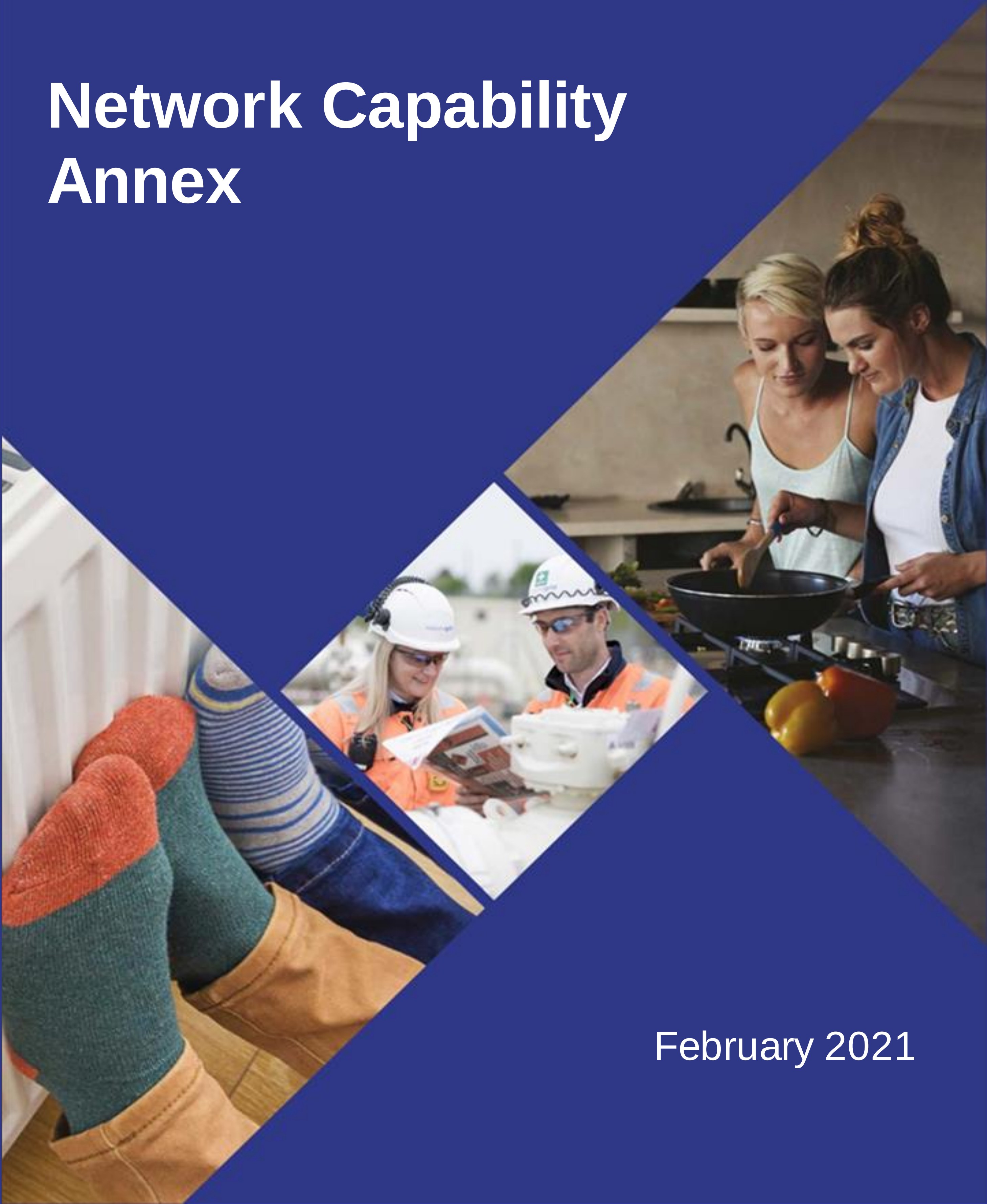
Gas Transmission

nationalgrid

Network Capability Annex



February 2021

Contents

1. Executive Summary

Network Capability refers to the process developed by National Grid to articulate the capability of the Gas National Transmission System and illustrate whether the network is appropriately sized to meet the needs of our customers; now and into the future, against a range of future energy scenarios. The output of this process informs what changes may be necessary to market rules, commercial tools or physical assets, to ensure continued safe and efficient operation of the Gas National Transmission System.

