes to better manage the risks that arise from such uncertainties.

In order to aid understanding of entry capability, we have used the concept of entry zones which contain groups of ASEPs (figure 4.4A). The entry points contained within each zone will tend to make use of common sections of infrastructure to transport gas from entry to market, and therefore have a high degree of interaction; however, there remain key interactions between supplies in different zones which mean that interactions between key 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.

The commonly used zonal groupings are:

**South East** – includes Bacton and Grain; both use common infrastructure away from the Bacton area.

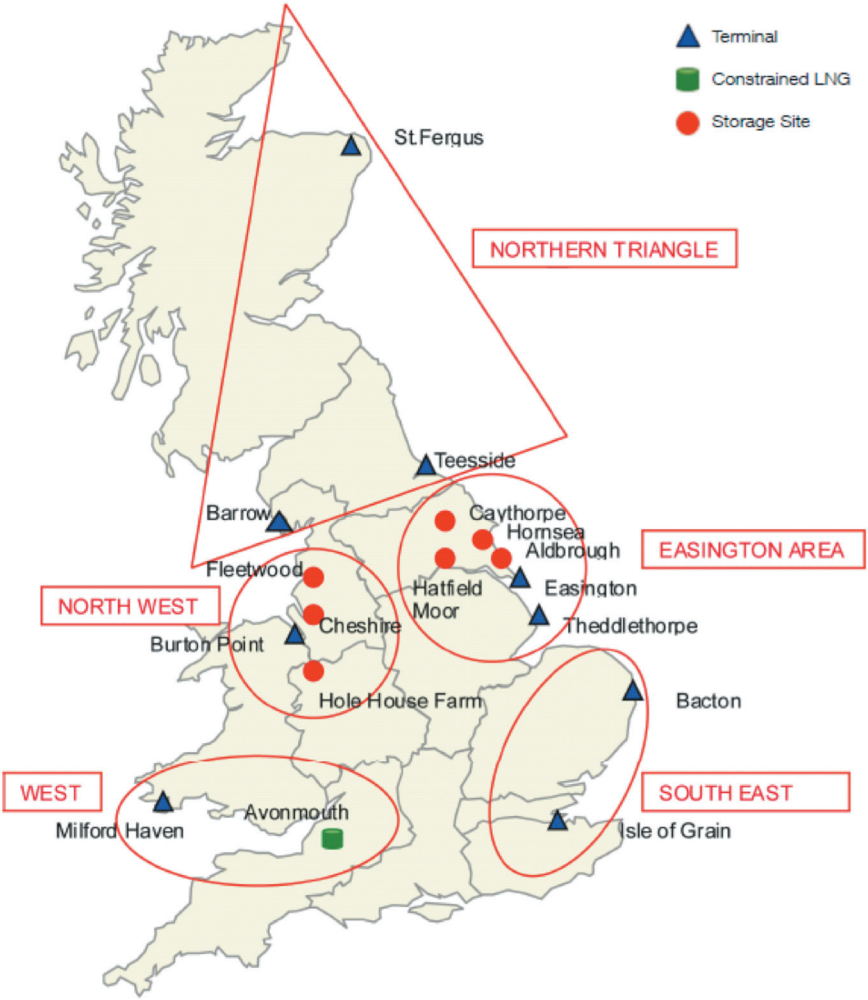
**Easington Area** – includes Easington, Rough, Aldbrough, Hornsea and Caythorpe; all use common routes out of the Yorkshire area.

**Northern Triangle** – includes St. Fergus, Teesside and Barrow; all of 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.

**West UK** – this zone enables sensitivity analysis around potential supplies from Milford Haven.

**North West Corridor** – includes storage at HoleHouse Farm and Cheshire.

*Figure 4.4A*
*Zonal grouping of interacting supplies*
*Source National Grid*



An example of this approach is that the analysis of the south east would consider higher flows from the Bacton and Isle of Grain entry points whilst reducing the other supplies to create a demand balance for the day being considered.

Key scenarios examined 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, several commercially driven sensitivities are also investigated. For example, a sensitivity with a reduction in imported gas requiring high MRS (medium-range storage) entry flows to meet winter demand.

Historically these scenarios have been considered 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 to consider the ability of the system to switch between different flow scenarios, explicitly considering 'transient' (changing) flows on the network.

If this technique indicates future requirements from the network are outside of current capability, a range of possible solutions (regulatory, commercial and physical) are investigated where appropriate. This ensures broad spectrums of solutions are identified. Where investment in assets is the optimum solution, this would be developed with further optioneering through the planning consents framework.

### 4.4.2 Available (Unsold) NTS Entry

The following table 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) is available at each relevant ASEP and could also be used to make capacity available at other ASEPs via entry capacity substitution. Substitution may also be possible across entry zones.

*Table 4.4A*
*Entry Capacity by zone. See figure 4.4A for entry zones*

| Entry Zone | ASEP | Obligated Capacity | Unsold Capacity | | |
|---|---|---|---|---|---|
| | | | 2013/14 | 2017/18 | 2020/21 |
| | | GWh/day | GWh/day | GWh/day | GWh/day |
| Northern Triangle | Barrow | 309.1 | 30.9 | 32.3 | 49.8 |
| | Canonbie | 0.0 | 0.0 | 0.0 | 0.0 |
| | Glenmavis | 99.0 | 99.0 | 99.0 | 99.0 |
| | St. Fergus | 1,670.7 | 1,182.0 | 1,446.5 | 1,624.9 |
| | Teesside | 476.0 | 98.4 | 321.0 | 402.9 |
| North West | Burton Point | 73.5 | 35.8 | 73.5 | 73.5 |
| | Cheshire | 542.7 | 140.2 | 28.6 | 28.6 |
| | Fleetwood | 650.0 | 650.0 | 650.0 | 650.0 |
| | Hole House Farm | 296.6 | 13.2 | 13.2 | 13.2 |
| | Partington | 215.0 | 193.0 | 215.0 | 215.0 |
| Easington Area | Caythorpe | 90.0 | 0.0 | 0.0 | 0.0 |
| | Easington (incl. Rough) | 1,407.2 | 106.2 | 106.2 | 143.4 |
| | Garton | 420.0 | 0.0 | 0.0 | 0.0 |
| | Hatfield Moor (onshore) | 0.3 | 0.3 | 0.3 | 0.3 |
| | Hornsea | 233.1 | 27.3 | 27.3 | 27.3 |
| | Hatfield Moor (storage) | 25.0 | 3.0 | 3.0 | 3.0 |
| | Theddlethorpe | 610.7 | 568.0 | 610.7 | 610.7 |
| West | Avonmouth | 179.3 | 157.3 | 179.3 | 179.3 |
| | Barton Stacey | 172.6 | 82.6 | 82.6 | 100.6 |
| | Dynevor Arms | 49.0 | 27.0 | 49.0 | 49.0 |
| | Milford Haven | 950.0 | 0.0 | 0.0 | 150.0 |
| | Wytch Farm | 3.3 | 3.3 | 3.3 | 3.3 |
| South East | Bacton | 1,783.4 | 877.8 | 1,016.3 | 1,146.3 |
| | Isle of Grain | 699.7 | 43.6 | 35.4 | 35.4 |

### Entry Zone – Northern Triangle

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

The quantity of unsold capacity in this region combined with the reduced St. Fergus forecast flows indicates a high likelihood that capacity could be made available via 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

The quantity of unsold capacity in this region indicates a good likelihood that some capacity could be made available via entry capacity substitution; however, it should be noted that 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 further quantities of additional capacity but then significant pipeline reinforcement would 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

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 then significant pipeline reinforcement would be required resulting in long (Planning Act) timescales.

### Entry Zone – West

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

The quantity of unsold capacity in this zone is principally at the Avonmouth and Dynevor Arms ASEPs associated with the LNG storage facilities and 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, Isle of Grain

While there is a high degree of interaction between the Bacton and Isle of Grain ASEPs, the quantity of unsold capacity in this zone cannot be interpreted as an indication of entry capacity substitutability. 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 quantities of additional capacity but then significant pipeline reinforcement would be required resulting in long (Planning Act) timescales.

# 4.5 Entry Capacity – Auction Results Summary

The QSEC auctions opened on Monday 11th March 2013 and closed on Tuesday 12th March 2013.

In order for incremental obligated entry capacity to be released, and hence the obligated entry capacity level to be increased, sufficient bids for entry capacity must be received during the QSEC auctions to pass an economic test. If insufficient bids are received to pass the economic test, 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.

During the March 2013 QSEC auctions, bids were received for incremental entry capacity (for Q1 2014 and 2015) at the Easington Aggregate System Entry Point (ASEP). The bids received were insufficient to pass the economic test for the release of incremental obligated entry capacity; however, following a risk assessment process non-obligated entry capacity was released to meet all the bids at Easington (for Q1 2014 and Q1 2015). The incremental risk created by the volumes requested, over the specific periods in question, was identified as being operationally manageable and unlikely to lead to disproportionate commercial risk.

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

### 4.5.1 Investment implications

No direct investments were identified or triggered, since no incremental obligated entry capacity was released.

# 4.6
# Stakeholder Engagement

Below we have detailed some of the specific areas that would like to hear your feedback in relation to this chapter, although we would welcome feedback and views on any area. We intend to engage further in these areas during the first half of 2014. We are happy to receive engagement of any kind through the following means and of course at any other opportunities we get to meet:

- At consultation events as part of the customer seminars
- At operational forums
- Through responses to the GTYS email **Box.systemoperator.gtys@nationalgrid.com**
- Organising bilateral stakeholder meetings

You can find a full set of the questions in word format for each chapter on our website.

We have described the new connection and capacity processes at high level. How well do you understand how you can connect to our system or how you can tell us about any changes to your requirements?

Do you have any views on how the information concerning capacity availability and lead times can be developed?

We have presented a lot of information on capacity signals. How well do you understand how capacity obligations and capacity sales affect our network planning?

How well do you understand how flexibility and pressure commitments affect our network planning?

What further information could we share on capacity availability, flexibility and pressure to improve the transparency in this area?

How do you think EMR could impact on new connections for CCGTs. What improvements to our planning processes and customer agreements could help facilitate this?

Chapter Five

# Meeting Future Capability Requirements

Set out in this chapter are the currently sanctioned NTS reinforcement projects, those that are presently under construction for 2014 and indicative investment options for later years. These are assessed against the scenarios and sensitivities detailed in the Future Energy Scenarios document and signals received in the recent entry capacity auctions and exit commitments.

**Key messages in this chapter**

- The uncertainty around supply and demand scenarios is making it increasingly complex to plan the future capability on the Gas Transmission System
- Our current business plan has a total level of investment in the range £1.1 bn to £2.2 bn (2009/10 prices). This variation is largely due to the range of potential incremental entry or incremental exit capacity signals we may see in the next ten years
- We currently operate 64 gas driven compressors across our compressor fleet. There are eight sites with a total of 17 gas driven compressors that produce emissions above the thresholds set by the Industrial Emissions Directive (IED) and must be compliant with new limits by 31st December 2023. This can be achieved by investment (typically replacement), closure (as either capability is no longer required or capability can be met using other solutions) or derogation (very limited running hours)
- Compressor utilisation is largely driven by gas supply and demand patterns across the network which are increasingly uncertain into the future. We have already seen some key changes to the capability requirements of the compressor fleet. Some compressors are now required to support network flows in a reversed direction from their original design; some compressors have become increasingly important across a large demand range; and some only at peak demand conditions or certain supply patterns in order to avoid significant constraints. Looking forward, changing capability requirements will inevitably influence investment decisions
- We are undertaking a project to review the future requirements for the system. We are considering how different events or factors across gas days and within day might affect the way that the system is managed and possible asset, commercial and operability options that could be progressed to deliver more capability in this area
- A specific project has been highlighted as a result of the changing flows on the system. The network has historically been designed around high St. Fergus gas flows and hence significant ‘north to south’ flows. The decline of future St. Fergus flows is showing a need to move gas ‘south to north’ however; the system capability to do this is limited. Our planning analysis shows that we are approaching a point where, without additional network capability to deliver ‘south to north’ flows, we will not be able to meet our 1-in-20 demand obligations in Scotland. In response to feedback received during our RIIO Talking Networks stakeholder consultation process, we requested funding for these projects in our final RIIO-T1 submission and categorised the funding as ‘1-in-20 Licence Obligation’. We are already actively progressing a number of these projects through our internal governance processes towards approval for construction to ensure that we continue to meet our obligations
- We intend to start engagement with the industry on our future network capability requirements with respect to compressors and network flexibility from Q2 2014. This engagement will start with quantifying the need case for future network capability requirements and then consider the solutions to meet this.

# 5.1
# Introduction

There are many different ways the energy market in the UK could develop over the next 20 years and we understand from talking to our customers and stakeholders that we need to better articulate how this uncertainty might affect gas network development.

We are working to further develop and better articulate our strategy across different areas that impact how we develop the system such as:

- Legislative requirements to improve gaseous emissions from operating our compressor fleet;
- Customer requirements for new connections and expansions at existing sites;
- Customer requirements driving more dynamic use of the system under all demand conditions; and
- Maintaining levels of system reliability and resilience.

We also believe there is further scope to work with distribution network colleagues to optimise future investment plans across the NTS and distribution networks, reducing the overall cost of investment to system users.

Set out in this section are the currently sanctioned NTS reinforcement projects, those that are presently under construction for 2014 and indicative investment (and where applicable, commercial) options for later years, assessed against the scenarios and sensitivities detailed in the Future Energy Scenarios document and signals received in the recent entry capacity auctions and exit capacity allocations.

The annual planning process performs a critical role in allowing us to prepare for likely future system capability requirements whilst also ensuring that investment decisions that have not yet progressed to construction remain valid in light of the latest supply and demand scenarios. Maps showing the current NTS and future investments are presented in Appendix 4.

# 5.2 Load Related Investment

Load related investment is the term given to reinforcement projects generated by signals for incremental entry capacity or incremental exit capacity.

A key part of our planning process is understanding any system reinforcements that may be necessary to meet future customer requirements as a result of the enquiries we receive for new connections to the network (including expansions at existing customer sites). This process enables us to give a view on where there may be spare capability in the system (to meet new connection requests without reinforcement) and conversely where the system is operating close to its current capability and any new connection will likely result in a requirement for reinforcement. This year, we are publishing this information in the form of capacity maps in response to customer requests for more information about where connections to the system would require little or no reinforcement (see sections 4.2 & 4.4).

As described in section 2.3, peak demand over the ten year period to 2023 under both our Gone Green and Slow Progression scenarios is similar. Any incremental entry or exit capacity signals received against either background are likely to trigger similar levels of total investment to enhance network transmission capability (to increase the levels of end of day volumes of gas that can be put on to or taken from the system).

We are working with developers wishing to connect to the NTS to understand the options for asset and other solutions to enable release of incremental capacity under the Planning Consent Agreement (PCA) process, and these discussions have informed our latest business plan. However, as we have not yet received firm signals for all of the above projects, there is significant variability in our investment plans going forward for load related projects.

Our current business plan has a total level of investment in the range £1.1 bn to £2.2 bn (2009/10 prices). This variation is largely due to the range of potential incremental entry or incremental exit capacity signals we may see in the next ten years. These could arise due to signals for:

- New power station connections in the south west of England
- New power station connections in the south east of England
- New power station and / or storage connections in the north west of England
- New entry connections in the south east of England

It is important to stress that reinforcement projects in our business plan are indicative and dependent on the receipt of appropriate user signals. The timing of such projects will, in part, be dependent on the effect of entry and exit capacity substitution but will be endorsed by the signals received through entry and exit commercial processes. We will also consider non-asset based solutions alongside system reinforcement when considering options for meeting capacity requests from customers. Non-asset based solutions could be to negotiate bi-lateral “turn up” or “turn down” contracts with other users of the network, which may be more economic if additional capability is only required over a relatively short timescale. Other options could be to develop optimised investment strategies across the NTS and distribution networks in collaboration with distribution network owners that reduce the need for large scale investment on the NTS.

# 5.3
# Non-Load Related Capacity Requirements

A major driver for expenditure in the non-load related category is investment for emissions abatement. A further driver is investment to provide resilience in the event of unplanned events. Examples of these projects are discussed below:

### 5.3.1 Investment for Emissions Abatement

National Grid uses gas generators to power a significant number of the compressors necessary to move gas around the NTS. We are committed to the monitoring and reduction of emissions from these machines such that full legal compliance is maintained whilst ensuring the safe, secure and reliable transportation of natural gas across the UK.

Compressor utilisation is largely driven by gas supply and demand patterns across the network which, as already outlined above, are increasingly uncertain into the future. We have already seen some key changes to the capability requirements of the compressor fleet:

- Some compressors that traditionally saw high annual operating hours have experienced a marked reduction in operating hours as a consequence of changes to supply patterns;
- Some compressors are now required to support network flows in a reversed direction from original design;
- Some compressors have become increasingly or indeed decreasingly critical at peak demand conditions or certain supply patterns in order to avoid significant constraints.

Looking forward, changing supply and demand patterns in to the future will see changing capability requirements and will inevitably influence investment decisions.

Emissions from our installations have been subject to EU-wide legislation for some time; the predominant legislation which drives our continued investment in this area 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).

### 5.3.2 Environmental Legislation

The IPPC Directive was implemented in the UK through the Environment Permitting Regulations (2010) enforced in England and Wales by the Environment Agency (EA), and the Pollution Prevention and Control Regulations (2000) enforced in Scotland by the Scottish Environment Protection Agency (SEPA). These regulations were updated in early 2013 by the Environmental Permitting (England and Wales) (Amendment) Regulations 2013 in England and Wales and the Pollution Prevention and Control (Scotland) Regulations 2012 which enact the requirements of the Industrial Emissions Directive.

The regulations require us to comply with limits on the gaseous emissions of oxides of nitrogen (NOx) and carbon monoxide (CO) to manage local air quality around all our gas driven compressor sites (regardless of the power rating of the individual units). The environmental agencies issue permits which allow individual compressor sites to operate on the basis that they are deemed to be Best Available Technique (BAT) or have a strategy in place to implement BAT. Both the EA and SEPA have extensive powers to take enforcement action if conditions of the permits are breached. Enforcement action can range from issuing a letter with an improvement notice to, in extreme circumstances, fines and prosecution.

A long term strategy has been developed for the NTS in consultation with Ofgem and the relevant environmental regulators to allow prioritisation of investment across our compressor fleet by dividing investment over phases, as detailed below. This allows us to target sites currently operating high NOx emitting compressor units or with high forecast utilisation and achieve the most environmental improvement at the lowest cost. The priority of sites targeted for investment is reviewed annually through the Network Review process which documents our investment strategy, together with historical and forecast compressor utilisation.

This approach has proved cost effective, with investment delayed at those sites with higher emissions based on current operation but with reducing or uncertain utilisation into the future due to changing system flow patterns.

### 5.3.3 IPPC: Phases 1, 2 and 3

Emissions related investment is currently progressing at the following sites under Phases 1 and 2 of our IPPC Emissions Reduction Programme, expected to be operational during early 2014:

- St. Fergus (2 new electrically driven compressor units)
- Kirriemuir (1 new electrically driven compressor unit)
- Hatton (1 new electrically driven compressor unit)

Phase 3 of the Emissions Replacement Programme includes investment at Huntingdon and Peterborough to comply with IPPC NOx and CO emissions limits by 2021. These sites are of an older design. These sites are anticipated to remain high utilisation sites into the future.

Operation of these sites is affected by supply flows (from the terminals to the north, Bacton terminal and LNG imports from the Milford Haven and Isle of Grain terminals) and demand in the south of the system. Both sites are needed to manage network flows in the south and east of the system including at the 1-in-20 peak day demand level described by our Design Standard[1] as defined in our transportation licence. Peterborough and Huntingdon compressors to operate together to maintain flows and pressures in the system at high demand levels, and can be used interchangeably at lower demand levels, to provide network resilience (for example, to allow maintenance to be undertaken on one of the sites or to maintain minimum system pressures during unplanned outages).

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

We have undertaken extensive analysis of the requirement for operating both sites against our future energy scenarios, under a range of different network flow patterns. We have confirmed through the analysis that both sites are required to manage network flows across a range of supply and demand patterns in the longer term and that there is a future capability requirements are very similar to the current capability provided at these sites so the existing units should be replaced. We have progressed these projects to the stage of readiness to commission the Front End Engineering Design (FEED) and expect to award contracts for this stage by the end of 2013. This design stage will assess the exact requirements for the replacement units (including power rating and number of units). Our current view is that these units will need to be replaced by 2021 in order to manage outage requirements on the system and the interaction with investment required as a result of the Industrial Emissions Directive (see below). Given the uncertainty around future supplies and demands, we will be regularly reviewing the requirement for this investment as each stage of the programme of works progresses.

Phase 4 of the emissions reduction programme is being considered and we are in discussion with the EA and SEPA on the future projects that fall within the scope of this programme.

### 5.3.4 Industrial Emissions Directive

EU environmental policy has been developed in the past few years and has placed stricter controls on industrial emissions. Seven Directives[2] related to industrial emissions into a single clear legislative instrument, the Industrial Emissions Directive (IED), which came into force on 6 January 2011. Some key aims of the change in policy are to:

- Ensure clearer and consistent application of Best Available Techniques (BAT) across Member States;
- Improve inspections, review of environmental permit conditions and reporting on compliance;
- Promote cost-effectiveness;
- Encourage technological innovation; and
- Deliver greater environmental benefits.

The IED was transposed into UK law as the Pollution Prevention and Control (Scotland) Regulations 2012, effective from 7 January 2013 and Environmental Permitting (England and Wales) (Amendment) Regulations 2013, effective from 27 February 2013.

The most significant impacts of the IED on National Grid are the setting of a new limit for the emissions of carbon dioxide (CO) and a more stringent limit for the emissions of oxides of nitrogen (NOx) for all our large combustion plant (individual gas driven compressor units >50MW net thermal input). Our large combustion plant had previously been exempt from the LCP Directive limit for NOx by virtue of its age. The IED is now, however, removing this age related exemption and the limit for NOx will now apply to all of our large combustion plant.

[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.

[2] The IPPC Directive, the LCP Directive, the Waste Incineration Directive, the Solvents Emissions Directive and three Directives on Titanium Dioxide

The IED will also strengthen the principle of applying BAT to the way in which a compressor installation is designed, built, maintained, operated and decommissioned through the setting of environmental permit conditions, issued by the EA and SEPA. The environment agencies may also set stricter permit conditions than those achievable by the use of BAT.

It is important to note that the other requirements of the existing Environmental Permitting (England & Wales) and Pollution Prevention & Control Regulations (Scotland) are maintained, i.e the principles of BAT will still apply to all of the gas compressor stations operating machinery <50MW thermal input as the drive to reduce emissions of NOx & CO from all industrial combustion plant continues.

The implications of the IED for National Grid are that a number of the larger gas turbines operated by National Grid will need modifying or replacing in order to meet the new and revised limits. Where units are replaced or where new compressor installations are built, the demonstration of BAT applied during the design phase is mandatory in order to obtain environmental permits so that the site can be operated.

Compliance with the new emissions limits is mandatory after 6 January 2016 however, National Grid will be entering those machines in its fleet which are not compliant with the requirements of the IED into a limited life derogation, allowing the continued operation of these non-compliant machines until either 31 December 2023, or when the machine has accumulated a total of 17,500 operating hours (whichever is soonest).

Derogations can be granted in specific and well justified cases where an assessment shows that the achievement of emission levels associated with the BAT conclusions would lead to disproportionately higher costs compared to the environmental benefits, due to the geographical location or the local environmental conditions of the installation concerned or the technical characteristics of the installation concerned.

All of our large combustion plant that continues to operate on our system must be compliant with new limits for oxides of nitrogen and carbon monoxide by 31st December 2023. This can be achieved by investment, closure (as either capability is no longer required or capability can be met using other solutions) or derogation.

We currently operate 64 gas turbine driven compressors across our compressor fleet. There are eight sites with a total of 17 gas turbine driven compressors (>50MW net thermal input) of an aero derivative design that produce emissions above the thresholds set by the IED.

### 5.3.5 IED Phase 1: Aylesbury

Aylesbury is located in the south of the system and is affected by supply flows from the Bacton and Isle of Grain terminals and demand in the south of the system. It is a key site in a series of compressor stations between Hatton in the north east, to Lockerley in the south west which move flows around the system and support 1 in 20 peak day demand levels in the south west. At lower demand levels than the 1-in-20 peak day demand, this group of compressors can be operated to manage linepack within the system to maintain system resilience to plant failure or unavailability and within day flow variation to the levels we are experiencing on the network today. Under lower demand conditions Aylesbury is also of particular importance as a gas-powered backup site to the downstream Lockerley compressor station which only has electrically driven compressor units installed as a consequence of strict local planning constraints.

We have determined that Aylesbury is still required under our future energy scenarios to meet 1-in-20 peak day demand levels in the south of the system. We have also identified that the site could require enhancement to accommodate additional flows (above obligated entry capacity levels) from the Bacton or Isle of Grain terminals or to support system pressures if new CCGTs connect in the south west.

The timing of works at Aylesbury remains uncertain as we are currently assessing the available technical options prior to commencing Front End Engineering Design works. Aylesbury has gas driven compressor units that are compliant on NOx emissions limits but would be unable to comply with CO emissions limits imposed by 2023 under the IED legislation. If technically viable, a modification option could allow us to comply with IED requirements could allow the existing units to be modified to comply with the IED requirements. If technically viable, a modification option could allow us to comply with IED requirements by 2016; replacement of the units will take longer due to the additional lead-times for procurement of new machine trains and construction required.

In order to minimise constraint costs related to outage requirements and the interaction with Huntingdon and Peterborough IPPC investment (these compressor stations interact and provide resilience for each other), it is preferable if this investment is done by 2016. However, alongside the technical solutions, we also need to consider fully any uncertainties arising through future supply and demand patterns, including new connections to our system and this could mean that it is more efficient to plan for a later delivery date. For these reasons, we will continue to review the options for emissions reduction investment at Aylesbury alongside developments in other areas of the NTS.

## Industrial Emissions Directive – Future Phases

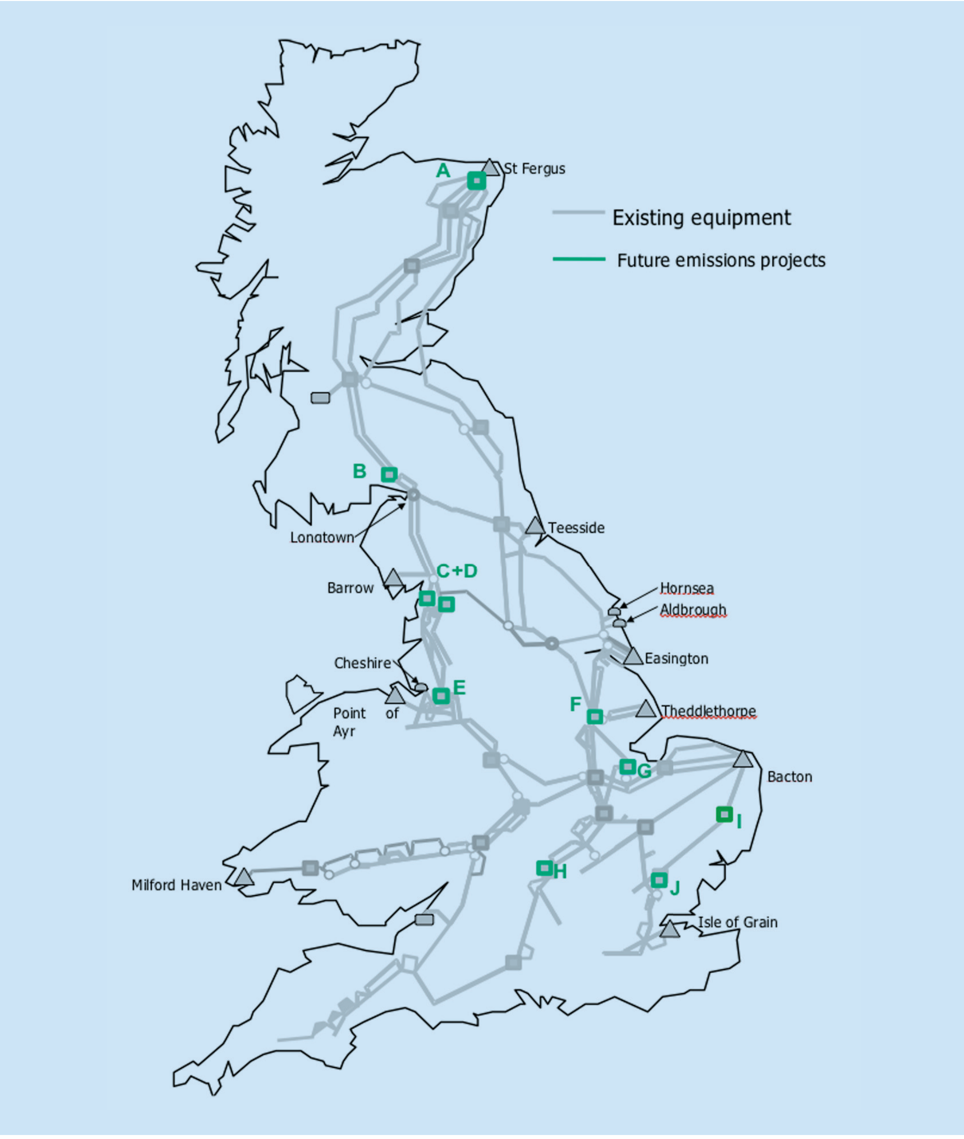
As mentioned, the Industrial Emissions Directive requires National Grid to meet stricter NOx and carbon monoxide emissions limits arising from the operation of its gas compressors.

The RIIO-T1[3] price control has introduced an uncertainty mechanism for IED investment, as future network capability requirements were subject to change due to uncertain future supply and demand patterns. The uncertainty mechanism allows National Grid to develop its strategy for the emissions reduction programme and present an updated view of future investment that might be required to comply with the IED legislation in May 2015. Ofgem have specifically asked National Grid to present a fully justified plan to deliver the required emissions abatement investment in order that the regulatory allowances for this next stage of investment may be revised up or down:

*"…This plan will need to demonstrate comprehensive cost-benefit analysis of all the engineering and commercial options available to NGGT. The plan will need to consider compression requirements on the network as a whole, not just at individual sites, as well as performance against other incentives such as venting. It will also take into account any guidance on IED issued by the EA and SEPA, as well as finalised IPPCD Phase 4 requirements."*

We are currently progressing feasibility and initial design for a number of sites that are not compliant with IED requirements including gas compressors at St. Fergus (A), Hatton (F), Wisbech (G), Aylesbury (H), Carnforth (C), Nether Kellet (D), Warrington (E), Moffat (B), Diss (I), Chelmsford (J).

[3] RIIO-T1: Final Proposals for National Grid Electricity Transmission and National Grid Gas, Cost assessment and uncertainty supporting document, para 7.101.



St Fergus
A
Existing equipment
Future emissions projects
B
Longtown
Teesside
C+D
Barrow
Hornsea
Aldbrough
Easington
Cheshire
E
Point of Ayr
F
Theddlethorpe
G
Bacton
I
Milford Haven
H
J
Isle of Grain

As described, we have until December 2023 to reach compliance, otherwise we will not be able to operate the site or units affected. Our current experience is that it takes between 5 and 7 years for such projects to progress from inception to commissioning (starting operational duty). These lead-times are driven by a number of factors including the:

- Application process for planning and consents to develop existing sites or increase the size of the site
- Electrical connections to the relevant electricity distribution network to provide or upgrade the power supply for electrically driven compressors
- Assessment and demonstration of Best Available Technology (BAT) to the EA or SEPA (mandatory under the IED) to obtain or revise the environmental permits for the site or units so that they can be operated
- Procurement of long lead items such as the compressor units themselves.

We also need to consider long-term outage requirements for these projects alongside our regular maintenance activities, so such works do not degrade our network capability and impact on customers connected to our system. Further work is required to assess the capability requirements of the system into the future, considering any need for providing additional system flexibility required by customers or new connections to the system.

This will mean some projects are planned for relatively early delivery in the period up to 2023 as part of a phased construction and commissioning plan to allow system reliability and resilience to be maintained.

We are considering all options, from like for like replacement, potential opportunities to reduce the installed compression power at sites where our long term scenarios do not show a need for continuing with existing levels of capability and are also considering sites that may be decommissioned over the long term.

We are reliant on the information provided by our stakeholders and customers through the FES consultation process and through bi-lateral discussions to provide reliable data to base these decisions on. However, we have established processes that update this information on an annual basis and we will continue to enhance our engagement on these areas. Any decision to reduce compression in areas of the system will impact on our ability to meet obligated entry and exit capacity levels in some areas of the system and we are keen to understand from customers, stakeholders and especially developers whether this has a material impact on projects under development or the way they intend to flow into or out of the system in the future.

We will continue to review the need case for each site and for the entire compressor fleet in terms of providing the capability for bulk transmission of gas, for providing system flexibility and for maintaining system resilience. Due to the range of scenarios that could occur, our approach is to determine our least regrets option for compressor investment at each stage in the project and continue to review this regularly, to be able to make our final investment decisions with an increased level of certainty. The alternative is to try and anticipate today what the exact requirements for the long term, which will possibly lead to less effective outcomes.

We will be engaging industry on these issues from Q2 next year with a view to providing detailed proposals for May 2015 IED Reopener window.

# 5.4 Avonmouth

The Liquefied Natural Gas Storage (LNGS) facility at Avonmouth was built in the 1970s and provides both commercial and regulated gas storage services. It provides commercial storage services to shippers. It also provides regulated services to the NTS to maintain operational security in the form Operating Margins (OM); and to meet the 1-in-20 design standard in the form of Constrained LNG (CLNG) services in the south west extremities of the National Transmission System (NTS). It also provides a service for Scotland Gas Networks (SGN) for supplying LNG through tankers to four towns in Scotland (known as the Scottish Independent Undertakings (SIUs)) which are not connected to the gas distribution networks. A decision has been made to close the storage facility, due to the significant levels of investment required to continue operation of the site in the long term. It is anticipated that the site will cease to operate in 2018.

National Grid also procures OM and Constrained services from other providers in the south west and reviews these requirements and contracts annually. As the current level of contractual cover provided by these other service providers does not fully replace the services offered by the Avonmouth LNGS facility, there is a need to understand the impact of the removal of Avonmouth as a service provider to the NTS in the longer term.

Within National Grid's RIIO-T1 submissions, it was identified that there was an enduring need for the capability provided by the Operating Margins (OM) gas and constrained LNG services, in the south west of the gas network.

Based on the enduring need for services and an assessment of possible alternative options, (re-life of Avonmouth, alternative (contractual) provision of services, pipeline solution), funding was provided for construction of a pipeline solution as the most efficient and economic option.

We are undertaking further analysis using the latest information from the Future Energy Scenarios to update our capability requirements and the options that can be used to replace the OM and CLNG services provided once the Avonmouth LNG facility closes. This will also inform our discussions with the HSE in respect of our Safety Case for the NTS (since the OM services form part of the Safety Case) and any future planning applications made under the 2008 Planning Act (i.e for pipeline or compressor solutions to meet capability needs).

We are progressing the early stages of planning for the latest reinforcement options due to investment lead-times to ensure they remain viable options.

We have understood from our stakeholders, through our RIIO Talking Networks consultations that we need to be more transparent with the way we apply our statutory obligations to plan the system and ensure system security, given the uncertainties in future flow patterns. Our current plan is to commence engagement with the wider industry in Q1/Q2 2014 to explain the capability needs, the options available and how projects are progressing.

# 5.5
# Changing Use of the Network

We have also highlighted two new drivers for gas network development that arise from the changing use of the NTS, that the current regime to signal incremental entry and exit capacity requirements does not address:

- Investment to meet 1-in-20 peak day demand levels resulting from declining supplies into an area
- Investment for network flexibility requirements.

We will continue to work with individual developers to understand their requirements for capacity on our system and where system capability to meet different user needs should be enhanced or maintained. Where several drivers for investment are apparent in areas of the system we intend to develop regional strategies for investment and non-investment solutions for further discussion and refinement with the wider industry.

We are undertaking a project to review the future requirements for the system. We are considering how different events or factors across gas days and within day might affect the way that the system is managed and possible asset, commercial and operability options that could be progressed to deliver more capability in this area. This project is discussed in more detail at the end of chapter 3 in the section titled "Defining the future network flexibility capability requirements."

# 5.6
# 1-in-20 Obligation for Scotland

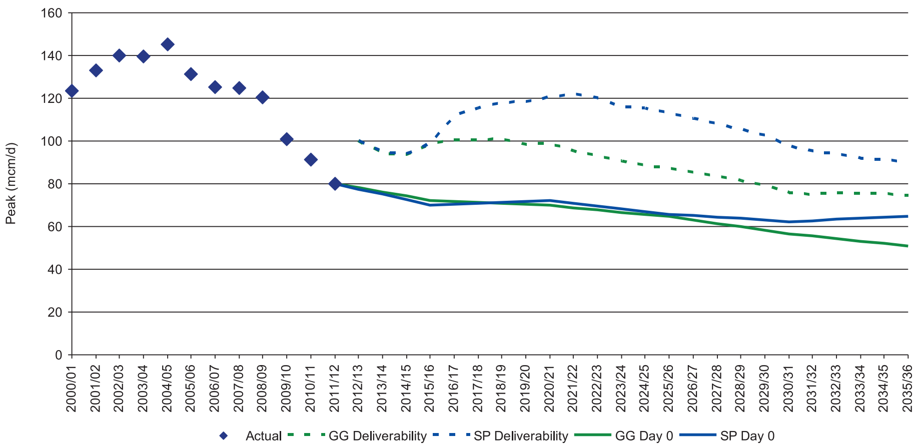
Figure 5.6A shows ten years of forecast gas supplies at St. Fergus, as informed by our industry consultative processes. It clearly shows that supplies are dropping away far quicker than anyone (including the shippers bringing the gas to shore) had previously anticipated with expected peak day (Day 0) supply volumes some 30 to 50 mcm/d lower than the terminal's full deliverability.

Against this backdrop of falling supplies, demand in Scotland (including the Moffat offtake to Ireland) has risen, reaching the point where on some days this demand is already marginally greater than the supplies from St. Fergus. For a number of years our scenarios have strongly indicated this situation will worsen over the coming years as existing UKCS supplies through St. Fergus continue to decline and become more uncertain. The uncertainty at St. Fergus is mainly driven by uncertainty in Norwegian supplies which can go to European markets via the offshore pipeline system or arrive in the UK via the Easington importation terminal.

The reduction in supply at St. Fergus has been compensated for by additional supplies at Southern ASEPs, therefore to maintain supplies in Scotland it will be increasingly necessary to route gas 'south to north' within the network. Actual peak flows and future slow decline in peak forecasts imply south north flows are likely to become the norm.

The network has historically been designed around high St. Fergus gas flows and hence significant 'north to south' flows; it presently has very limited physical capability to actively move gas 'south to north'. Our planning analysis shows that we are approaching a point where, without additional network capability to deliver 'south to north' flows, we will not be able to meet our 1-in-20 demand obligations in Scotland.

*Figure 5.6A*
*Forecast flows from the St. Fergus ASEP 2013*
*Source: National Grid*



As noted, the reduction in St. Fergus flows has been compensated for by additional supplies at southern ASEPs, however, we have not seen signals for incremental capacity sufficient (either individually or in combination) to trigger these projects through the existing industry and regulatory processes.

As the current regime is based on customer commitment underpinning the provision of incremental capacity and this situation has arisen through changing / decremental flows, there was no clear trigger mechanism to identify these projects and provide funding for a solution (be it commercial, operational or asset based).

We have identified a number of modifications to the network, designed to enhance the network capability to maintain Scottish pressures and enhance 'south to north' flows.

In response to feedback received during our RIIO Talking Networks Stakeholder Consultation process, we requested funding for these projects in our final RIIO-T1 submission and categorised the funding as '1-in-20 Licence Obligation'. We are already actively a progressing a number of these projects through our internal governance processes towards approval for construction to ensure that we continue to meet our obligations.

Taking account of our licence obligations and having considered non-investment options we believe that, based on current information, these projects represent the optimum initial solution.

We have identified a sequence of projects that would allow us to enhance 'south to north' capability. The first projects involve compressor station modifications, which would allow the stations to maintain Scottish pressures and compress gas flowing south to north. As part of the work we carried out preparing for RIIO, we worked with the DNOs to review pressure and flex requirements to seek to reduce overall network investment.

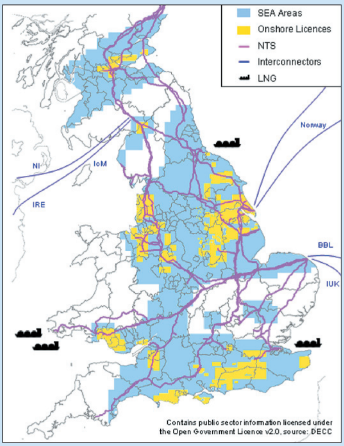
Solutions are required to support demand in Scotland and through the Irish interconnector. Irish interconnector flows are an uncertainty for us and lower flows, caused by reduced demand and / or increased Irish supplies may allow us to defer some of these projects; however, the first projects are relatively low cost, no regrets investments, leading us towards continuing these modifications.

## Shale Gas

Shale gas is natural gas that is found trapped within shale formations and extracted by hydraulic fracturing (fracking). Although the volume of shale reserves within the UK is uncertain, figures from a British Geological Survey and DECC report suggest that at a conservative recovery rate of 10% and annual UK gas consumption rates of about 80 bcm, shale gas alone would provide 46 years of gas supply. A shale gas case study can be found in the 2013 edition of our Future Energy Scenarios document.

Shale deposits are spread across large areas of the country. Large areas of the onshore UK do not currently have extraction licences granted. The map shows existing licence areas (some relating to conventional deposits, e.g. Wytch Farm in Dorset) and areas covered by DECC's ongoing Strategic Environmental Assessment (SEA) in preparation for a 14th onshore licensing round.

An overlay of the National Transmission System shows good concurrence and scope for connection with current and potential areas of exploration. We do not foresee a capacity issue at this stage for the volumes in our case study, and the likely points of entry, the number, size and location of future shale gas contributions is currently very uncertain.




We recognise that issues for shale extraction in the UK differ from those in US, including the economics, technology, and environmental safeguards required to extract the gas. Large volumes of shale gas that exceed local distribution network demands would require connection to the NTS, and a reduced need for compression to high pressure favours local distribution network connection for small volumes. Gas quality will need to be considered due to GS(M)R (regardless of which system they are connected to) and may vary widely with the local geology. Ballasting, enrichment, and cleaning of gas may be required. However we are committed to working with developers to ensure that this is not a barrier to projects progressing.

Our case study describes a shale gas sensitivity considering the impact of large volumes of shale, from an annual perspective. We have been approached by a small number of developers regarding shale developments; however we still do not possess enough information about the potential requirements for connections and future flows from proposed sites to inform a large scale study of the impact on the network.

Where a number of developers are interested in delivering gas into the system in a geographic area, we would expect to work with all parties to find the most effective way to connect to the gas system (including DN system). We are keen to engage with shale gas producers to understand their requirements and develop a coordinated approach to allow efficient access to the system for these new potential sources of supply.

We are also interested in the secondary impact of global shale gas production, for example, how it may affect LNG importation into the UK and the impact on gas as a choice of marginal fuel for power generation. This will have an impact on our assumptions around minimum levels of flow that can be anticipated at LNG terminals and through Interconnectors, and customer requirements for flexibility in using the NTS.

# 5.7
# Projects Under Construction

The tables below indicate the status of existing construction projects.

Final commissioning of the two new electrically driven compressors at Hatton and Kirriemuir is currently underway as part of our ongoing programme of works for emissions reductions. These projects will then be tested under operational conditions during the early part of 2014.

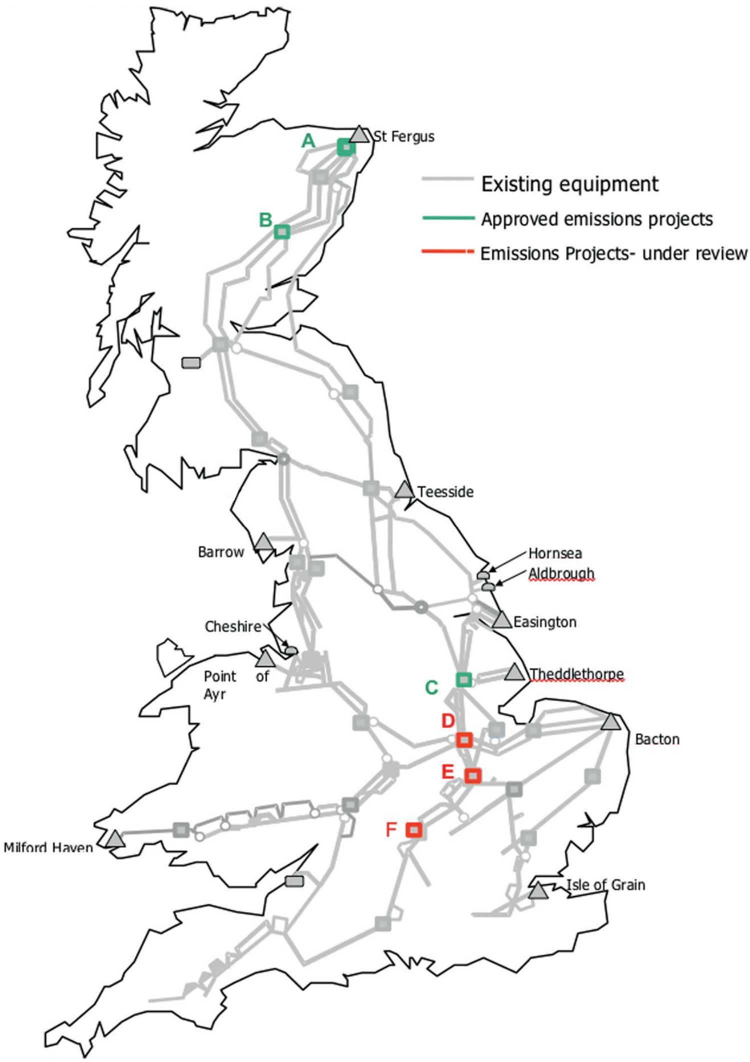
*Table 5.7A*
*Projects under construction*

| Map ref. | Project | Scope | Driver |
|---|---|---|---|
| A | St. Fergus Compressor Station | New Unit | Emissions Reduction |
| B | Kirriemuir Compressor Station | New Unit | Emissions Reduction |
| C | Hatton Compressor Station | New Unit | Emissions Reduction |

*Table 5.7B*
*Projects under review (please note locations are indicative and subject to change as we progress through the planning process)*

| Map ref. | Project | Scope | Driver |
|---|---|---|---|
| D | Peterborough Compressor Station | New Unit | Emissions Reduction |
| E | Huntingdon Compressor Station | New Unit | Emissions Reduction |
| F | Aylesbury Compressor Station | New Unit | Emissions Reduction |

*Figure 5.7C*
*NTS projects, completed, approved and under review*
*Source: National Grid*



# 5.8
# Stakeholder Engagement

Below we have detailed some of the specific areas that would like to hear your feedback in relation to this chapter, although we would welcome feedback and views on any area. We intend to engage further in these areas during the first half of 2014. We are happy to receive engagement of any kind through the following means and of course at any other opportunities we get to meet:

- At consultation events as part of the customer seminars
- At operational forums
- Through responses to the GTYS email **Box.systemoperator.gtys@nationalgrid.com**
- Organising bilateral stakeholder meetings

You can find a full set of the questions in word format for each chapter on our website.