Our Network Capability process, which we run annually, is triggered by the publication of industry scenarios of supply and demand, as detailed in the Future Energy Scenarios (FES) publication produced by the Electricity System Operator in July and culminates in the publication of an Annual Network Capability Analysis Report (ANCAR) the following June.

Our stakeholders have told us that they would value early visibility of the changes in our flow forecasts that result from the updated FES scenarios, prior to publishing ANCAR in June. We therefore propose to publish an interim document, referred to as the Network Capability Annex (this document), each year as an appendix to the Gas Ten Year Statement, which is published each November. This appendix will give stakeholders an opportunity to understand the initial impact of the latest FES scenarios and associated flow forecasts, relative to the previous assessments of the capability of the network.

1.1 Scope

This Network Capability Annex contains the following information:

- A summary of the changes in the FES scenario framework between FES 2018, which formed the basis of our December 2019 RIIO-2 business plan submission to Ofgem, and FES 2020.
- Updated visualisations, known as ‘flame charts’, based on the 2020 FES flow data. The network capability lines on these charts have not yet been updated; these will be available in the ANCAR published in June, however early analysis indicates that we do not expect them to differ significantly from those calculated for our RIIO-2 business plan submission.
- Network Capability is an evolving process and there are still areas for development. For example, the resilience of the network is a complex concept, and we are seeking better ways to articulate this to our stakeholders. Some examples of how we could to do this are included in this document, and we welcome your feedback.

This document also starts our engagement with our stakeholders on the content of the ANCAR.

1.2 Future Energy Scenarios

The ESOs Future Energy Scenario framework has changed significantly between 2018 and 2020, largely due to the UK’s adoption of a Net Zero target for carbon emissions by 2050. The 2018 framework did not include any scenarios which achieved Net Zero, whereas the 2020 framework includes two scenarios that achieve Net Zero by 2050, and a further scenario which achieves Net Zero by 2045. It is only Steady Progression that is not Net Zero compliant and gas is burnt unabated.

By 2050, in all Net Zero scenarios either natural gas is burnt and the carbon output is captured or it has been replaced as a fuel. The main differentiating factor between these scenarios is the extent to which this energy use is replaced by electricity or by decarbonised gases such as hydrogen or ‘green’ gas.

This naturally leads to a wider range of potential outcomes for the Gas National Transmission System by 2050, but the range of scenarios in the next 10 years, and therefore the capability required of the network throughout this period, remains largely unchanged.

1.3 Impact on Capability Requirements

Our RIIO-2 business plan recognised the evolving requirements of the NTS and we proposed to reduce the number of compressor units on the NTS from 72 to 54 by 2030. Our plan also included a decision to accept limited running hour derogations on other compressor units from 2030. This will, allow decisions on decommissioning to be made at a later date when there is greater certainty over the energy future and the operational requirements for these compressor units. Our initial assessment based on FES 2020 is that these proposals remain the right ones for consumers.

We have also proposed a small number of investments in some of our older compressor units that will be non-compliant with emissions legislation from 2030. Ofgem has accepted the need to consider replacing these units during RIIO-2, and these are subject to Uncertainty Mechanisms which will be informed by the Network Capability process.

1.4 Stakeholder Engagement

ANCAR is a stakeholder-led process. We are developing this approach to better articulate the impacts any changes to the network might have on stakeholders. This allows us to have an informed discussion with stakeholders on the potential impacts. This document signposts the potential areas of constraint based on the current business plan and updated FES scenarios. We will engage with impacted stakeholders around these areas to understand the impacts on them.