How well do you think we have articulated the need for developing capability on our system?

How well do you understand the drivers for changing the capability of the network?

Are there any further drivers you are aware of that might affect how we develop system capability in the future?

We discuss how in some areas of the system we may not need to replace key assets (such as compressors that do not comply with new emissions legislation) if there are no long term requirements for these assets. Do you have any views on whether we should continue to invest to maintain existing system capability where there are no customer signals that indicate this capability is required in the long term?

# Chapter Six
# **Way Forward**

We are committed to ensuring that the GTYS continues to evolve and that each year our stakeholders have the opportunity to shape the development of this document. This chapter details the engagement process which will run in 2014.

# 6.1
# Introduction

We encourage you to provide feedback and comments on this document. Please participate in our Stakeholder Engagement Programme in 2014 so we may better understand and respond to your future needs. Please provide any feedback on all aspects of the 2013 GTYS via e-mail:
**Box.systemoperator.gtys@nationalgrid.com**

# 6.2
# Continuous Development

We will ensure that 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 stakeholders
- to provide opportunities for engagement throughout the process to enable constructive debate
- to create open and two-way communication processes around assumptions, drivers and outputs with our stakeholders
- to provide feedback on how stakeholder views have been considered and the outcomes of any engagement process.

The GTYS annual review process will facilitate the continuous development of the statement, encouraging participation from all interested parties with the view of enhancing future versions of the document.

# 6.3
# Feedback from 2013 Stakeholder Engagement

**Where we received our feedback:**
The GTYS 2013 consultation took place through a variety of channels; the majority of feedback was received at RIIO Talking Networks events, National Grid Future Energy scenarios and the Gas Customer Seminar workshops.

## Provide more information on connection opportunities

**You told us:**

**GTYS needs to provide more information on where there are opportunities to connect without incurring significant lead times.**

**Our response:**
We have created a new chapter focused on customer system capability requirements. We have included information regarding the lead time for providing NTS Entry and Exit Capacity across different geographical zones as an indicative guide for customers.

## Further quantify the network risks associated to network flexibility

**You told us:**

**With respect to network flexibility, National Grid needs to better describe what could happen, under a range of credible scenarios, if no action were taken and the status quo prevailed in terms of the current commercial arrangements governing system management.**

**Our response:**
We are undertaking a project to review the future requirements for a more flexible system. We are considering how different events or factors across gas days and within day might affect the way that the system is managed and possible asset, commercial and operability options that could be progressed to deliver more capability in this area.

The categories we are considering include supply-side behaviour (e.g. supply shocks, supply profiling), 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 Standard and Security Standard is applied in our planning and operational processes and whether these are appropriate for supply and demand patterns we may see in the future.

We intend to start engagement with the industry on these areas from Q2 2014. This engagement will start with quantifying the impact that these issues will have on customers if no action is taken.

## Increasing the lead time for connection as a result of the Planning Act (2008) was not a viable solution

**You told us:**

**That increasing the lead-time for connection as a result of the Planning Act (2008) was not a viable solution as it would require customers to commit to capacity with lead times that were not consistent with their own project investment decision timescales.**

**Our response:**
We have been working with you further develop solutions to modify and align the NTS Capacity and Connections Processes more effectively. The proposed solution involves the introduction of a bi-lateral contract, the Planning and Advanced Reservation of Capacity Agreement (PARCA), for parties wishing to signal incremental capacity. The PARCA approach was developed at the monthly Transmission Workgroup meetings leading to UNC modification proposals and the development of the associated changes to our Gas Transporters Licence and Methodology Statements, and the PARCA contract. Each aspect of the solution was discussed at Transmission Workgroup meetings, allowing the industry to participate in shaping the final solution.

Two alternative options have been developed for the initial user commitment; one based on location specific capacity prices and one based on average entry or exit prices. At the time of writing this document, the modification was being assessed by Ofgem.

# 6.4 Stakeholder Engagement

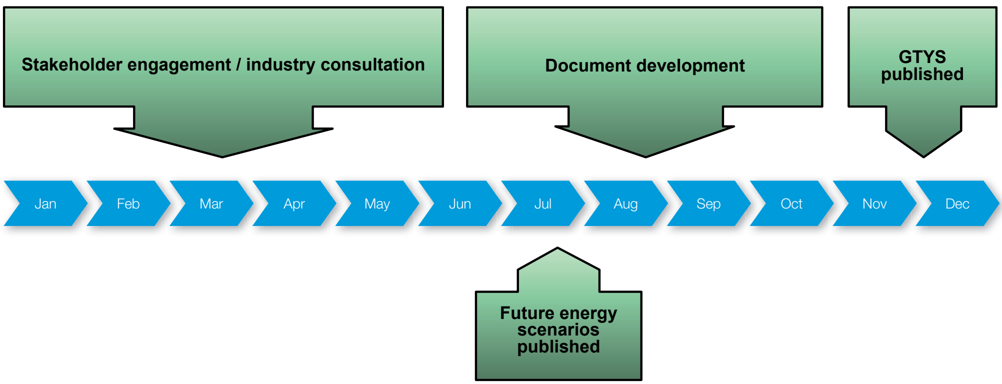
The GTYS is subject to an annual review process, facilitated by National Grid, and involving all stakeholders who use the publication. The purpose of this review is to ensure the GTYS evolves alongside industry developments. Some of the areas to consider are:

- Does the GTYS:
  - illustrate the future development of the transmission system in a coordinated and efficient way?
  - provide information to assist customers in identifying opportunities to connect to the transmission network?
- Are there any areas where the GTYS can be improved to meet these aims?

We are happy to receive engagement of any kind through the following means and of course at any other opportunities we get to meet:

- At consultation events as part of the customer seminars
- At operational forums
- Through responses to the GTYS email: **Box.systemoperator.gtys@nationalgrid.com**
- Organising bilateral stakeholder meetings depending on the feedback

Our indicative timetable for the 2014 GTYS Engagement Programme is shown below:



# 6.5 Stakeholder Engagement

Below we have detailed some of the specific areas that would like to hear your feedback in relation to this chapter, although we would welcome feedback and views on any area. We intend to engage further in these areas during the first half of 2014. We are happy to receive engagement of any kind through the following means and of course at any other opportunities we get to meet:

- At consultation events as part of the customer seminars
- At operational forums
- Through responses to the GTYS email **Box.systemoperator.gtys@nationalgrid.com**
- Organising bilateral stakeholder meetings

You can find a full set of the questions in word format for each chapter on our website.

We have described how we are developing our views on key areas of our Gas Network Strategy such as network flexibility and emissions abatement investment and that we intend to start discussing these with the wider industry from Q2 2014. We are presently developing our stakeholder engagement plans. We would like to understand further how we can make this engagement more valuable for you. Do you have any views on how you would like us to engage with you and in what forms you would like this engagement to be delivered?

# Appendix One
## Process Methodology

# A1.1 Demand

The purpose of this section is to give a brief overview of the methodology that is adopted to develop scenarios of annual and peak demand. All three scenarios are based on different axioms (explained further in the Future Energy Scenarios document). Unlike previous years, whilst the axioms vary, the same methodology is used for each scenario. The methodology can be categorised into three main modelling areas; annual demand, demand / weather and peak demand modelling. For more information please see our Gas Demand Forecasting Methodology document.

### A1.1.1 Annual Demand Modelling

The development of annual gas demand scenarios considers a wide range of factors, from complex econometrics to an assessment of individual load enquiries. For any scenario process a set of planning assumptions is required, which if necessary can be flexed to create alternative scenarios. In the case of the scenarios presented in this document, assumptions include economic, fuel prices, environmental and tax policies, etc. A number of these assumptions are based on data from independent organisations. Our scenarios are also benchmarked against the work of a number of recognised external sources, such as DECC. These are referred to as axioms and differ between scenarios (explained further in the Future Energy Scenarios document).

To gain a better understanding of how these assumptions are utilised and the modelling approach adopted it is necessary to consider the LDZ and NTS processes separately.

### A1.1.2 LDZ Modelling

LDZ demand is split into 3 NDM (non-daily metered) load bands and total DM (daily metered) demand. For each sector models have been developed that make allowance for economic conditions, local demand intelligence, new large load enquiries, relative fuel prices, potential new markets and other factors, such as the Climate Change Levy, that could affect future growth in demand.

By adopting this approach we are able to take account of varying economic conditions and specific large loads within different LDZs.

### A1.1.3 NTS Modelling

Historically, NTS demand (i.e. loads with their own connection to the NTS) was limited to a small number of large industrial sites and chemical works. However, with the advent of gas-fired power generation and interconnectors to Ireland and Continental Europe, a new methodology had to be developed. This methodology can best be described by looking at each sector in turn.

### A1.1.4 Power Generation

The power generation forecast consists of two main elements, firstly, the capacity available to generate and secondly, how frequently this capacity is in operation.

The first element is developed by comparing information from connections requests and load enquiries with feedback received from the Future Energy Scenarios consultation process and a range of commercial sources. In addition, the influence of commercial arrangements, Government policies and legislation are taken into account when deciding which power stations will be built or closed.

To complete the second element, a model has been developed to forecast the demand for electricity generation by fuel type and individual station over the forecast period. The modelling process takes account of station specific operating assumptions, constraints, costs and availability. Actual station data is also used to support the process.

The resultant power generation forecast, encompassing all fuel types, is then used to derive a split between gas-fired stations supplied by the NTS (or embedded within the DNs) and those with their own dedicated pipeline delivering supplies direct from the beach.

### A1.1.5 Exports

Forecast flow rates to and from Europe via the Belgium Interconnector (IUK) are based on a market assessment between Continental Europe and the UK, allowing for the seasonal variation of UK gas demand.

Exports to Ireland are derived from a sector-based analysis of energy markets in Northern Ireland and the Republic of Ireland, including allowances for the depletion and development of indigenous gas supplies, feedback from the Future Energy Scenarios consultation, commercial sources and regulatory publications.

### A1.1.6 Industrials

The production of forecasts within this sector is dependent on forecasts of individual new and existing loads based on recent demand trends, Future Energy Scenarios feedback, load enquiries and commercial sources.

### A1.1.7 Demand / Weather Modelling

Demand models are based on Composite Weather Variables (CWVs) defined and optimised for each LDZ. The CWV combines temperatures and wind speeds into a single weather variable that is linearly related to NDM demand. Seasonal normal CWVs (one for each day and each LDZ) are produced using the EP2 methodology, which adjusts seasonal normal weather for climate change. All seasonal normal and average demand forecasts are now based on an EP2 average condition. National Grid has modified the CWV used for these forecasts[1]. The modification results in a slight increase in demand in very cold weather to account for the consistent under forecast that occurs when using the unmodified version.

### A1.1.8 Peak Day Demand Modelling

Once the annual demand forecasts and daily demand weather models have been developed, a simulation methodology is employed, using historical weather data for each LDZ, to determine the peak day (in accordance with statutory / licence obligations) and severe winter demand estimates. Where possible, the peak day demand of the NTS supplied loads, such as the power stations, are based on the contractual arrangements. Export demands are treated slightly differently; the Belgian Interconnector is assumed not to be exporting at times of peak demand, due to the high price of British Gas, and Irish demand is derived from the market sector based approach mentioned above. The post exit undiversified peak day is the sum of the expected peak demand at each location and differs from contractual obligations based on sold capacity and baseline capacity.

[1] The CWV used for Demand Estimation and published in Data Item Explorer on the National Grid website remains unchanged from last year.

# A1.2
# Supply

The main purpose of our supply scenarios is to allow a picture of supply and demand to be derived, which can be used to assess potential National Transmission System (NTS) investments and other business requirements such as compressor utilisation and security of supply analysis. In the past, this process was dominated by developments in the UKCS, as our assessments of Aggregated System Entry Point (ASEP) capacity requirements were dependent on accurate forecasts of UKCS field production. While UKCS data is still an important element of this process, we continue to adapt our processes to manage increasing levels of imported gas. In terms of network design and operation it is not just about the increasing level of imports but how the supply diversity brought about by a combination of surplus of import capacity and potential storage developments will be utilised.

In constructing our long-term gas supply scenarios, we continue to rely on information received from market participants, which we supplement with data from commercial sources. This year we have again had an excellent response to our Future Energy Scenarios consultation process in relation to UKCS supplies, with information from upstream players again accounting for approximately 90% of the total used to compile our UKCS scenarios. As a result, we believe our 2013 UKCS supply scenarios continue to reflect the collective expectations of the upstream UK gas industry.

In terms of future imports we also continue to receive a good response from developers through our Future Energy Scenarios consultation. Indeed in aggregate, the total supply capacity of import projects far exceeds the UK's existing and even future import requirement. On a peak basis the addition of proposals for new storage projects compounds the supply uncertainty as does increasing requirements for network exit capacity from networks, gas fired power stations and for storage injection. As in previous years, National Grid has used various supply scenarios to assist our planning process and stimulate industry debate.

For each of the demand scenarios, we have created dedicated supply scenarios, governed by the axioms that underpin all our Future Energy Scenarios modelling. For example, in the Slow Progression scenario, where progress towards environmental targets is slower than in Gone Green, the axiom for UKCS supply calls for

- Further development of smaller fields (including development of West of Shetland) due to government initiatives drives higher UKCS supply and lower rate of decline than in Gone Green.

Similarly, in Slow Progression there is some requirement for new seasonal storage as import dependency increases. In Gone Green the increased requirement for flexible supplies to match intermittent renewable generation come from fast cycling storage sites, LNG and access to European storage.

When forecasting future levels of gas storage, we have used generic capacity rather than specific storage sites.

# A1.3
# NTS Capacity Planning

Using the supply / demand match as an input, we use a network analysis software package, to analyse the performance of the transportation system. The network analysis software allows us to identify the location of potential network capacity constraints and helps in the development of suitable reinforcement options that ensure the appropriate level of system security is maintained.

Having identified potential constraints on the system, we evaluate options for adding capacity to the network that represent a safe, economic and efficient solution, whilst maintaining system security. The options available to us to increase capacity include:

- Uprating pipeline operating pressures;
- Changing the way the system is configured (changing flow patterns and reversing flows);
- Constructing new pipelines or compressors stations;
- Uprating or modifying existing compressors or installing new compressor units; and
- Building additional flow control valves (regulators) and offtakes.

Investment options are considered with the primary aim of minimising the net-present costs, in accordance with our "economic" and "efficient" obligations under the Gas Act. The drivers for investment are:

- Provision of 1 in 20 peak day capacity, in accordance with Standard Special Condition A9 of the GT Licence in respect of the NTS;
- Reduction of environmental emissions from compressor stations; and
- Delivering customer contracted quantities of capacity.

The aim of minimising the net-present costs associated with investment requires network analysis to be applied over a long term (at least ten years) horizon, and many demand conditions (1 in 20 peak day through to summer conditions).

Further information on our investment planning process and how this interacts with commercial processes for capacity release may be found in our Transmission Planning Code, available on our website at:
**http://www2.nationalgrid.com/UK/Industry-information/Future-of-Energy/Gas-Ten-Year-Statement/Transmission-Planning-Code/**

# A1.4
# Investment Procedures and Project Management



All investment projects must comply with our Transmission Investment Management Procedure, which set out the broad principles that should be followed when evaluating high value investment or divestment projects. These guidelines are supported by specific guidelines for the UK Transmission and Distribution businesses.

The investment guidelines define the methodology to be followed for undertaking individual investments in a consistent and easy to understand manner. Together with the planning and budgeting methodology, they are used to ensure maximum cost efficiency is obtained. For non-mandatory projects, the key investment focus in the majority of cases is to undertake only those projects that carry an economic benefit. For mandatory projects, such as safety-related work, the focus is on minimising the net-present cost whilst not undermining the project objectives or the safety or reliability of the network.

The successful management of major investment projects is central to our business objectives. Our project management strategy involves:

- Determining the level of financial commitment and appropriate method of funding for the project;
- Undertaking preliminary studies to ensure projects are feasible and confirm budget estimates;
- Developing the most appropriate purchasing contracts methodology;
- Monitoring and controlling the progress of the project to ensure that financial and technical performance targets are achieved; and
- Post project and post investment review to ensure compliance and capture lessons learnt.

When a transmission project is approved, a multi-discipline team prepares an invitation to tender in accordance with the EU Utilities Directive. For major projects, specialist consultants with experience of preparing and evaluating tender documents are used.

Tenders are received and evaluated against previously agreed technical, quality, safety, financial and programme criteria. They are compared on a cost basis with a database of capital projects. An award is then made to the most economically advantageous tender consistent with these criteria.

The successful contractor completes the project in accordance with an agreed programme of works. It remains the contractor's responsibility to manage and supervise the works. We monitor the work on a day-to-day basis and manage the funding of the project by careful cost control. Following completion, a Post Completion Review is carried out to provide feedback to management on project performance and to improve future decision making processes. Our project management of major investment projects is designed to ensure that they are delivered on time, to the appropriate quality standards at minimum cost. The project management process in particular makes use of professional consultants and specialist contractors, all of who are appointed subject to competitive tender. When the project is complete a financial closure report is submitted to the level of management appropriate to the total cost. Lessons learnt are then recorded for future utilisation.

# A1.5
# Transmission Planning Code

Special Condition 7B requires that National Grid prepares and maintains a Transmission Planning Code that describes the methodology used to determine the physical capability of the system. It is intended to inform parties wishing to connect to and use the NTS of the key factors affecting the planning and development of the system.

National Grid undertakes investment planning up to a ten-year planning horizon on an annual basis. The investment plan is developed using long term supply and demand scenarios which are informed by information gathered through the commercial processes to reserve capacity on the system.

National Grid will commence its annual planning cycle after the initial data has been gathered through the Future Energy Scenarios consultation process and will use this data to compile long-term supply and demand scenarios. The planning process will consider those investments that may be required to respond to potential entry and exit capacity signals from the market. National Grid will use detailed network models of the NTS under different supply and demand scenarios in order to understand how the system may behave under different conditions up to the ten year planning horizon.

During this process, Distribution Network Operators (DNOs) and Shippers can apply for exit capacity from the NTS to support their long-term needs, and Shippers may signal their requirements in the long-term entry capacity auctions, under rules set out in the Uniform Network Code (UNC). The information received from these commercial processes will be used to decide the final set of investments that are necessary to develop the system.

National Grid will consider long-term signals received for additional capacity above the prevailing obligated / contracted capacity levels and long-term capacity bookings / reservations within obligated / contracted capacity levels within the same annual planning process.

Commercial options available to National Grid will also be considered to avoid or defer investment and to determine the most economic and efficient outcome. Commercial arrangements can include (but are not limited to) booking of constrained services at LNG storage sites, supply turn up contracts, buy-back contracts and interruption contracts.

In light of industry and regulatory developments, the Transmission Planning Code was reviewed and a consultation carried out during 2012 covering changes resulting from the impact of the Industrial Emissions Directive, the European Union Third Package, the Planning Act 2008, and the capacity and connections processes. A further review is anticipated in light of RIIO-T1 final proposals.

# A1.6
# Planning Act (2008)

The Planning Act (2008) introduced a new process for planning decisions for Nationally Significant Infrastructure Projects (NSIPs), which is applicable to gas infrastructure projects. For NSIPs, the new planning process requires extensive optioneering and consultation with the community prior to the consideration of the application by the Planning Inspectorate and decision by the Secretary of State. This is likely to increase lead-times for complex construction projects up to an estimated 72 to 96 months from the point of a formal capacity signal to delivery of that capacity; however, the default lead times contained within National Grid's Transporter licence places an obligation on National Grid to deliver Incremental Entry and Exit NTS Capacity to a 42- and 36-month lead-time respectively.

In response to the changes introduced by the Planning Act, National Grid has developed a generic multi-stage timeline, which has been shared with the industry, to illustrate the planning process stages leading up to a submission to the planning Inspectorate. It is important to note that this is a generic timeline, and the actual duration of each stage will be dependent on the nature and complexity of each construction project.

| Planning Stage | | Activity | Duration |
|---|---|---|---|
| 1a | Strategic Optioneering | Establish the need case and identify technical options | Up to 6 months |
| 1b | | Develop Strategic Options Report (SOR) | Up to 6 months |
| 2 | Outline Routing and Siting | Identify Preferred Route Corridor / Siting Studies | Up to 15 months |
| 3 | Detailed Routing & Siting | Undertake Environmental Impact Assessment (EIA) & detailed design | Up to 24 months |
| 4 | Development Consent Order (DCO) Application Preparation | Formal consultation, finalising project, preparation of application documentation | Up to 6 months |
| 5 | DCO Application, Hearings and Decision | Submission and examination | Up to 15 Months |
| 6 | | Approval process | |

Through our Talking Networks events, we highlighted that the impact of the Planning Act (2008) meant that the current obligated lead-times applicable to incremental entry and exit capacity were not achievable where significant network investment would be required. Releasing Incremental NTS Capacity to these obligated lead times could result in considerable constraint management costs to the industry. Simply increasing these lead times was not deemed to be a viable solution as it would require customers to commit to capacity with lead-times that were not consistent with their own project investment decision timescales.

National Grid's March 2012 RIIO-T1 business plan submission included a number of proposals that could address this issue whilst facilitating the overarching objective of delivering connections and capacity together, in the most efficient lead-time and in a transparent manner. Following this, National Grid and the industry have been working together in order to further develop potential solutions to modify and align the NTS Capacity and Connections processes more effectively.

The proposed solution involves the introduction of a bi-lateral contract, the Planning and Advanced Reservation of Capacity Agreement (PARCA), for parties wishing to signal incremental capacity. The PARCA arrangements would enable customer and National Grid timelines to be aligned, with connections and capacity being delivered together. This process aims to provide more certainty to project developers, with transparency of all the process steps and deliverables required from both parties and sets out a timeline from initial contact through to capacity release whilst also allowing the review, discussion and potential revision of that timeline and break-out points. The timelines will be developed in conjunction with our customers and will be assessed on a site-by-site / project-by-project basis and as a result lead times may be variable. This would be accompanied by a phased user commitment that would ramp up in line with progression through the process, culminating in full user commitment once a formal capacity signal is received in line with the current UNC and licence principles.

# Appendix Two
## Gas Demand & Supply Volume Scenarios

# A2.1
# Demand

*Table A2.1.A*
*Slow Progression Scenario: Annual Demand – Split by Load Categories (TWh)*

| | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 | 2021 | 2022 | 2023 | 2024 | 2025 | 2026 | 2027 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 - 73.2 MWh | 333 | 329 | 325 | 321 | 319 | 318 | 317 | 317 | 317 | 318 | 320 | 323 | 324 | 323 | 323 |
| 73.2 - 732 MWh | 43 | 42 | 41 | 40 | 39 | 39 | 38 | 38 | 38 | 38 | 38 | 38 | 37 | 37 | 37 |
| NDM > 732 MWh | 66 | 63 | 60 | 58 | 55 | 53 | 51 | 48 | 46 | 44 | 42 | 41 | 39 | 37 | 35 |
| **Total NDM** | **442** | **433** | **426** | **418** | **413** | **409** | **406** | **404** | **401** | **400** | **400** | **401** | **400** | **398** | **396** |
| Total DM | 108 | 111 | 110 | 109 | 107 | 106 | 105 | 104 | 103 | 102 | 101 | 100 | 99 | 98 | 97 |
| LDZ Shrinkage | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 |
| **Total LDZ** | **554** | **548** | **539** | **530** | **524** | **518** | **514** | **510** | **507** | **505** | **504** | **503** | **501** | **498** | **495** |
| NTS Industrial | 31 | 31 | 31 | 31 | 31 | 31 | 31 | 30 | 30 | 30 | 30 | 30 | 29 | 29 | 29 |
| Exports to Ireland | 65 | 65 | 65 | 59 | 46 | 43 | 45 | 48 | 51 | 55 | 58 | 62 | 65 | 69 | 71 |
| NTS Power Generation | 157 | 170 | 166 | 152 | 141 | 134 | 130 | 170 | 190 | 199 | 206 | 208 | 199 | 192 | 191 |
| NTS Consumption | 252 | 265 | 262 | 242 | 218 | 207 | 205 | 248 | 271 | 284 | 294 | 299 | 294 | 290 | 291 |
| NTS Shrinkage | 5 | 5 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 |
| Total excluding IUK | 810 | 818 | 805 | 776 | 746 | 729 | 724 | 762 | 782 | 792 | 802 | 806 | 799 | 791 | 790 |
| IUK | 41 | 75 | 98 | 117 | 126 | 126 | 124 | 119 | 114 | 110 | 107 | 103 | 99 | 95 | 91 |
| **Total including IUK** | **851** | **893** | **903** | **893** | **872** | **856** | **848** | **881** | **896** | **903** | **908** | **910** | **898** | **887** | **881** |

Figures may not sum exactly due to rounding

*Figure A2.1A*
*Slow Progression: Annual Demand*

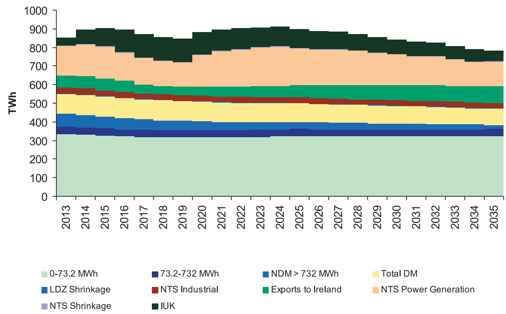


*Table A2.1.B*
*Gone Green Scenario: Annual Demand – Split by Load Categories (TWh)*

| | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 | 2021 | 2022 | 2023 | 2024 | 2025 | 2026 | 2027 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 - 73.2 MWh | 333 | 328 | 323 | 317 | 311 | 307 | 302 | 298 | 293 | 288 | 283 | 279 | 276 | 272 | 268 |
| 73.2 - 732 MWh | 44 | 43 | 43 | 43 | 43 | 43 | 43 | 43 | 43 | 43 | 43 | 43 | 42 | 41 | 40 |
| NDM > 732 MWh | 68 | 67 | 65 | 63 | 62 | 60 | 58 | 56 | 55 | 53 | 51 | 50 | 48 | 46 | 45 |
| **Total NDM** | **444** | **438** | **431** | **423** | **416** | **409** | **403** | **397** | **391** | **384** | **377** | **372** | **365** | **359** | **353** |
| Total DM | 109 | 113 | 112 | 110 | 110 | 108 | 106 | 105 | 102 | 100 | 98 | 94 | 91 | 89 | 88 |
| LDZ Shrinkage | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 |
| **Total LDZ** | **556** | **554** | **546** | **536** | **528** | **521** | **513** | **505** | **496** | **487** | **478** | **468** | **459** | **451** | **443** |
| NTS Industrial | 30 | 30 | 30 | 30 | 30 | 29 | 29 | 29 | 28 | 28 | 28 | 28 | 27 | 27 | 27 |
| Exports to Ireland | 66 | 66 | 67 | 61 | 48 | 44 | 46 | 47 | 48 | 50 | 54 | 59 | 63 | 67 | 70 |
| NTS Power Generation | 155 | 173 | 173 | 152 | 151 | 162 | 156 | 155 | 142 | 133 | 128 | 136 | 120 | 111 | 111 |
| NTS Consumption | 251 | 270 | 270 | 243 | 228 | 236 | 231 | 230 | 218 | 212 | 210 | 223 | 211 | 205 | 207 |
| NTS Shrinkage | 5 | 5 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 |
| Total excluding IUK | 812 | 829 | 820 | 783 | 761 | 761 | 747 | 739 | 718 | 703 | 692 | 695 | 673 | 659 | 654 |
| IUK | 39 | 46 | 51 | 61 | 65 | 64 | 64 | 62 | 58 | 58 | 56 | 51 | 49 | 47 | 43 |
| **Total including IUK** | **851** | **875** | **872** | **844** | **826** | **825** | **811** | **802** | **777** | **760** | **748** | **746** | **722** | **706** | **696** |

Figures may not sum exactly due to rounding

*Figure A2.1B*
*Gone Green: Annual Demand*

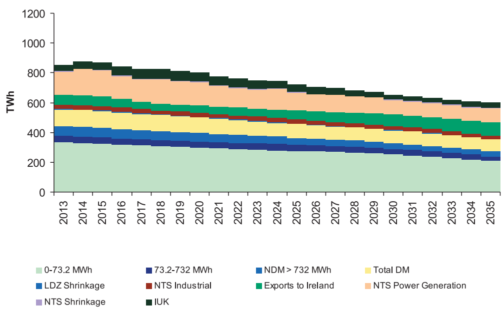


*Table A2.1C*
*Slow Progression: 1 in 20 Peak Day Undiversified Demand (GWh / day)*

| **National** | **12/13** | **13/14** | **14/15** | **15/16** | **16/17** | **17/18** | **18/19** | **19/20** | **20/21** | **21/22** | **22/23** | **23/24** | **24/25** | **25/26** | **26/27** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Scotland | 344 | 337 | 331 | 324 | 320 | 316 | 314 | 311 | 309 | 308 | 307 | 306 | 306 | 305 | 303 |
| Northern | 237 | 234 | 229 | 225 | 223 | 220 | 218 | 216 | 216 | 215 | 215 | 214 | 215 | 214 | 213 |
| North West | 552 | 541 | 532 | 521 | 514 | 509 | 505 | 500 | 498 | 497 | 495 | 494 | 495 | 493 | 491 |
| North East | 275 | 268 | 264 | 258 | 256 | 253 | 251 | 248 | 247 | 247 | 246 | 245 | 246 | 245 | 243 |
| East Midlands | 453 | 440 | 433 | 424 | 420 | 416 | 412 | 408 | 407 | 406 | 406 | 404 | 405 | 403 | 401 |
| West Midlands | 396 | 386 | 379 | 370 | 366 | 361 | 357 | 353 | 351 | 349 | 348 | 346 | 346 | 344 | 341 |
| Wales North | 49 | 48 | 47 | 46 | 46 | 45 | 45 | 44 | 44 | 44 | 43 | 43 | 43 | 43 | 43 |
| Wales South | 198 | 203 | 201 | 197 | 196 | 194 | 193 | 191 | 191 | 191 | 190 | 190 | 190 | 189 | 189 |
| Eastern | 357 | 351 | 346 | 340 | 337 | 333 | 332 | 330 | 330 | 330 | 330 | 329 | 332 | 332 | 331 |
| North Thames | 469 | 458 | 450 | 441 | 437 | 433 | 430 | 426 | 425 | 424 | 425 | 424 | 426 | 425 | 423 |
| South East | 490 | 495 | 492 | 482 | 479 | 475 | 473 | 470 | 471 | 471 | 472 | 472 | 474 | 475 | 474 |
| Southern | 360 | 352 | 348 | 341 | 338 | 335 | 333 | 330 | 330 | 330 | 329 | 329 | 330 | 330 | 329 |
| South West | 276 | 271 | 267 | 262 | 260 | 258 | 256 | 254 | 254 | 254 | 255 | 254 | 255 | 255 | 255 |
| **Total LDZ** | **4457** | **4386** | **4318** | **4232** | **4190** | **4149** | **4119** | **4083** | **4073** | **4064** | **4061** | **4051** | **4062** | **4052** | **4036** |
| NTS Industrial | 140 | 137 | 138 | 138 | 138 | 138 | 138 | 138 | 138 | 138 | 138 | 138 | 138 | 138 | 138 |
| NTS Power Generation | 1410 | 1378 | 1389 | 1434 | 1456 | 1510 | 1448 | 1628 | 1868 | 1994 | 2019 | 2019 | 2016 | 1934 | 1934 |
| Exports via Moffat | 361 | 361 | 329 | 329 | 329 | 329 | 329 | 329 | 329 | 329 | 329 | 329 | 329 | 329 | 329 |
| Exports via IUK | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| **Total NTS** | **1911** | **1875** | **1856** | **1901** | **1923** | **1977** | **1915** | **2095** | **2335** | **2461** | **2486** | **2486** | **2483** | **2401** | **2401** |
| **Total** | **6368** | **6261** | **6174** | **6132** | **6112** | **6126** | **6034** | **6178** | **6408** | **6525** | **6548** | **6537** | **6545** | **6454** | **6437** |

Figures may not sum exactly due to rounding

*Figure A2.1C*
*Slow Progression: 1 in 20 Peak Day Undiversified Demand*

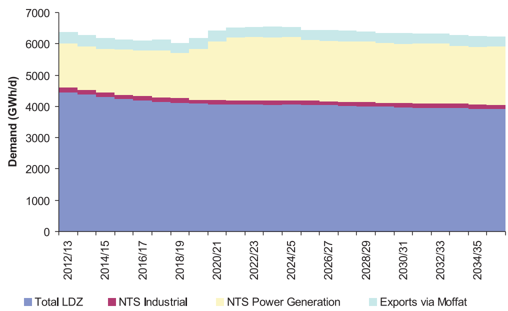


*Table A2.1D*
*Gone Green: 1 in 20 Peak Day Undiversified Demand (GWh / day)*

| National | 12/13 | 13/14 | 14/15 | 15/16 | 16/17 | 17/18 | 18/19 | 19/20 | 20/21 | 21/22 | 22/23 | 23/24 | 24/25 | 25/26 | 26/27 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Scotland | 345 | 340 | 335 | 328 | 323 | 318 | 314 | 309 | 304 | 299 | 294 | 289 | 285 | 280 | 276 |
| Northern | 238 | 236 | 231 | 227 | 224 | 220 | 217 | 214 | 211 | 208 | 205 | 202 | 199 | 197 | 194 |
| North West | 553 | 545 | 537 | 526 | 517 | 510 | 503 | 494 | 488 | 481 | 473 | 464 | 459 | 453 | 446 |
| North East | 276 | 270 | 267 | 261 | 257 | 254 | 250 | 246 | 243 | 239 | 235 | 231 | 228 | 225 | 221 |
| East Midlands | 454 | 443 | 437 | 428 | 423 | 417 | 410 | 403 | 398 | 392 | 386 | 378 | 374 | 368 | 362 |
| West Midlands | 397 | 390 | 384 | 375 | 369 | 363 | 357 | 349 | 345 | 338 | 332 | 325 | 320 | 314 | 308 |
| Wales North | 49 | 48 | 48 | 47 | 46 | 45 | 45 | 44 | 43 | 42 | 42 | 41 | 40 | 40 | 39 |
| Wales South | 198 | 204 | 202 | 198 | 196 | 194 | 191 | 189 | 187 | 185 | 183 | 179 | 176 | 175 | 173 |
| Eastern | 358 | 354 | 349 | 342 | 338 | 333 | 329 | 324 | 320 | 316 | 311 | 305 | 303 | 299 | 294 |
| North Thames | 470 | 462 | 456 | 446 | 441 | 435 | 429 | 422 | 418 | 412 | 405 | 397 | 393 | 388 | 381 |
| South East | 491 | 498 | 494 | 483 | 478 | 471 | 465 | 456 | 452 | 444 | 436 | 426 | 419 | 412 | 406 |
| Southern | 360 | 355 | 351 | 344 | 339 | 335 | 331 | 325 | 322 | 317 | 312 | 307 | 304 | 300 | 295 |
| South West | 277 | 273 | 270 | 264 | 261 | 258 | 254 | 250 | 247 | 244 | 240 | 235 | 233 | 229 | 226 |
| **Total LDZ** | **4465** | **4418** | **4362** | **4269** | **4211** | **4152** | **4094** | **4025** | **3978** | **3918** | **3853** | **3779** | **3732** | **3678** | **3622** |
| NTS Industrial | 140 | 140 | 141 | 141 | 141 | 141 | 141 | 141 | 142 | 142 | 142 | 142 | 142 | 142 | 142 |
| NTS Power Generation | 1410 | 1378 | 1389 | 1434 | 1434 | 1510 | 1507 | 1590 | 1748 | 1900 | 1944 | 1985 | 1985 | 1984 | 2021 |
| Exports via Moffat | 361 | 361 | 329 | 329 | 329 | 329 | 329 | 329 | 329 | 329 | 329 | 329 | 329 | 329 | 329 |
| Exports via IUK | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| **Total NTS** | **1911** | **1878** | **1859** | **1904** | **1904** | **1980** | **1977** | **2060** | **2218** | **2370** | **2414** | **2456** | **2456** | **2454** | **2492** |
| **Total** | **6376** | **6296** | **6221** | **6173** | **6115** | **6133** | **6071** | **6085** | **6197** | **6289** | **6267** | **6235** | **6188** | **6132** | **6114** |

Figures may not sum exactly due to rounding

*Figure A2.1D*
*Gone Green: 1 in 20 Peak Day Undiversified Demand*

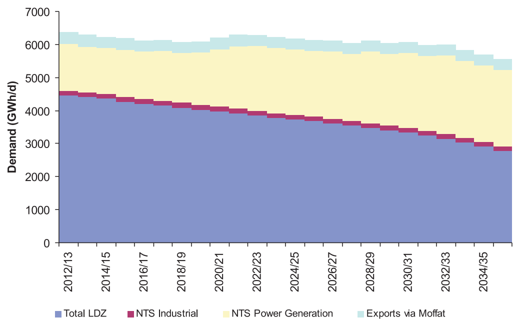


*Table A2.1E*
*Slow Progression: 1 in 20 Peak Day Diversified Demand (GWh / d)*

| Diversified Peak | 12/13 | 13/14 | 14/15 | 15/16 | 16/17 | 17/18 | 18/19 | 19/20 | 20/21 | 21/22 | 22/23 | 23/24 | 24/25 | 25/26 | 26/27 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 - 73.2 MWh | 3025 | 3010 | 2982 | 2935 | 2915 | 2900 | 2898 | 2889 | 2893 | 2906 | 2919 | 2926 | 2952 | 2957 | 2957 |
| 73.2 - 732 MWh | 352 | 341 | 333 | 323 | 320 | 314 | 308 | 304 | 305 | 302 | 302 | 300 | 300 | 300 | 299 |
| NDM > 732 MWh | 436 | 406 | 389 | 370 | 358 | 343 | 325 | 310 | 299 | 284 | 274 | 260 | 248 | 236 | 225 |
| **Total NDM** | **3813** | **3757** | **3703** | **3627** | **3593** | **3557** | **3531** | **3502** | **3497** | **3492** | **3494** | **3487** | **3501** | **3493** | **3480** |
| Total DM | 459 | 472 | 466 | 459 | 456 | 451 | 443 | 437 | 436 | 432 | 428 | 422 | 417 | 414 | 411 |
| LDZ Shrinkage | 9 | 9 | 9 | 9 | 9 | 8 | 8 | 8 | 8 | 8 | 8 | 8 | 8 | 7 | 7 |
| **Total LDZ** | **4282** | **4238** | **4179** | **4095** | **4058** | **4016** | **3983** | **3948** | **3941** | **3932** | **3930** | **3917** | **3926** | **3915** | **3899** |
| NTS Industrial | 85 | 85 | 85 | 85 | 85 | 85 | 85 | 84 | 84 | 83 | 83 | 82 | 82 | 81 | 80 |
| Exports to Ireland | 361 | 361 | 329 | 329 | 329 | 329 | 329 | 329 | 329 | 329 | 329 | 329 | 329 | 329 | 329 |
| NTS Power Generation | 794 | 897 | 947 | 908 | 873 | 811 | 755 | 740 | 924 | 911 | 980 | 983 | 1019 | 1047 | 1064 |
| **NTS Consumption** | **1239** | **1342** | **1361** | **1322** | **1287** | **1225** | **1169** | **1154** | **1337** | **1324** | **1392** | **1395** | **1430** | **1457** | **1474** |
| NTS Shrinkage | 13 | 13 | 12 | 12 | 12 | 12 | 11 | 11 | 11 | 11 | 11 | 11 | 10 | 10 | 10 |
| Total excluding IUK | 5534 | 5593 | 5552 | 5429 | 5356 | 5253 | 5163 | 5113 | 5289 | 5267 | 5333 | 5322 | 5366 | 5382 | 5382 |
| IUK | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| **Total including IUK** | **5534** | **5593** | **5552** | **5429** | **5356** | **5253** | **5163** | **5113** | **5289** | **5267** | **5333** | **5322** | **5366** | **5382** | **5382** |

Figures may not sum exactly due to rounding

*Figure A2.1E*
*Slow Progression: 1 in 20 Peak Day Diversified Demand*

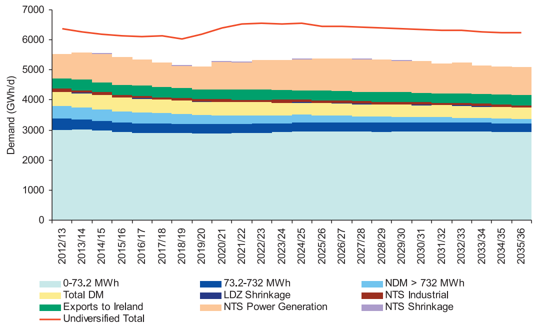


*Table A2.1F*
*Gone Green: 1 in 20 Peak Day Diversified Demand (GWh / d)*

| Diversified Peak | 12/13 | 13/14 | 14/15 | 15/16 | 16/17 | 17/18 | 18/19 | 19/20 | 20/21 | 21/22 | 22/23 | 23/24 | 24/25 | 25/26 | 26/27 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 - 73.2 MWh | 3022 | 3007 | 2972 | 2902 | 2855 | 2810 | 2770 | 2721 | 2680 | 2637 | 2588 | 2533 | 2504 | 2470 | 2436 |
| 73.2 - 732 MWh | 355 | 349 | 347 | 344 | 347 | 347 | 346 | 346 | 351 | 349 | 348 | 343 | 339 | 331 | 323 |
| NDM > 732 MWh | 444 | 425 | 417 | 406 | 399 | 387 | 373 | 360 | 352 | 340 | 330 | 318 | 306 | 295 | 284 |
| **Total NDM** | **3821** | **3782** | **3736** | **3652** | **3601** | **3544** | **3489** | **3426** | **3383** | **3327** | **3266** | **3194** | **3149** | **3096** | **3044** |
| Total DM | 461 | 478 | 476 | 469 | 468 | 465 | 458 | 452 | 451 | 446 | 441 | 433 | 425 | 421 | 418 |
| LDZ Shrinkage | 9 | 9 | 9 | 9 | 9 | 8 | 8 | 8 | 8 | 8 | 8 | 8 | 8 | 7 | 7 |
| **Total LDZ** | **4291** | **4269** | **4221** | **4130** | **4078** | **4018** | **3955** | **3887** | **3841** | **3781** | **3715** | **3634** | **3582** | **3525** | **3469** |
| NTS Industrial | 85 | 84 | 84 | 83 | 82 | 81 | 81 | 80 | 79 | 78 | 77 | 76 | 75 | 75 | 74 |
| Exports to Ireland | 361 | 361 | 329 | 329 | 329 | 329 | 329 | 329 | 329 | 329 | 329 | 329 | 329 | 329 | 329 |
| NTS Power Generation | 792 | 897 | 963 | 932 | 867 | 784 | 712 | 649 | 766 | 717 | 820 | 842 | 1009 | 1028 | 1090 |
| **NTS Consumption** | **1237** | **1341** | **1376** | **1344** | **1278** | **1195** | **1122** | **1058** | **1174** | **1124** | **1226** | **1248** | **1413** | **1432** | **1493** |
| NTS Shrinkage | 13 | 13 | 12 | 12 | 12 | 12 | 11 | 11 | 11 | 11 | 11 | 11 | 10 | 10 | 10 |
| Total excluding IUK | 5541 | 5623 | 5609 | 5486 | 5367 | 5224 | 5089 | 4956 | 5027 | 4916 | 4952 | 4893 | 5005 | 4967 | 4972 |
| IUK | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| **Total including IUK** | **5541** | **5623** | **5609** | **5486** | **5367** | **5224** | **5089** | **4956** | **5027** | **4916** | **4952** | **4893** | **5005** | **4967** | **4972** |

Figures may not sum exactly due to rounding

*Figure A2.1F*
*Gone Green: 1 in 20 Peak Day Diversified Demand*

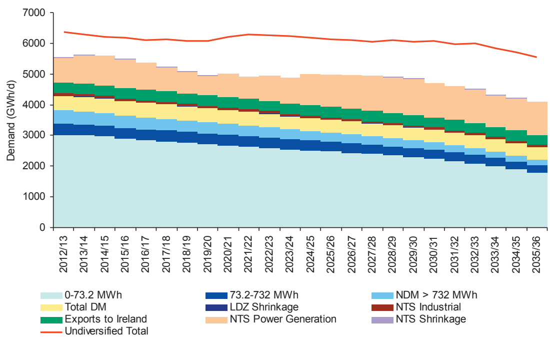


*Figure A2.1G*
*2013/14 Load Curve – Slow Progression*

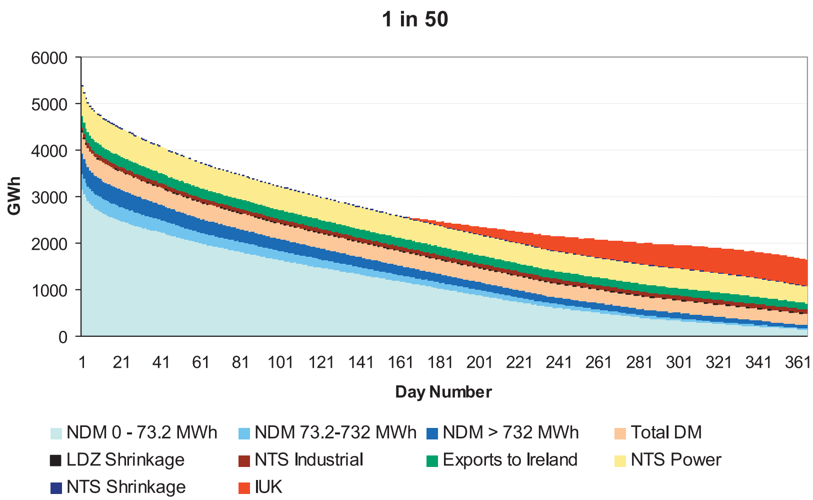
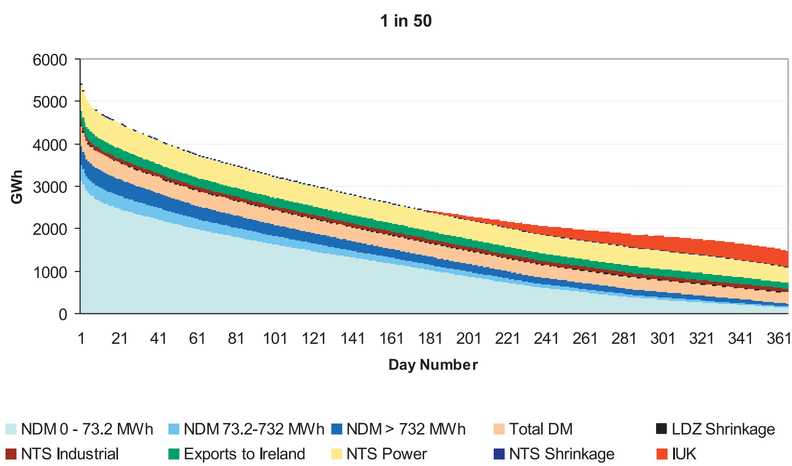



*Figure A2.1H*
*2013/14 Load Curve – Gone Green*




Note: Figures A2.1G – A.2.1L are severe 1 in 50 Load Duration Curves.