As part of this stakeholder-led process we would welcome your feedback on this document and how it can be improved. We also seek your views on our proposed reliability visualisations and whether there is other information that you would find helpful to include in the ANCAR.

2 Introduction

2.1 The Network Capability Annex

This publication is the first one of its kind and it is intended that the information it contains will be published on an annual basis.

This Annex is a precursor to the Annual Network Capability Analysis Report (ANCAR), which will be published in June 2021. We see the Annex as the start of our conversation with you about the network and potential impacts of changes, as well as the final form that the ANCAR should take.

We intend to develop the document so that it becomes an invaluable tool to us and our stakeholders. However, we do ask that you, as a reader, will take the time to give us feedback on what you would like to see and what you think is relevant.

This document contains future entry and exit flow data for the National Transmission System (NTS) capability zones, based upon the latest Future Energy Scenario (FES) data, in the form of 'flame charts'. Overlaid on the Entry flame charts are current entry capability lines, as the network is today, and on the Exit charts this year's 1 in 20 demand values, consistent with our Pipeline Security Standard[1].

FES 2020 has three of its four scenarios reaching Net Zero, whereas in previous years there were none. The four Net Zero scenarios are Leading the Way, Consumer Transformation and System Transformation. The one non-Net Zero scenario is Steady Progression. A consequence of the introduction of the Net Zero scenarios is that the underlying supply and demand included in the flame charts have changed their appearance, particularly post 2030, from those illustrated in our RIIO-2 Business Plan submission. The most substantial changes are to be seen in System Transformation. As the scenario's name suggests, the system will be 'transformed' into a hydrogen based one although this is likely to mean that today's capability lines may be of little relevance by 2050. To a lesser extent this is true for all the Net Zero scenarios.

The ANCAR focusses on the capability requirement over the next 10 years, aligned with our business plan. This timeframe reflects the reality that we are managing a network that is being rationalised and consolidated in line with the projected reduction in gas demand, as opposed to a network that is growing. FES illustrates there is significant uncertainty that exists beyond this period.

The last section of the Annex describes how we are developing network capability and how we are trying to make the information more readily accessible. Network capability is a complex subject with a number of interacting facets, the clearer we can make it, the more beneficial it will be. So again, we do ask you to contact us with any thoughts or suggestions on the subject that you may have (see also section 1.3).

2.2 The ANCAR – Annex relationship

As part of the RIIO-2 Final Determinations NGGT Annex[2], Ofgem has decided that we have a new Licence obligation to produce a report detailing the required capability of the network, that is the ANCAR. We welcome this and we believe greater transparency about how we plan the network's development will promote more discussion on the topic which will benefit all parties. We will continue to develop this document to make the document more useful to our stakeholders, with your help, as we move forward. The ANCAR publication will include the following:

- flow forecasts across all network Entry and Exit Zones
- the level of physical Network Capability for each of these Entry and Exit Zones
- the level of Network Capability that can be delivered using commercial tools for each of these Entry and Exit Zones, which we will share subject to the results of a tendering process.

[1] https://epr.ofgem.gov.uk//Content/Documents/Standard%20Special%20Condition%20-%20PART%20A%20Consolidated%20-%20Current%20Version.pdf
[2] https://www.ofgem.gov.uk/system/files/docs/2020/12/final_determinations_-_nggt_annex.pdf

- changes to the level of physical network capability at all Entry and Exit Zones compared to the previous year, including an explanation of the drivers of these changes
- a forecast of the target level of physical Network Capability in 10 years' time, taking account of the needs of NTS users.

Providing the correct level of Network Capability forms the basis for all network development proposals. It principally defines what we have now and what we believe will be needed in the next ten years, as well as what the potential requirements for the network could be in the future.

The ANCAR document will be published in June of each year, when all the data, such as FES, capability analyses and business plan proposals, are derived from the same year's sources. That is, we will not combine 2020 FES data with 2019 capability analyses data.