*Figure A2.1I*
*2025/26 Load Curve – Slow Progression*

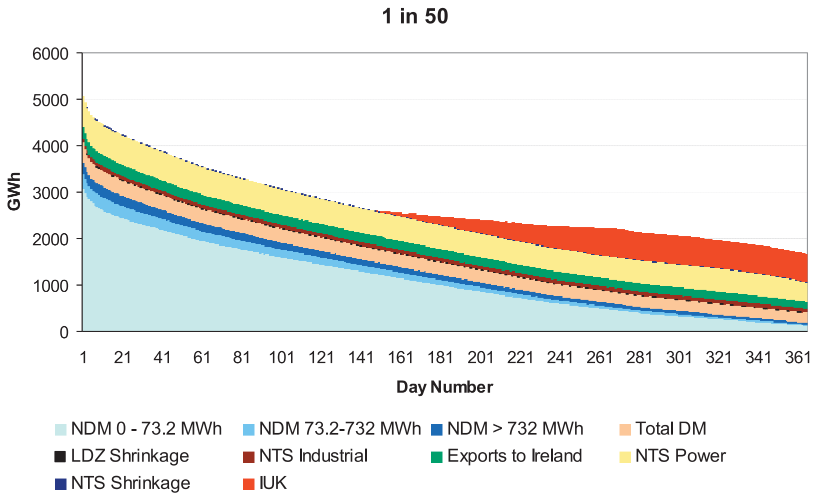



*Figure A2.1J*
*2025/26 Load Curve – Gone Green*

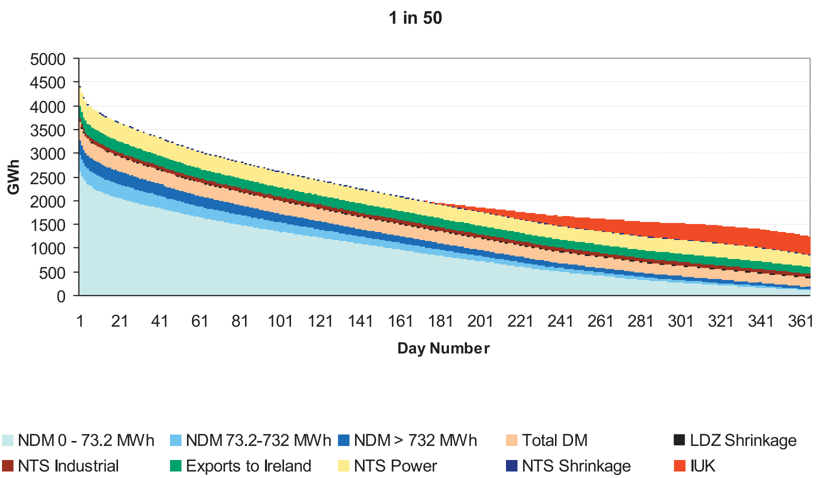


*Figure A2.1K*
*2030/31 Load Curve – Slow Progression*

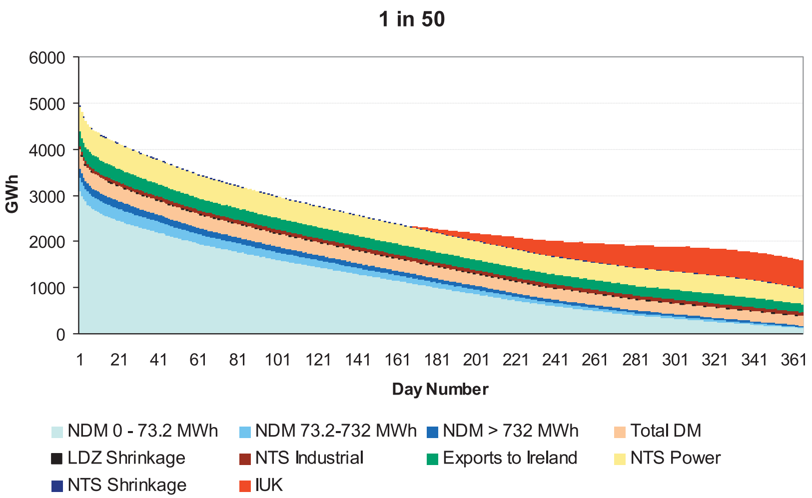
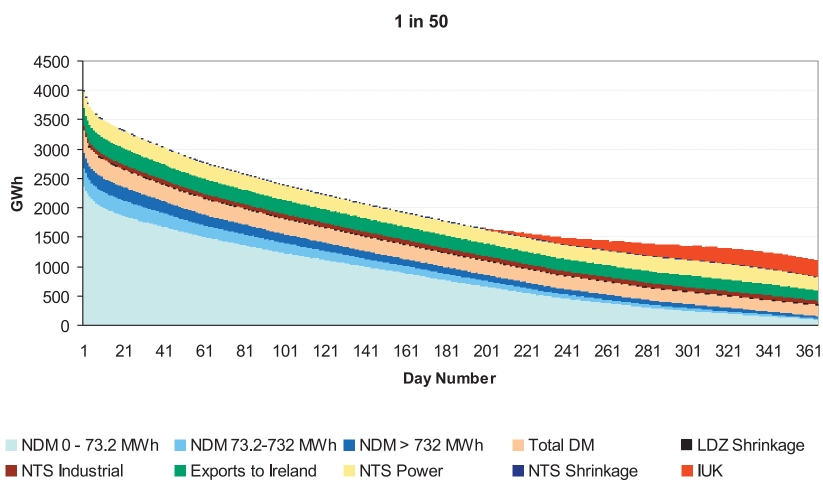



*Figure A2.1L*
*2030/31 Load Curve – Gone Green*



# A2.2
# Supply

*Figure A2.2A*
*Peak Bacton Scenarios (mcm/d)*

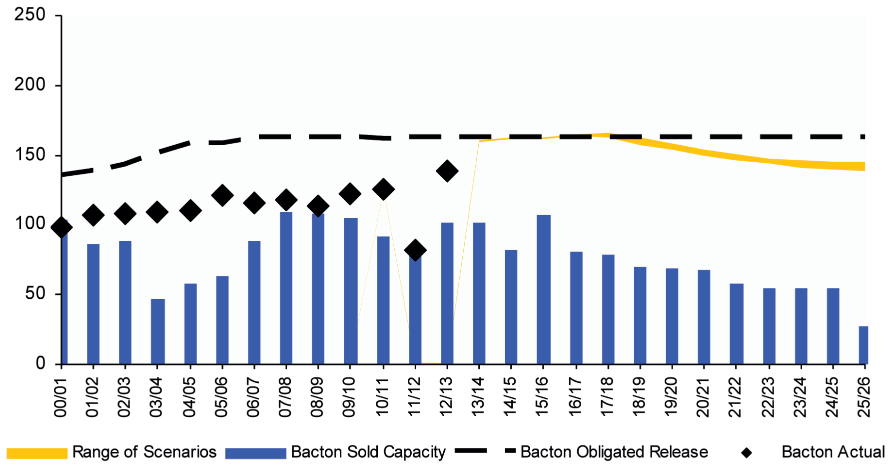



*Figure A2.2B*
*Peak Barrow Scenarios (mcm/d)*

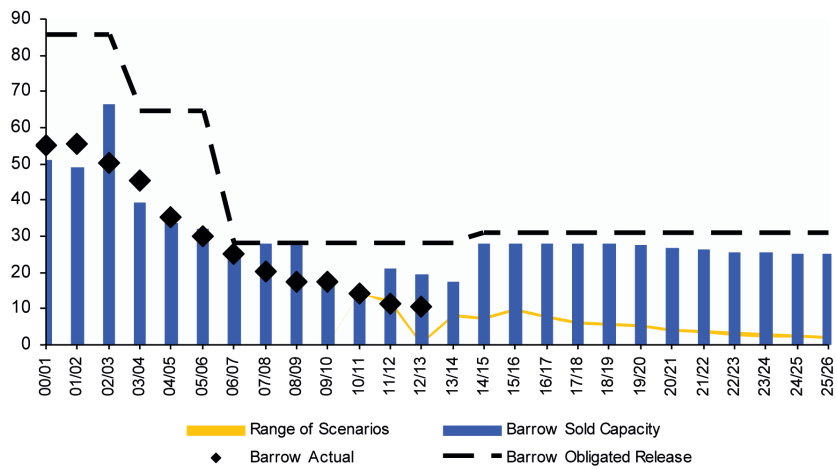


*Figure A2.2C*
*Peak Easington Scenarios (mcm/d)*

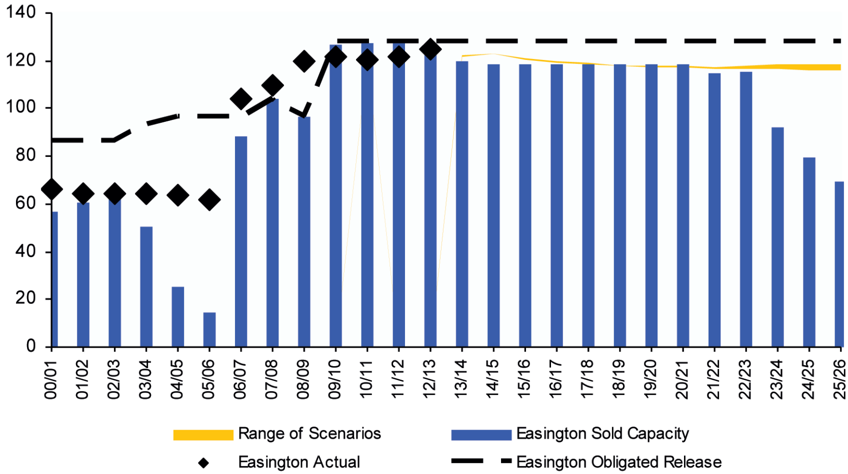



*Figure A2.2D*
*Peak St Fergus Scenarios (mcm/d)*

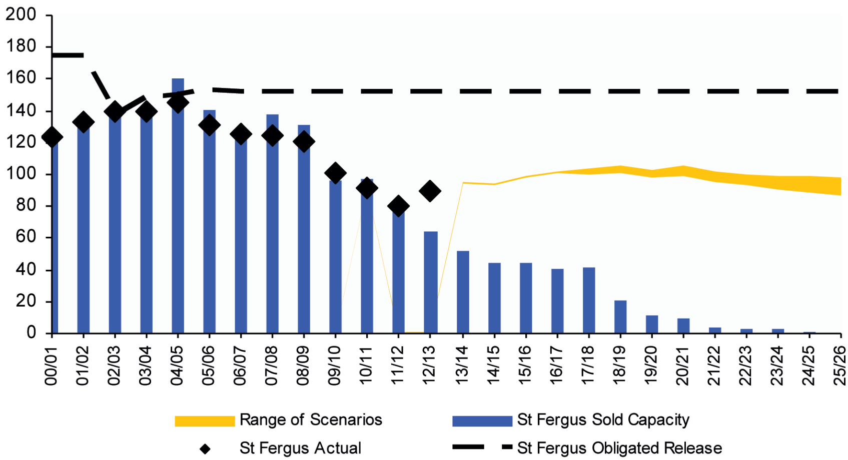


*Figure A2.2E*
*Peak Teesside Scenarios (mcm/d)*

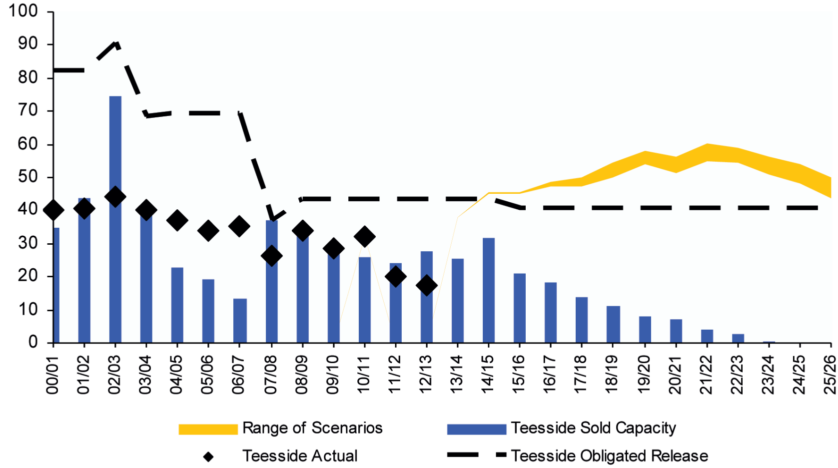



*Figure A2.2F*
*Peak Theddlethorpe Scenarios (mcm/d)*

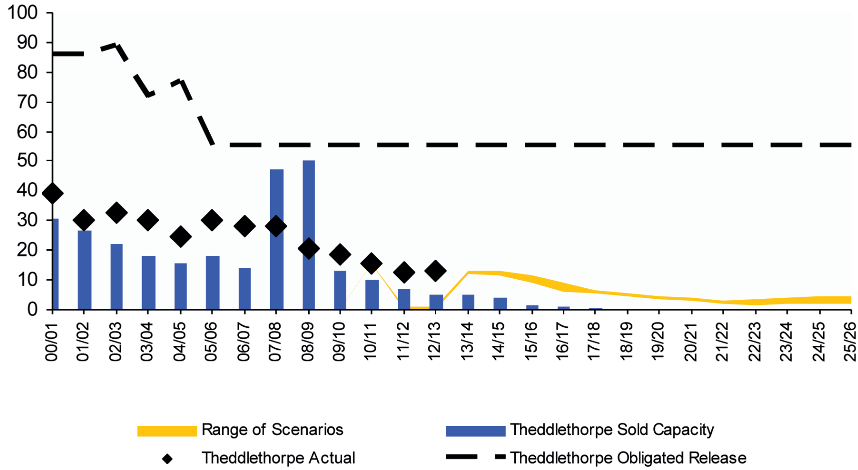


*Figure A2.2G*
*Peak Grain LNG Scenarios (mcm/d)*

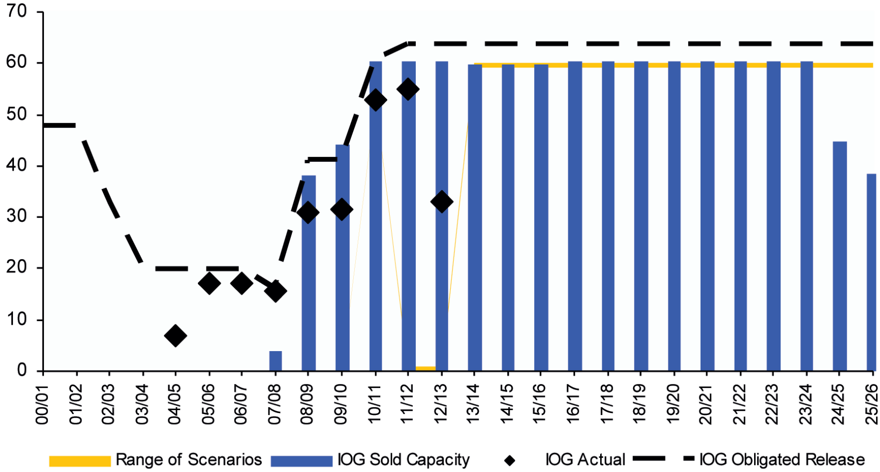
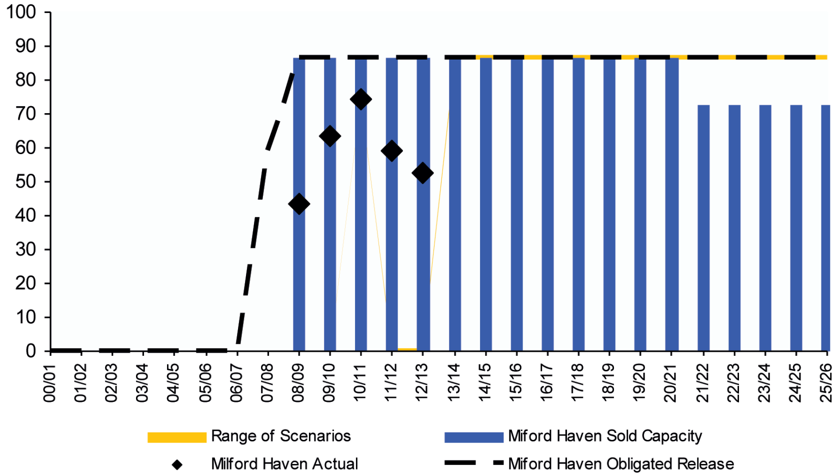
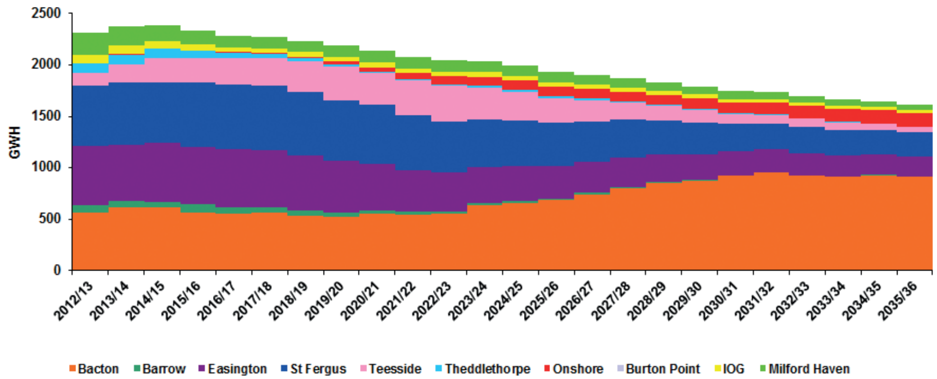


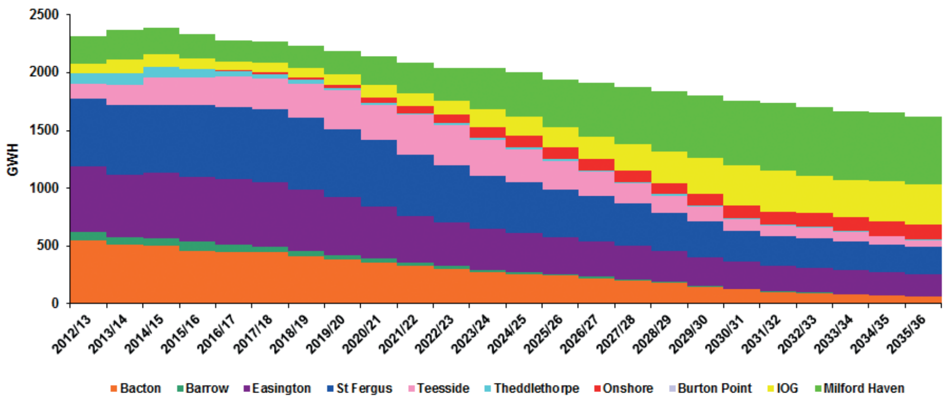

*Figure A2.2H*
*Peak Milford Haven Scenarios (mcm/d)*



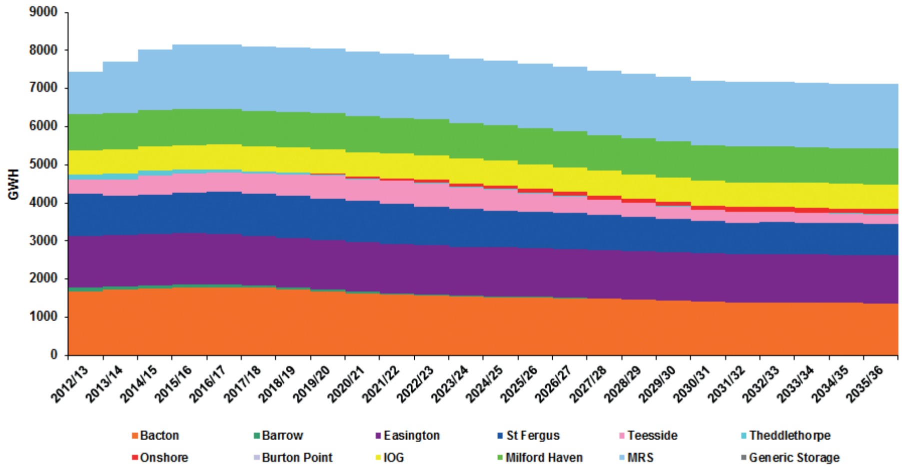
*GG HC Annuals*



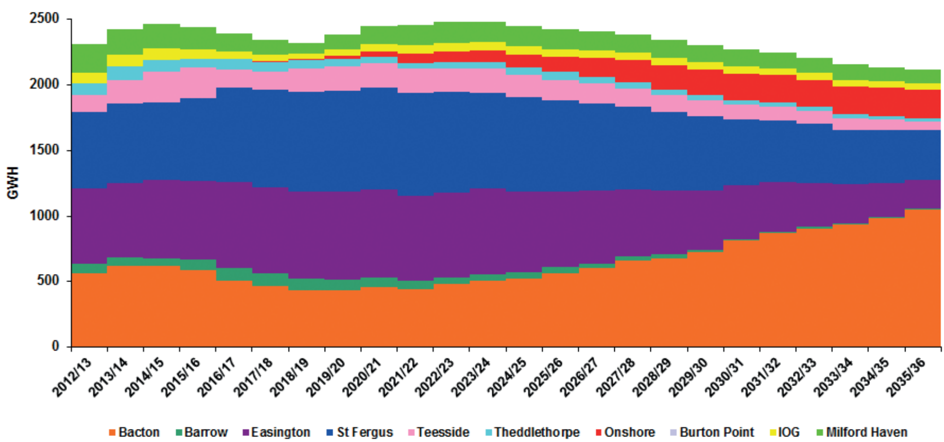

*GG HL Annuals*



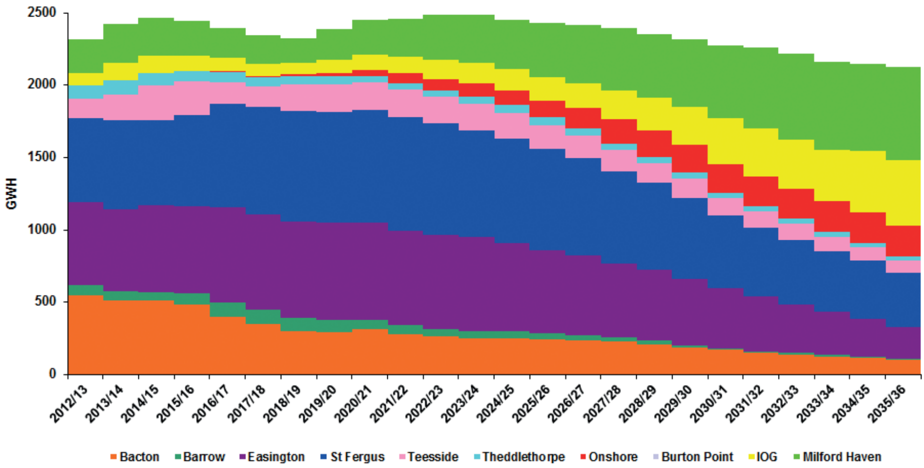
*GG Peaks*



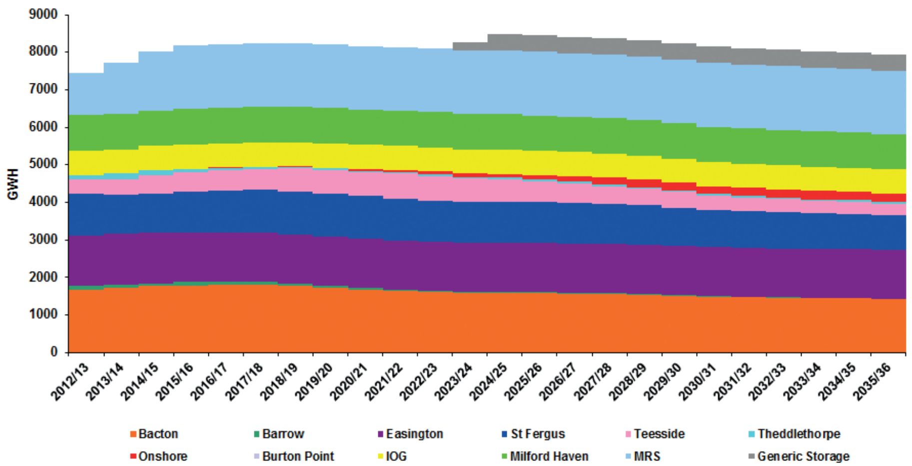

*SP HC Annuals*



*SP HL Annuals*




*SP Peaks*

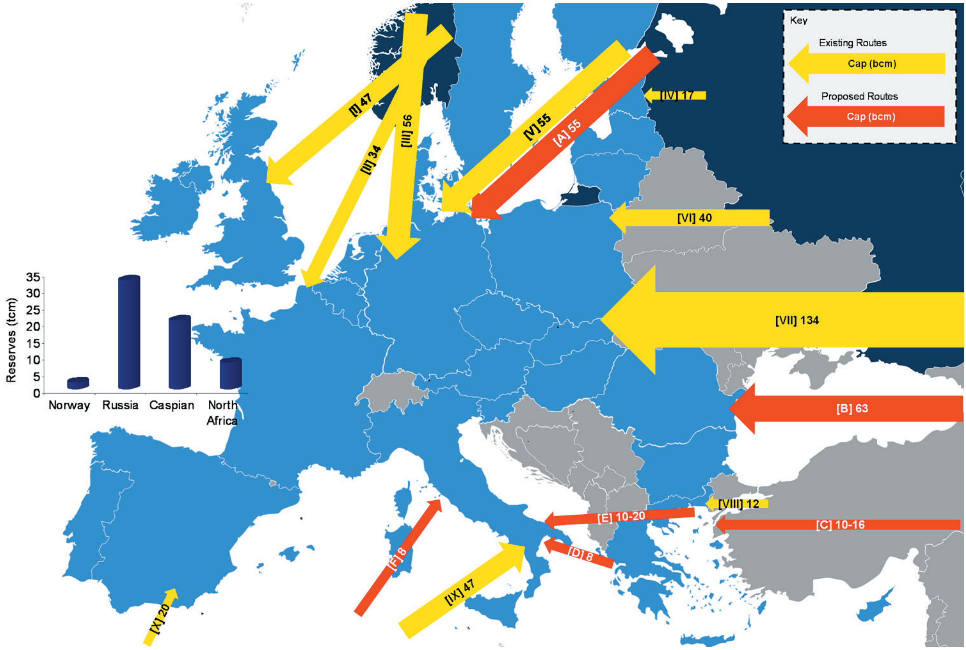


A2.3

# European Pipeline Infrastructure

Excluding indigenous supplies and LNG imports, the European Union has three major sources of supply; Russian / Central Asian supplies from the east, North African from the south and Norwegian from the north west. Figure A2.3A highlights existing and proposed pipeline capacities from these sources.

*Figure A2.3A*
*European Pipeline Map*
*Source: National Grid, Wood Mackenzie, IEA, Gassco, Various*[2]




[2] Where available the project developer / operator website is used as the source for the capacity and route.

*Table A2.3B*
*Capacity of Existing Routes*[2]

| Code | Name | Source | Capacity (bcm) | Route |
|---|---|---|---|---|
| I | Langeled / Vesterled / FLAGS | Norway | 47 | Norway - UK |
| II | Franpipe / Zeepipe | Norway | 34 | Norway - France / Belgium |
| III | Europipe / Norpipe | Norway | 56 | Norway - Germany / Netherlands |
| IV | Russia-Finland / Baltics | Russia | 17 | Russia - Finland / Estonia / Latvia |
| V | Nordstream I / II | Russia | 55 | Russia - Germany |
| VI | Yamal-Europe | Russia | 40 | Russia - Poland / Lithuania |
| VII | Brotherhood / Soyuz | Russia | 134 | Russia/Ukraine - Slovakia / Hungary / Poland / Romania |
| VIII | ITG | Caspian | 12 | Turkey - Greece |
| IX | Greenstream / Transmed | North Africa | 47 | Algeria / Tunisia / Libya - Italy |
| X | Maghreb / Medgaz | North Africa | 20 | Algeria - Spain |

*Table A2.3C*
*Capacity of Proposed Projects*[3]

| Code | Name | Source | Capacity (bcm) | Route | FID |
|---|---|---|---|---|---|
| A | Nord Stream III / IV | Russia | 55 | Russia - Germany | No |
| B | South Stream | Russia | 63 | Russia - Bulgaria - Austria / Italy | Yes |
| C | TANAP | Caspian | 10 - 16 | Azerbajian / Georgia - Turkey | No |
| D | IGI Poseidon | Caspian / Middle East | 8 | Greece - Italy | No |
| E | TAP | Caspian / Middle East | 10 - 20 | Albania - Italy | No |
| F | Galsi | North Africa | 8 | Algeria - Italy | No |

One of the more significant changes over the last year has been the decision to select an expansion of the South Caucasus Pipeline (SCP), and construction of two new pipelines the Trans Anatolian Pipeline (TANAP) and the Trans Adriatic Pipeline (TAP) in favour over the Nabucco Project as the transportation route for the Shah Deniz stage 2 gas. Whilst these projects have not yet taken Final Investment Decisions (FID) these are expected to coincide with the FID for Shah Deniz which is expected in late 2013[4].

In order for the proposed projects to be realised there are significant hurdles to be overcome such as access to the required capital, approval from the relevant authorities, access to gas supplies, uncertainty over end user demand along with the technical challenges of the project. If all the projects were to be completed they could add over 170 bcm extra import capacity to the EU.

In addition to the importation projects there are also several projects aimed at increasing the level of interconnection across Europe in order to increase security of supply and to aid the development of the internal energy market. To support these goals the European Commission has allocated over €9bn of funding through the "Connecting Europe[5]" initiative to energy infrastructure projects.

[2] Where available the project developer/operator website is used as the source for the capacity and route.

[3] Where available the project developer/operator website is used as the source for the capacity and route.

[4] http://www.bp.com/sectiongenericarticle.do?categoryId=9046884&contentId=7080518

[5] Connecting Europe http://ec.europa.eu/news/energy/111019_en.htm

# A2.4
# 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 156 bcm/y, this is split into three near equal sources, the Continent (46 bcm/y), Norway (56[6] bcm/y) and LNG (53 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 A2.4A shows completed UK import projects and table A2.4B shows proposals for further import projects.

*Table A2.4A*
*Existing UK Import Infrastructure*
*Source – National Grid*

| Project | Operator / Developer | Type | Location | Capacity (bcm/y) |
|---|---|---|---|---|
| Interconnector | IUK | Pipeline | Bacton | 26.9[7] |
| BBL Pipeline | BBL Company | Pipeline | Bacton | 17.6[8] |
| Isle of Grain 1 - 3 | National Grid | LNG | Kent | 20.4 |
| GasPort | Excelerate Energy | LNG | Teesside | 4.1 |
| South Hook 1 - 2 | Qatar Petroleum and ExxonMobil | LNG | Milford Haven | 21 |
| Dragon 1 | BG Group / 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 |
| Gjøa | Gassco | Pipeline | St. Fergus | 6.2 |
| | | | **Total** | **154** |

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

[7] Adjusted for UK standard conditions. Value reported on interconnector.com is 25.5 bcm/y at normal conditions.

[8] Adjusted for UK CV and standard conditions; bblcompany.com report 20.6 GWh/h at CV of 36.9 MJ/m3 (normal).

*Table A2.4B*
*Proposed UK Import Projects*[9]
*Source – National Grid*

| 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 | 2016+ | 5 | Open Season |
| Amlwch | Halite Energy | LNG | Anglesey | - | ~30 | Approved Onshore |
| | | | | **Total** | **30+** | |

Please note tables A2.4A – A2.4B represent the latest information available to National Grid at time of going to press. Developers are welcome to contact us to add or revise this data.

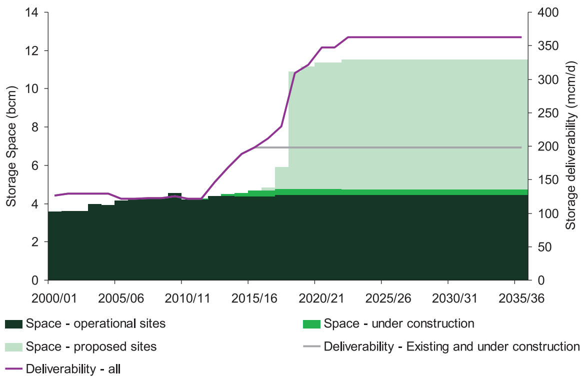
[9] This list is by no way exhaustive, other import projects have at times been detailed in the press.

# A2.5
# UK Storage Developments

Figure A2.5A shows our latest view of gas storage projects, in terms of currently operational facilities, those under construction and those with a proposed start date. Recently, DECC announced that no subsidies would be provided for new gas storage. This has led to a number of projects being put on hold indefinitely or cancelled. These projects are not included in figure A2.5A. There are still proposals for a further 7 bcm of space, but it is unclear whether these projects will be brought to fruition. Despite numerous proposals for new developments, actual storage space has only increased by around 1 bcm over the last 10 years to a current level of around 4.6 bcm.

Deliverability has increased recently, this has been driven primarily by developments at Aldbrough and Holford. The start up of Hill Top Farm and Stublach is expected to add further deliverability over the next 12 months, once these sites have been fully developed name plate delivery is expected to be around 200 mcm/d. Any subsequent increase in storage space or deliverability will be from developments not yet under construction or from further enhancements at existing facilities.

*Figure A2.5A*
*Potential UK Storage Developments*
*Source - National Grid*




The chart shows developers' views of storage developments in 2013. Extra space comes from a combination of proposed seasonal storage (long range storage) and smaller, fast-cycle salt cavern storage (mid range storage).

In our 2013 scenarios, Slow Progression includes extra seasonal storage to accommodate high imports and greater use of gas in the energy mix compared to Gone Green. Gone Green assumes higher utilisation of fast flexible storage and access to European storage to balance variable renewable generation.

To avoid being site specific, generic storage sites have been used for network planning, to allow one site to be substituted for another. For network investment purposes the proposed storage sites are evaluated on a site by site basis or are assessed collectively alongside demand sensitivities such as wind variability.

# A2.6
# UK Storage Projects

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

*Table A2.6A*
*Existing UK storage*
*Source – National Grid*

| Project | Operator | Location | Space (bcm) | Approximate maximum delivery (mcm/d) |
|---|---|---|---|---|
| Rough | Centrica Storage | Southern North Sea | 3.3 | 41 |
| Aldbrough | SSE / Statoil | East Yorkshire | 0.3 | 40[10] |
| Hatfield Moor | Scottish Power | South Yorkshire | 0.07 | 2 |
| Holehouse Farm | EDF Trading | Cheshire | 0.05 | 11 |
| Holford | E.ON | Cheshire | 0.2 | 22 |
| Hornsea | SSE | East Yorkshire | 0.3 | 18 |
| Humbly Grove | Humbly Grove Energy | Hampshire | 0.3 | 7 |
| Avonmouth | National Grid LNGS | Avon and Somerset | 0.08 | 13[11] |
| | | **Total** | **4.6** | **154** |

Note, due to operational considerations, the space and deliverability may not be fully consistent with that used for operational planning as reported in our 2013/14 Winter Outlook Report.

*Table A2.6B*
*Storage under construction*
*Source – National Grid*

| Project | Operator | Location | Space (bcm) | Deliverability (mcm/d) | Planned Start Up |
|---|---|---|---|---|---|
| Hill Top Farm[12] | EDF Energy | Cheshire | 0.1 | 15 | 2013/14 |
| Stublach[13] | Storengy UK | Cheshire | 0.2 | 15 | 2013/14 |
| | | **Total** | **0.3** | **30** | |

Over the last 1-2 years, a number of projects have been put on hold or cancelled. These include Aldbrough 2, Baird, Caythorpe, Gateway and Portland. Table A2.6C shows other storage site proposals.

[10] Represents nameplate capacity.

[11] Represents maximum capability.

[12] Represents completed space (fully available from 2017).

[13] Data represents phase 1 which is currently under construction.

*Table A2.6C*
*Proposed Storage*[14]

| Project | Operator | Location | Space (bcm) | Status |
|---|---|---|---|---|
| Deborah | eni | Offshore Bacton | 4.6 | Planning granted, no FID |
| Islandmagee | InfraStrata | County Antrim, Northern Ireland | 0.5 | Planning granted, no FID |
| King Street | King Street Energy | Cheshire | 0.3 | Planning granted, no FID |
| Preesall | Halite Energy | Lancashire | 0.6 | Planning not yet granted |
| Saltfleetby | Wingaz | Lincolnshire | 0.8 | Planning granted, no FID |
| Stublach[15] | Storengy UK | Cheshire | 0.2 | Planning granted, no FID |
| Whitehill | E.ON | East Yorkshire | 0.5 | Planning granted, no FID |
| | | **Total** | **7.5** | |

Please note tables A2.6B and A2.6C represent the latest information available to National Grid at time of going to press. Developers are welcome to contact us to add or revise this data

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

[15] Represents second phase which is currently undecided.

# Appendix Three
# Actual Flows 2012/13

# Introduction

This Appendix describes annual and peak flows during the calendar 2012 and gas year 2012/13.

# A3.1
# Annual Flows

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 re-allocation of demand between 0-73.2 MWh/y and >73 MWh/y firm load bands to allow for reconciliation, loads crossing between thresholds, etc. The load band splits shown in table A3.1 are slightly different from those incorporated in the National Grid accounts.

Table A3.1A provides a comparison of actual and weather corrected demands during the 2012 calendar year with the forecasts presented in the 2012 Ten Year Statement. Annual demands are presented in the format of LDZ and NTS load bands / categories, consistent with the basis of system design and operation.

*Table A3.1A*
*Annual Demand for 2012 (TWh) – LDZ / NTS Split*

| | Actual Demand (TWh) | Weather Corrected Demand (TWh) | G-TYS (2011) GG Demand |
|---|---|---|---|
| 0 - 73 MWh | 359 | 337 | 329 |
| 73 - 732 MWh | 48 | 45 | 44 |
| >732 MWh Firm | 175 | 172 | 178 |
| **LDZ Consumption** | **582** | **554** | **551** |
| NTS Industrial | 31 | 31 | 29 |
| NTS Power Gen. | 168 | 168 | 195 |
| Exports | 113 | 113 | 143 |
| Total | 312 | 312 | 366 |
| Shrinkage | 8 | 8 | 8 |
| **Total Consumption** | **894** | **866** | **917** |
| **Total System Demand** | **901** | **873** | **925** |

Figures may not sum exactly due to rounding

Table A3.1A indicates that our 1 year ahead forecast for 2012 was accurate to 2.5% at an LDZ level. The combined forecasts of the NTS Industrial, NTS Power Generation and Exports were accurate to 6.0%. Total system demand was accurate to 4.2%.

# A3.2
# Peak & Minimum Flows

### A3.2.1 System Entry – Maximum Day Flows

For winter 2012/13, the day of highest supply to the NTS was also the day of highest demand. This was 16 January 2013, when 392 mcm fed a demand of 393 mcm. This is lower than the highest demand day in the 2011/12 gas year, in which 414 mcm of gas was supplied for a demand of 419 mcm.

The day of minimum demand in 2012/13 was 17 August 2013, when NTS demand was 96 mcm. This was also the day of minimum supply, when 114 mcm of gas was supplied to the NTS.

*Table A3.2A*
*IGMS M+15 Physical NTS Entry Flows: 16 January 2013 (mcm/d)*

| **Terminal** | **Max Day 16 January 2013** | **G-TYS (2012) GG Supply Capability** | **Highest Daily (per terminal)** |
|---|---|---|---|
| Bacton inc IUK and BBL | 85 | 186 | 139 |
| Barrow | 7 | 25 | 11 |
| Easington inc Rough & Langaled | 115 | 205 | 125 |
| Isle of Grain (exc. LDZ inputs) | 16 | 52 | 30 |
| Milford Haven | 14 | 120 | 53 |
| Point of Ayr [Burton Point] | 0 | 0 | 4 |
| St. Fergus | 67 | 214 | 90 |
| Teesside | 13 | 81 | 17 |
| Theddlethorpe | 9 | 40 | 13 |
| **Sub Total** | **327** | **923** | **482** |
| MRS and LNG Storage | 66 | 112 | 66 |
| **Total** | **392** | **1035** | **548** |

**Notes**

- The maximum supply day for 2012/13 refers to NTS flows on 16 January 2013
- 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 2012 Gas Ten Year Statement. Conversions to mcm have been made using a CV of 39.6 $MJ/m^3$
- 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.

### A3.2.3 System Exit – Maximum and Peak Day Flows

Table A3.2C shows actual flows out of the NTS on the maximum demand day of gas year 2011/12 compared to the forecast peak flows.

*Table A3.2B*
*IGMS M+15 Physical NTS Entry Flows: 17 August 2013 (mcm/d)*

| Terminal | Minimum Day 17 August 2013 |
|---|---|
| Bacton inc IUK and BBL | 27 |
| Barrow | 6 |
| Easington inc Rough & Langaled | 5 |
| Isle of Grain (exc. LDZ inputs) | 0 |
| Milford Haven | 16 |
| Point of Ayr [Burton Point] | 3 |
| St. Fergus | 46 |
| Teesside | 3 |
| Theddlethorpe | 8 |
| **Sub Total** | **114** |
| MRS and LNG Storage | 0 |
| **Total** | **114** |

### Notes

- The minimum supply day for 2012/13 refers to NTS flows on 17 August 2013. 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.

## A3.2.2 System Entry – Minimum Day Flows

*Table A3.2C*
*IGMS D+5 Physical LDZ Demand flows: 16 January 2013*

| LDZ | Maximum Day 16 January 2013 | GTYS (2012) 1 in 20 Undiversified GG Peak |
|---|---|---|
| Eastern | 26 | 32 |
| East Midlands | 34 | 41 |
| North East | 20 | 25 |
| Northern | 17 | 21 |
| North Thames | 31 | 43 |
| North West | 37 | 48 |
| Scotland | 25 | 31 |
| South East | 29 | 46 |
| Southern | 23 | 32 |
| South West | 17 | 25 |
| West Midlands | 26 | 35 |
| Wales [North & South] | 16 | 24 |
| **LDZ Total** | **301** | **403** |
| **NTS Loads** | **91** | **182** |
| **Total** | **393** | **585** |

### Notes

- The maximum day for gas year 2012/13 refers to 16 January 2013. 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 (GG) 1 in 20 Peak Day Firm Demand forecast was published in the 2012 Gas Ten Year statement. Conversions to mcm have been made using a CV of 39.6 $MJ/m^3$
- Figures may not sum exactly due to rounding.

## A3.2.4 System Exit – Minimum Day Flows

*Table A3.2D*
*IGMS D+5 Physical LDZ Demand flows: 17 August 2013*

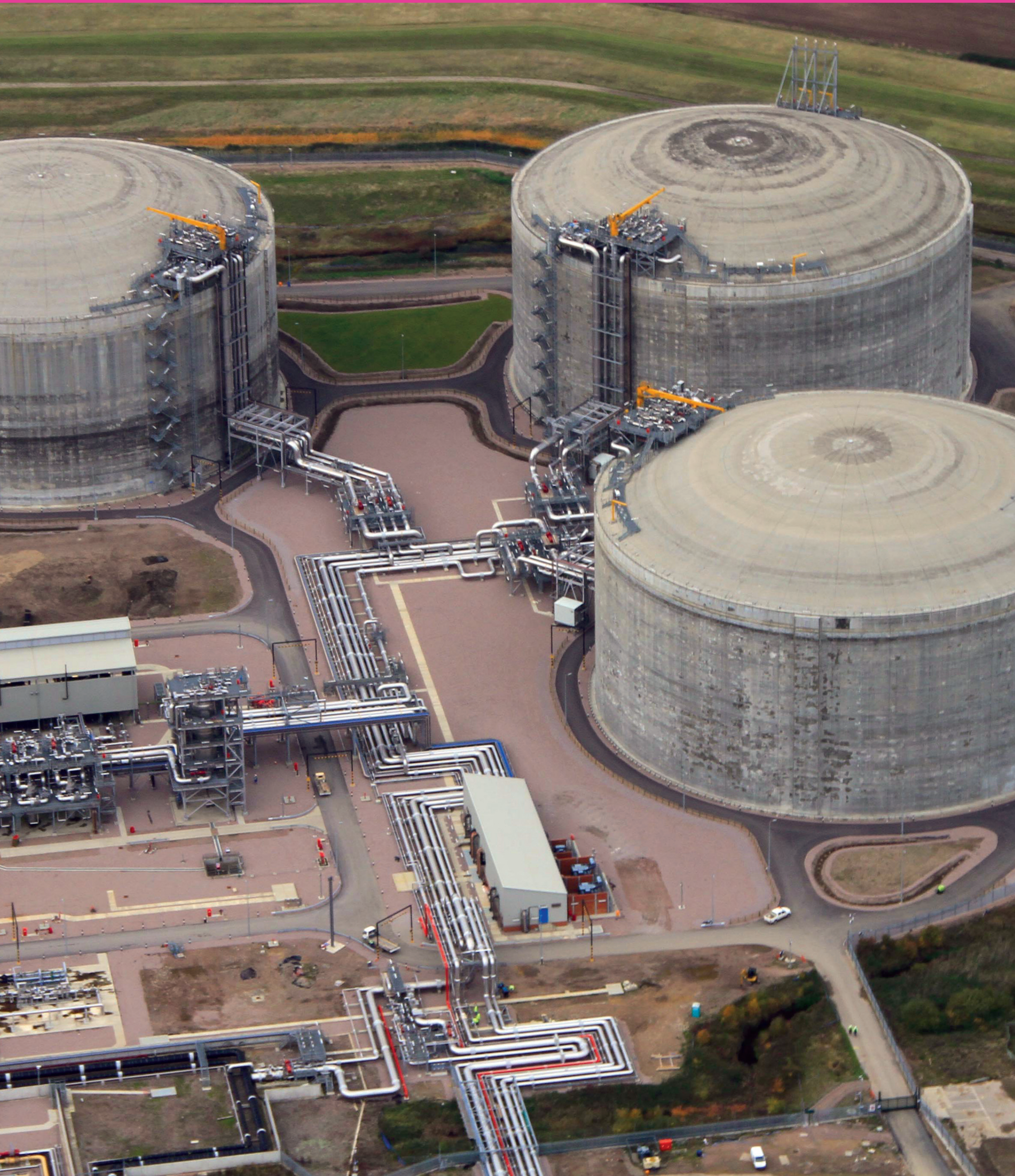
| LDZ | Minimum Day 17 August 2013 |
|---|---|
| Eastern | 4 |
| East Midlands | 5 |
| North East | 4 |
| Northern | 3 |
| North Thames | 5 |
| North West | 8 |
| Scotland | 5 |
| South East | 2 |
| Southern | 4 |
| South West | 2 |
| West Midlands | 4 |
| Wales [North & South] | 4 |
| **LDZ Total** | **50** |
| **NTS Loads** | **46** |
| **Total** | **96** |

### Notes

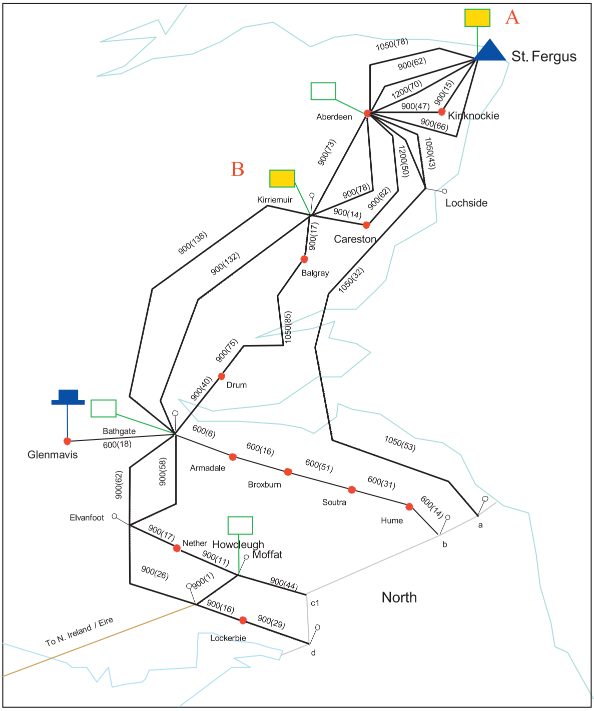
- The minimum day for gas year 2012/13 refers to 17 August 2013. This was the overall lowest demand day, but individual LDZs may have seen lower demands on other days
- NTS actual loads include interconnector demand
- Due to linepack changes, there may be a small difference between total demand and total supply on the day
- Figures may not sum exactly due to rounding.

Appendix Four

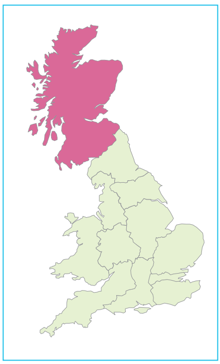
# The Gas Transportation System



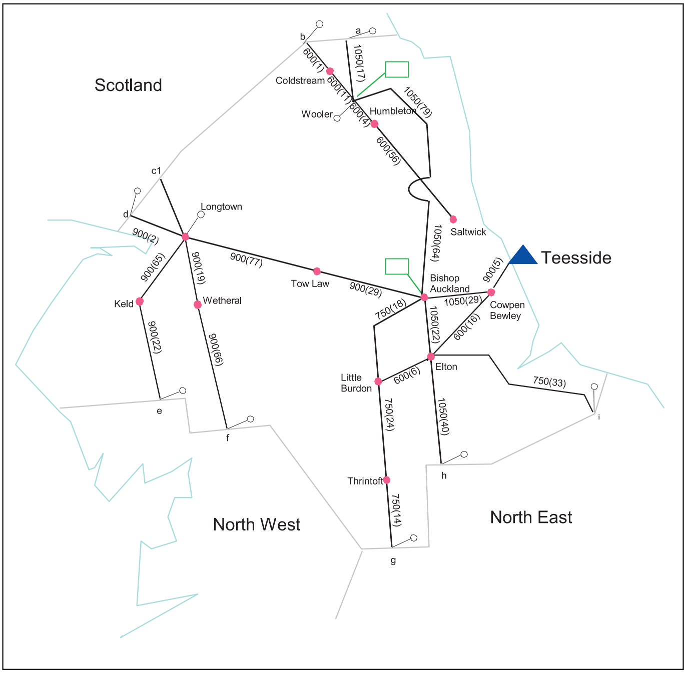
## *Scotland (SC) – NTS*



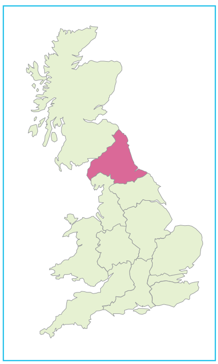

Terminal
LDZ boundary
900(17) Existing pipeline (with distance marker)
900 Pipeline diameter (mm)
(17) Length (km)
a Denotes a crossing point between LDZs
Proposed pipeline
Offtake
Storage facility
Existing compressor
New compressor or compressor modifications
Alternative route
Uprating of Pipelines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



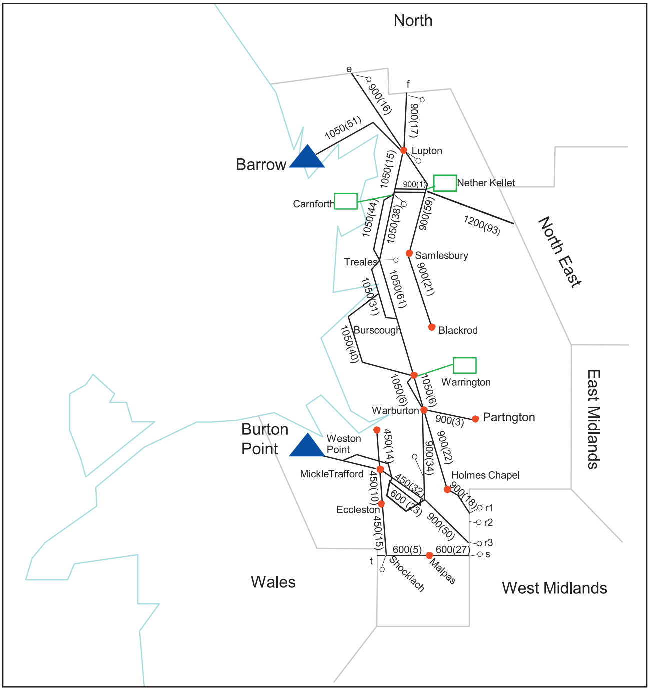
## *North (NO) – NTS*

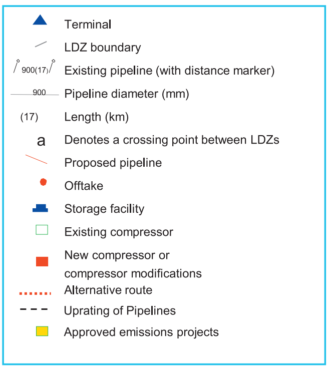


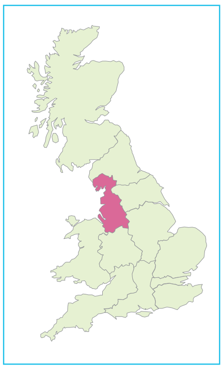

Terminal
LDZ boundary
900(17) Existing pipeline (with distance marker)
900 Pipeline diameter (mm)
(17) Length (km)
a Denotes a crossing point between LDZs
Proposed pipeline
Offtake
Storage facility
Existing compressor
New compressor or compressor modifications
Alternative route
Uprating of Pipelines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



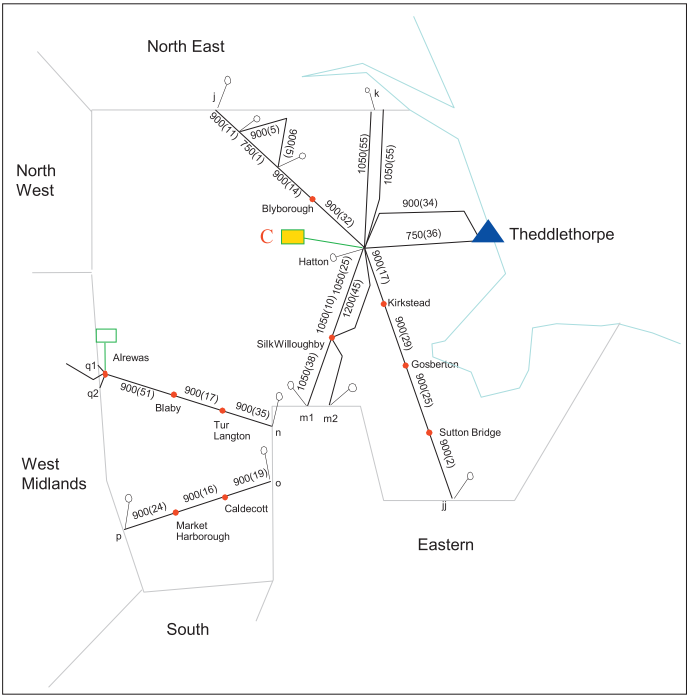
*North West (NW) – NTS*



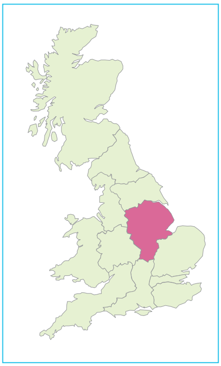



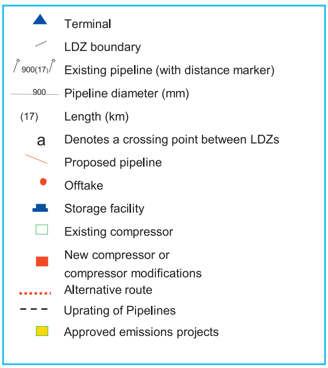
## *East Midlands (EM) – NTS*

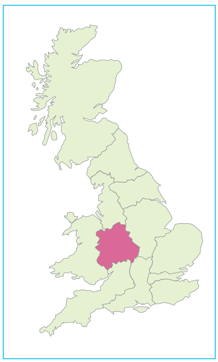



- Terminal
- LDZ boundary
- Existing pipeline (with distance marker)
- Pipeline diameter (mm)
- (17) Length (km)
- a Denotes a crossing point between LDZs
- Proposed pipeline
- Offtake
- Storage facility
- Existing compressor
- New compressor or compressor modifications
- Alternative route
- Uprating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

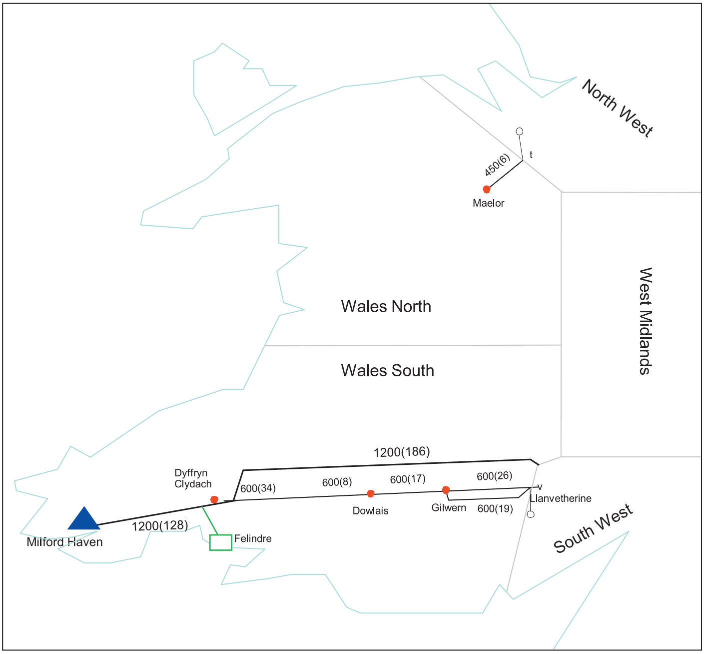


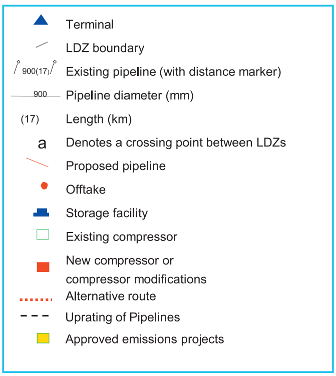
## *West Midlands (WM) – NTS*

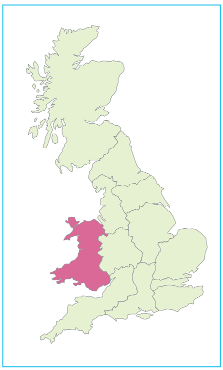



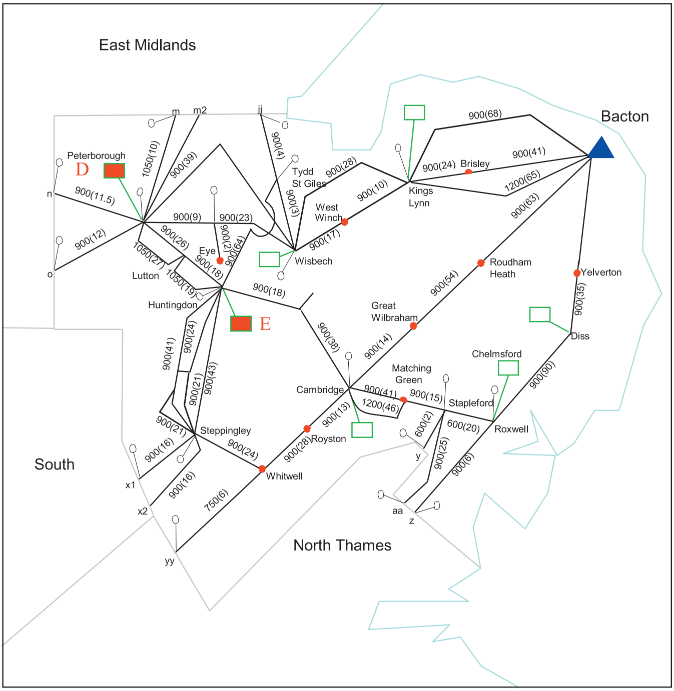
## *Wales (WN & WS) – NTS*



## *Eastern (EA) – 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

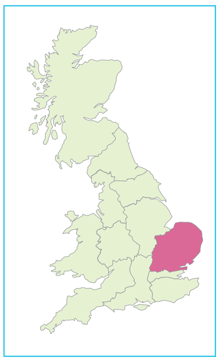
Existing compressor

New compressor or compressor modifications

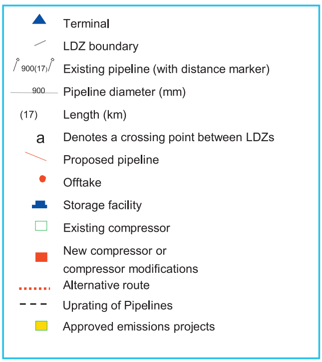
Alternative route

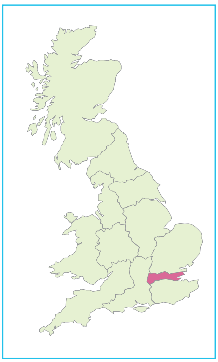
Uprating of Pipelines

Approved emissions projects

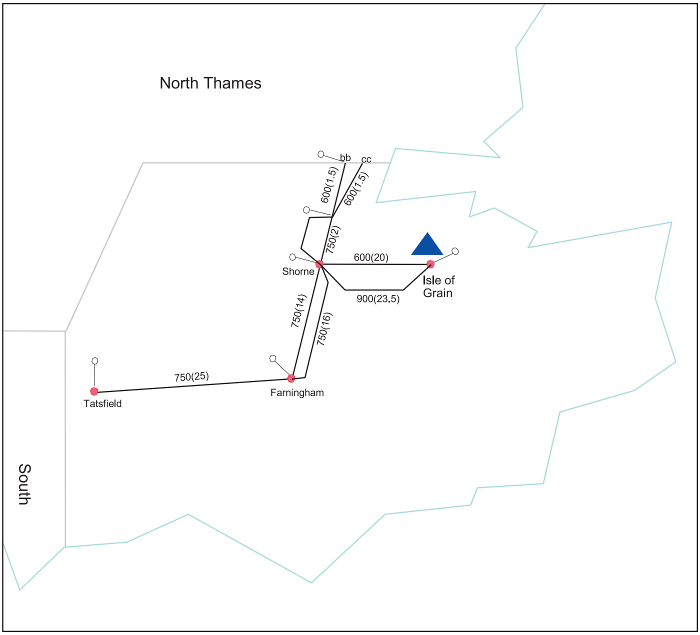


## *North Thames (NT) – NTS*

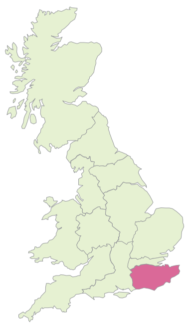



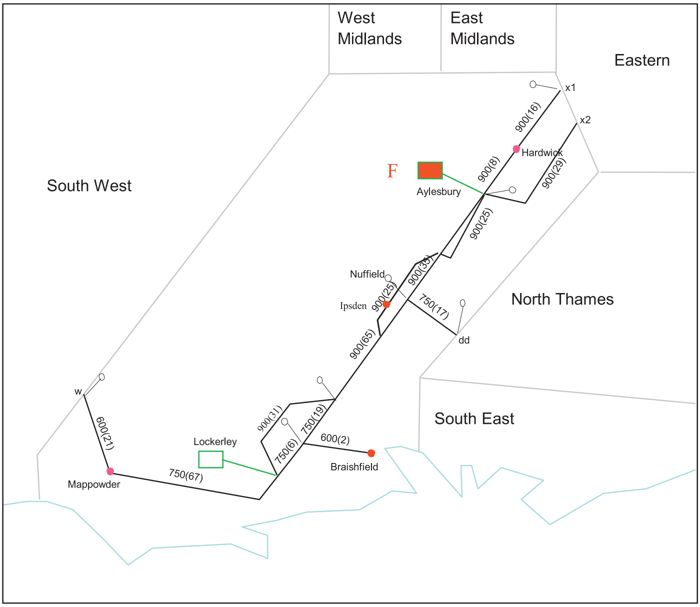
## South East (SE) – NTS




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



*South (SO) – 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
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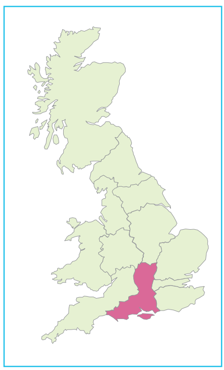
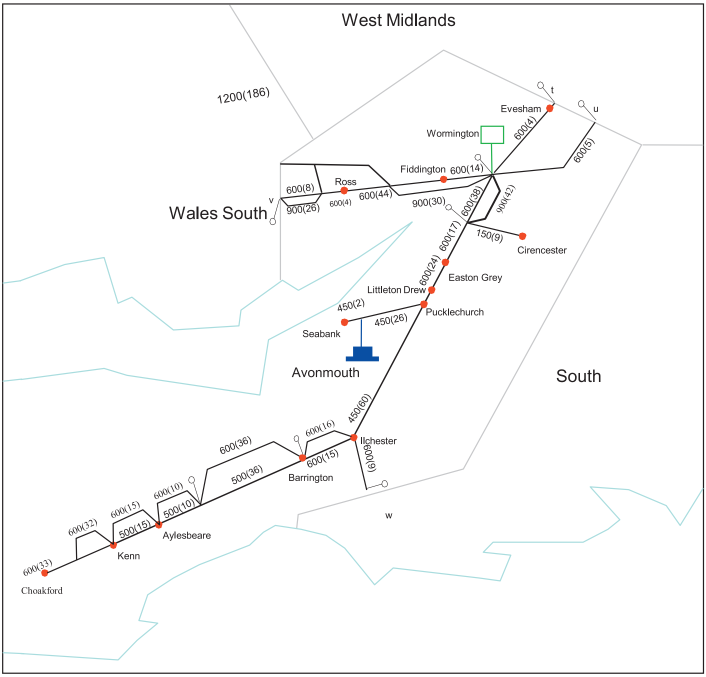
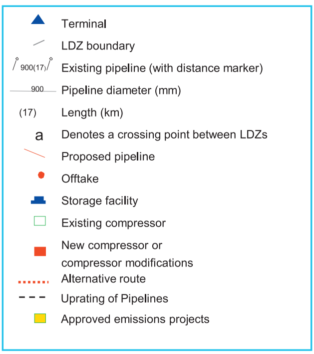
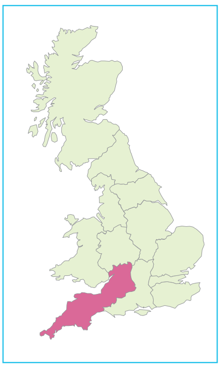


## *South West (SW) – NTS*



Appendix Five

# Connections to the National Transmission System (NTS)

# A5.1
# Introduction

We provide a service to our customers to connect their facilities to our high-pressure National Transmission System (NTS). All customers have the option to choose other parties to build their facilities, have the connection adopted by the host gas transporter (depending upon circumstances), pass assets to a chosen system operator, transporter, or retain ownership of them.

The following are the various categories of NTS connection:

- **Entry Connections:** connections to delivery facilities processing gas from gas producing fields or LNG vaporisation (i.e. importation) facilities, for the purpose of delivering gas into the NTS;
- **Exit Connections:** connections that allow gas to be offtaken from the NTS to 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, who is not a gas transporter, for the purpose of transporting gas to premises consuming more than 2,196 MWh per annum.
- **Storage Connections:** connections to storage facilities for the purpose of offtaking gas from the NTS and delivering it back at a later date;
- **International Interconnector Connections:** connections to pipelines connecting Great Britain to other countries that may both offtake gas from and / or deliver gas to the NTS.

Please note that for Storage and International Interconnector Connections, specific arrangements pertaining to NTS entry and exit connections will apply.

Any customer requirement to modify an existing connection arrangement (e.g. increased supply of gas) will be considered similar to a customer requirement for a new NTS connection.

## A5.2
# NTS Connections – Customer Application and Offer



The Uniform Network Code (UNC) provides a robust and transparent framework for our customers that require a new connection to, or a revision to an existing connection on, the NTS and can be summarised as follows:

- 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 produce a connection offer:
  - Initial connection offer - up to 2 months
  - Full connection offer – up to 6 months (simple), 9 months (medium / complex)
- timescales for customers to accept an Initial/Full connection offer (up to 3 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.

Further information relating to the processes for new connections and changes to existing connections can be found on our website:
**http://www.nationalgrid.com/uk/Gas/Connections/National+Transmission+System+-+Gas+Connections/**

It should be noted that any customer wishing to connect to the NTS or requiring changes to their existing connection arrangements should contact us as early as possible. This will help us to fully understand and assess the customer's connection requirements and, provide us with the ability to deliver to the customer's desired project timescales; particularly as system reinforcements and / or a NTS Licence change may be required as outlined in A5.4.3.

Our connection charging policy for all categories of connection is set out in the publication "The Statement and Methodology for Gas Transmission Connection Charging" which complies with the "Licence Condition 4B Statement" (please use the previous link to access this document).

# A5.3
# 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 operator of all delivery, storage and interconnector facilities to 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.

### A5.3.1 Renewable Gas Connections

National Grid has a commitment to environmental initiatives that combat climate change. Recently we have started to receive an increasing number of customer requests regarding entry into our pipeline system for biomass derived renewable gas. In addition, we have also received a number of requests for gas entry from unconventional sources such as coal-bed methane.

National Grid welcomes these developments and is willing to facilitate the connection of such supply sources to the network, however it must be identified that all existing network entry quality specifications as detailed in section A5.3.2 still apply.

It should be recognised that biomass derived renewable gas may need to be connected to the Gas Distribution Networks instead of the National Transmission System, due to the pressure requirements. For information regarding connections to the Gas Distribution Networks please see the relevant documentation for the relevant Distribution Network (DN).

The twelve LDZs are managed within eight gas distribution networks. Following the sale by National Grid of four of the distribution networks, the owners of the distribution networks are now:

North west, London, West Midlands and east of England (East Midlands LDZ & East Anglia LDZ) are owned and managed by National Grid. To contact National Grid owned DNs about new connections please see **section 6 of the Long Term Development Plan**, (directly via link or navigate from **www.nationalgrid.com**, select 'UK Sites', 'Industry Information', 'Future of Energy', 'Gas Ten Year Statement', then 'Long-Term Development Plan').

Scotland & south of England (South LDZ & South East LDZ) are owned and managed by Scotia Gas Networks – operating as Scotland Gas Networks and Southern Gas Networks respectively. For further information visit **http://www.scotiagasnetworks.co.uk/**

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

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

### A5.3.2 Network Entry Quality Specification

For any new entry connection to our system, the connecting party should notify us as soon as possible as to the likely gas composition. We will then determine whether the gas can be accepted taking into consideration our existing statutory and contractual obligations. Our ability to accept gas supplies into the system is affected by, among other things, the composition of the new gas, the location of the system entry point, volumes entered and the quality and volumes of gas already being transported within the system. In assessing the acceptability of any proposed new gas supply, we will take account of:

a) Our ability to continue to meet statutory obligations (including, but not limited to, the Gas Safety (Management) Regulations 1996 (GS(M)R));

b) The implications of the proposed gas composition on system running costs; and

c) Our ability to continue to meet our contractual obligations

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

1. Hydrogen Sulphide
   - Not more than 5 $mg/m^3$
2. Total Sulphur
   - Not more than 50 $mg/m^3$
3. Hydrogen
   - Not more than 0.1% (molar)
4. Oxygen
   - Not more than 0.001% (molar)
5. Hydrocarbon Dewpoint
   - Not more than -2°C at any pressure up to 85 barg
6. Water Dewpoint
   - Not more than -10°C at 85 barg
7. Wobbe Number (real gross dry)
   - The Wobbe Number shall be in the range 47.20 to 51.41 $MJ/m^3$
8. Incomplete Combustion Factor (ICF)
   - Not more than 0.48
9. Soot Index (SI)
   - Not more than 0.60
10. Carbon Dioxide
    - Not more than 2.5% (molar)
11. Contaminants
    - The gas shall not contain solid, liquid or gaseous material that may 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
12. Organo Halides
    - Not more than 1.5 $mg/m^3$
13. Radioactivity
    - Not more than 5 Becquerels/g
14. Odour
    - Gas delivered shall have no odour that might contravene the statutory obligation not to transmit or distribute any gas at a pressure below 7 barg, which does not possess a distinctive and characteristic odour
15. 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 as the same shall vary from time to time
    - The entry pressure shall not exceed the Maximum Operating Pressure at the Delivery Point.
16. 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.

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 operational tolerance to be included within an agreement to ensure compliance with the GS(M)R.

Due to continuous changes being made to the system, any undertaking made by us on gas quality prior to signing an agreement will normally only be indicative.

### A5.3.3 Gas Quality Developments

The UK Government's 3-phase gas quality exercise, initiated in 2003, concluded in 2007 with the Government reaffirming that it will not propose to the Health and Safety Commission to make any changes to the GB gas specifications contained in the GS(M)R. The Government's forward plan proposed continued engagement with the European Commission and Member States on the issue of gas quality, with particular regard to the CEN (Comité Européen de Normalisation, European committee for standardisation) mandate M/400, under which CEN was invited to draw up standards for natural gas quality that were the broadest possible within reasonable costs.

Mandate M/400 envisaged two phases of work – the first being focused on the wobbe index via a testing programme to assess the performance of domestic appliances using different gas qualities and the second being to consider the non-combustion parameters and the drafting of European Standard(s) for natural gas quality. A final report on the phase 1 work has now been completed (2011) and phase 2 has now commenced with an expected completion in 2014. In addition, mandate M/400 required a cost-benefit analysis of gas quality harmonisation on the whole European gas supply chain to be conducted and the EC's consultants GL Noble Denton and Poyry produced a preliminary report for consultation in July 2011.

The development of a harmonised EU standard for gas quality is a separate project that is being carried out by CEN, (the European standards body). It is expected that the draft standard will be issued for consultation in 2014 and finally published in 2015, however it is not currently expected to be made legally binding for member states to adopt in place of their current national specification.

National Grid is also aware of, and continues to monitor continental developments that could, under some circumstances, combine to limit the UK's ability to import gas due to differences in prevailing gas quality specifications between the UK and continental Europe.

# A5.4
# Additional Information Specific to System Exit Connections



Any person can contact us to request a connection, whether a shipper, operator, developer or consumer. However, gas can only be offtaken from that new Supply Point if it has been confirmed by a shipper, in accordance with the Uniform Network Code.

### A5.4.1 National Transmission System (NTS) Offtake Pressures

The Applicable Offtake Pressure for the NTS, as referred to in the Uniform Network Code Section J 2.1 is normally 25 barg. Although system pressure is typically higher, it will be subject to variation over time and location on the network. We currently plan normal NTS operations with start of day pressures no lower than 33 barg, but such pressure cannot be guaranteed as pressure management is a fundamental aspect of the operation of an economic and efficient system.

NTS offtake pressures at any location will vary due to:

- gas demand
- gas supply pressures at Entry Points
- compressor operation
- pipeline sizes and maximum operating pressures
- special operations such as maintenance and system development works

Offtake pressure also varies within day, from day to day, season to season and year to year. As a general rule, NTS offtake pressures tend to be higher at pressure sources such as entry points and outlets of operating compressors, and lower at the system extremities and inlets to operating compressors.

Our policy is to provide, on reasonable request, forecast information and illustrative historical records for specific NTS connection enquiries.

Notwithstanding the above, shippers may 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.

### A5.4.2 Connecting Pipelines

Where a customer wishes to lay its own connecting pipeline from the NTS to premises expected to consume more than 2,196 MWh per annum, ownership of the pipe shall remain with that customer. This is National Grid's preferred approach for connecting pipelines.

However, the "The Statement and Methodology for Gas Transmission Connection Charging" describes alternative options regarding installation and ownership of connecting pipelines, though the costs of the pipeline remain with the connecting party for all options.

### A5.4.3 Reasonable Demands for Capacity

Operating under the Gas Act 1986 (as amended 1995), we have an obligation to develop and maintain an efficient and economical pipeline system and, subject to that, to comply with any reasonable request to connect premises, provided that it is economic to do so.

In many instances, specific system reinforcement may be required to maintain system pressures for the winter period after connecting a new supply or demand. Please note that dependent on scale, reinforcement projects may have significant planning, resourcing and construction lead-times and that as much notice as possible should be given. Therefore, we encourage project developers to 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. In practice, we find the optimum time is at least several years before customers need to book capacity through the formal Uniform Network Code (UNC) processes[16].

[16] In collaboration with our customers, National Grid is currently developing options to mitigate the challenges presented by the introduction of the Planning Act 2008. These options include aligning the arrangements pertaining to the physical NTS connections and, the commercial capacity regime; in addition, we are assessing short term options for transitional capacity products. We anticipate that any changes to the UNC capacity regime might be introduced from April 2014 – subject to Ofgem approval.

# Appendix Six
## Industry Terminology

**Advanced Reservation of Capacity Agreement (ARCA)**
An agreement between us and shippers relating to future NTS pipeline capacity for large sites in order that shippers can book NTS Exit Capacity in accordance with Uniform Network Code provision to meet gas requirements of large projects at a later date.

**Annual Quantity (AQ)**
The AQ of a Supply Point is its annual consumption over a 365-day year, under conditions of average weather.

**ASEP (Aggregate System Entry Point)**
A term used to refer to gas supply terminals.

**Balgzand – Bacton Line (BBL)**
A pipeline connecting Balgzand in the Netherlands to Bacton in the UK. This pipeline is currently uni-directional and flows from the Netherlands to the UK only.

**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.

**Calorific Value (CV)**
The ratio of energy to volume measured in megajoules per cubic metre (MJ/m3), which for a gas is measured and expressed under standard conditions of temperature and pressure.

**Composite Weather Variable (CWV)**
A measure of weather incorporating the effects of both temperature and wind speed. A separate composite weather variable is defined for each LDZ.

**Combined Cycle Gas Turbine (CCGT)**
A Combined Cycle Gas Turbine is a unit whereby electricity is generated by a gas powered turbine and also a second turbine. The hot exhaust gases expelled from the first turbine are fed into the heat exchanger to generate steam, which powers the second turbine.

**$CO_2e$**
Carbon Dioxide equivalent. A term used relating to climate change that accounts for the “basket” of greenhouse gasses and their relative effect on climate change compared to carbon dioxide. For example UK emissions are roughly 600 m tonnes $CO_2e$. This constitutes roughly 450m tonnes $CO_2$ and less than the 150m tonnes remaining of more potent greenhouse gasses 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.

**Connected System Exit Point (CSEP)**
A connection to a more complex facility than a single supply point. For example a connection to a pipeline system operated by another Gas Transporter.

**Cubic Metre ($m^3$)**
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 $10^6$ cubic metres, one billion cubic metres (bcm) equals $10^9$ cubic metres.

**Daily Flow Notification (DFN)**
A communication between a Delivery Facility Operator (DFO) and us, indicating hourly and end of day entry flows from that facility.

**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.

**DECC**
Department of Energy and Climate Change. DECC was formed in 2008 from the Energy Division of BERR and parts of DEFRA. Some references to BERR still exist and some energy related publications still reside on the BERR website, although the responsibility now resides with DECC.

**Delivery Facility Operator (DFO)**
Operators of the reception terminals, which process and meter gas deliveries from offshore pipelines before transferring the gas to our system.

**Distribution Network (DN)**
An administrative unit responsible for the operation and maintenance of the local transmission system (LTS) and <7 barg distribution networks within a defined geographical boundary. There are currently eight DNs, each consisting of one or more LDZs, supported by a national emergency services organisation.

### Distribution System
A network of mains operating at three pressure tiers: intermediate (2 to 7 barg), medium (75 mbarg to 2 barg) and low (less than 75 mbarg).

### 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 gasholders, or in the form of linepack within transmission, i.e. >7 barg, pipeline systems.

### ETYS
Electricity Ten Year Statement.

### ENTSOG
European Network of Transmission System Operators for Gas.

### ENA
Energy Networks Association.

### 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.

### Future Energy Scenarios (FES)
Our annual industry-wide consultation process encompassing questionnaires, workshops, meetings and seminars to seek feedback on our latest scenarios and shape future scenario work. The Future Energy Scenarios document is produced annually and contains our latest scenarios.

### GTYS
Gas Ten Year Statement.

### 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.

### Gas Transporter (GT)
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.

### 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.

### Gone Green (GG)
A National Grid scenario whereby the 2020 renewables target is met.

### IEA
International Energy Agency. An intergovernmental organisation that acts as energy policy advisor to 28-member countries.

### 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 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.

### IUK
Owner and operator of the Belgian Interconnector.

### Kilowatt Hour (kWh)
A unit of energy used by the gas industry. Approximately equal to 0.0341 therms. One Megawatt hour (MWh) equals 103 kWh, one Gigawatt hour (GWh) equals 106 kWh, and one Terawatt hour (TWh) equals 109 kWh.

### Large Combustion Plant Directive (LCPD)
European Union directive, effective from 2008, which aims to control emissions of sulphur dioxide, nitrogen oxides and dust from large combustion plants, including power stations.

### Linepack
The volume of gas within the National or Local Transmission System at any time.

### Liquefied Natural Gas (LNG)
Gas stored and / or transported in liquid form.

### Load Duration Curve (1 in 50 Severe)
The 1 in 50 severe load duration curve is that curve which, in a long series of years, with connected load held at the levels appropriate to the year in question, would be such that the volume of demand above any given demand threshold (represented by the area under the curve and above the threshold) would be exceeded in one out of fifty years.

**Load Duration Curve (Average)**
The average load duration curve is that curve which, in a long series of winters, with connected load held at the levels appropriate to the year in question, the average volume of demand above any given threshold, is represented by the area under the curve and above the threshold.

**Local Distribution Zone (LDZ)**
A geographic area supplied by one or more NTS offtakes. Consists of LTS and distribution system pipelines.

**Local Transmission System (LTS)**
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.

**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. Also known as Quarterly System Entry Capacity (QSEC).

**Margins Notice**
The purpose of the Margins Notice (MN) 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.

**National Balancing Point (NBP)**
A national point which represents the system for balancing purposes.

**National Transmission System (NTS)**
A high-pressure system consisting of terminals, compressor stations, pipeline systems and offtakes. Designed to operate at pressures up to 85 bar. NTS pipelines transport gas from terminals to NTS offtakes.

**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, etc.

**Non-Daily Metered (NDM)**
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.

**Odourisation**
The process by which the distinctive odour is added to gas supplies to make it easier to detect leaks.

**Office of Gas and Electricity Markets (Ofgem)**
The regulatory agency responsible for regulating Great Britain's gas and electricity markets.

**On the Day Commodity Market (OCM)**
This market constitutes the balancing market for GB and enables anonymous financially cleared on the day trading between market participants.

**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.

**Own Use Gas (OUG)**
Gas used by us to operate the transportation system. Includes gas used for compressor fuel, heating and venting.

**Planning and Advanced Reservation of Capacity Agreement (PARCA)**
A solution being developed in line with the enduring incremental capacity release solutions which have been developed following the implementation of the planning act.

**Price Control Review (PCR)**
Ofgem's periodic review of our allowed returns. The current price control period which ends 31 March 2012 is being extended by one year, and the new RIIO-T1 price control period will run from 1 April 2013 to 31 March 2021.

**Peak Day Demand (1 in 20 Peak 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 the 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 – see LTSEC.

**RHI (Renewable Heat Incentive)**
The domestic Renewable Heat Incentive (RHI) is due to start in July 2013, and provides long term financial support for renewable heat technologies so households can move away from fossil fuels for heating and to contribute to the UK's 2020 renewable energy target. The longer term objective is to prepare the country for the deployment of renewable technologies in the next decade to help meet the Government's carbon reduction targets. The Heat Strategy published in March 2012, provides the direction of travel on implementation of renewable heat to 2050.

**ROC**
Renewable Obligation Certificate. Administered by Ofgem. Awarded to owners of renewable projects for renewably generated electricity. Large electricity generators are required to have a minimum amount of electricity generated from renewable generation, any less and ROCs have to be bought to cover the shortfall, any excess can be sold via ROCs.

**Safety Monitors**
Safety Monitors in terms of space and deliverability are minimum storage requirements determined to be necessary to protect loads that can not 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.

**Seasonal Normal Composite Weather Variable (SNCWV)**
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.

**Shearwater Elgin Area Line (SEAL)**
The offshore pipeline from the Central North Sea (CNS) to Bacton.

**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.

**Slow Progression (SP)**
A National Grid scenario where the 2020 renewable energy target for 2020 is not met until some time between 2020 and 2025.

**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 Hourly Quantity (SHQ)**
The maximum hourly consumption at a Supply Point.

**Supply Offtake Quantity (SOQ)**
The maximum daily consumption at a Supply Point.

**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.

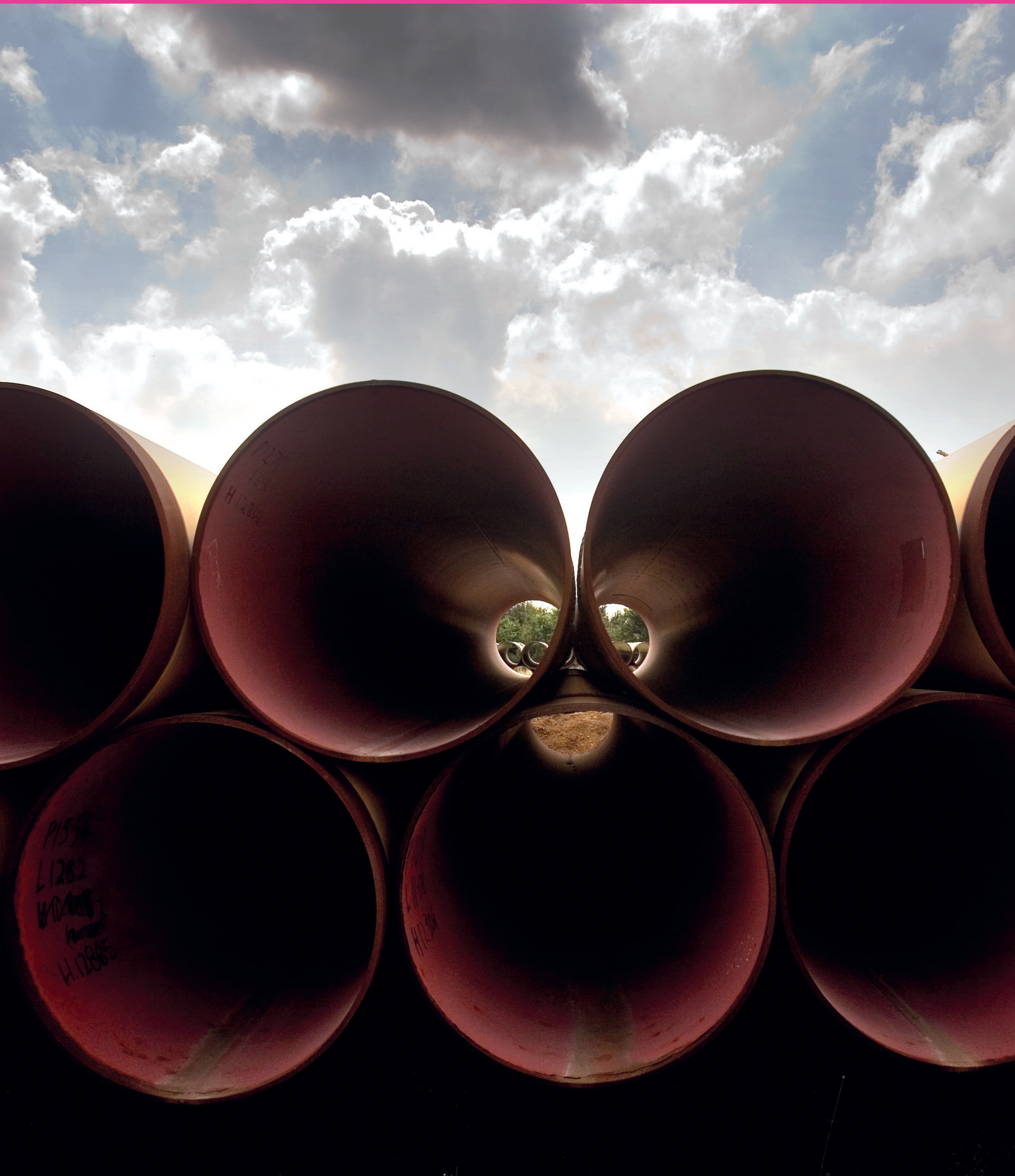
**TSO**
Transmission System Operator

**Unaccounted for Gas (UAG)**
Gas "lost" during transportation. Includes leakage, theft and losses due to the method of calculating the Calorific Value.

**Uniform Network Code (UNC)**
The Uniform Network Code replaced the Network Code and, as well as covering the arrangements within the Network Code, covers the arrangements between National Grid Transmission and the Distribution Network Operators.

**UKCS**
United Kingdom Continental Shelf.

# Appendix Seven
# **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.

| | To: Multiply | GWh | mcm | Million therms | Thousand toe |
|---|---|---|---|---|---|
| From | 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 CV of 39.6 MJ/m³*

GWh = Gigawatt Hours
mcm = Million Cubic Metres
Thousand toe = Thousand Tonne of Oil Equivalent