The purpose of this Annex is to give stakeholders a first view of the latest FES data, at a daily granulation, and it gives us an opportunity to signpost any impacts that the latest FES data may have on the system's capability requirements. We intend to engage with stakeholders, based on this Annex, so that the ANCAR will address topics that our stakeholders consider to be important (see section 2.3).

2.3 Engagement and feedback

Stakeholder engagement is a core part of the ANCAR approach to defining Network Capability and we have developed a targeted engagement plan that will be reviewed and refreshed each year, based on feedback. We intend to engage with our stakeholders with three objectives in mind, namely to:

- further develop and enhance the process and articulation of Network Capability.
- illustrate stakeholders' needs of the transmission system against the current capability, identify implications, challenges and opportunities ahead and feed them into the network development processes
- explain how the outputs of this work inform our decisions.

This Annex, associated conferences, bi-lateral and multi-lateral meetings between now and June will continue this engagement process.

We will also gratefully receive any approaches made to us by interested parties. We may be contacted at **Box.OperationalLiaison@nationalgrid.com**.

3 The Future Energy Scenario (FES) backdrop

The FES process is delivered independently by the Electricity System Operator on behalf of the industry and creates plausible energy pathways out to 2050. The 2020 FES[3], for the first time, introduced Net Zero for its scenarios. Net Zero by 2050 is the outcome achieved in three of the four scenarios, namely Leading the Way, Consumer Transformation and System Transformation. Only Steady Progression does not achieve the Net Zero target.

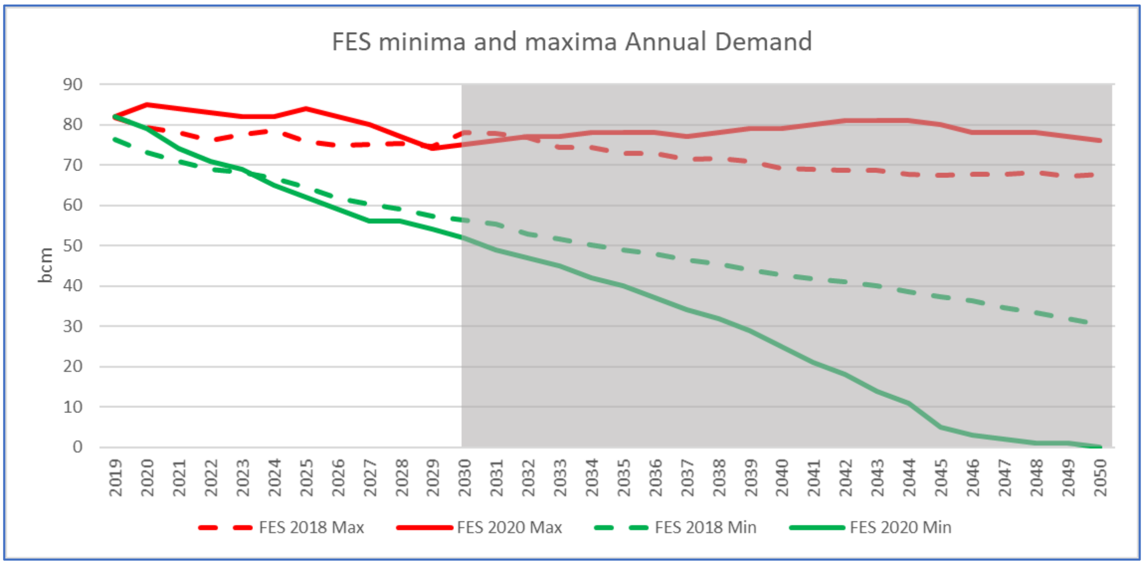
We use the data from FES to produce flame charts, these are a visualisation of the range of potential flows into and out of the network. Section 4.2 gives a fuller explanation of the process.

3.1 FES developments 2018 to 2020

The first set of flame charts, which were used in the Business Plan, were based upon FES 2018 data[4]. The flame charts in this document, and the subsequent ANCAR, are based upon FES 2020 data.

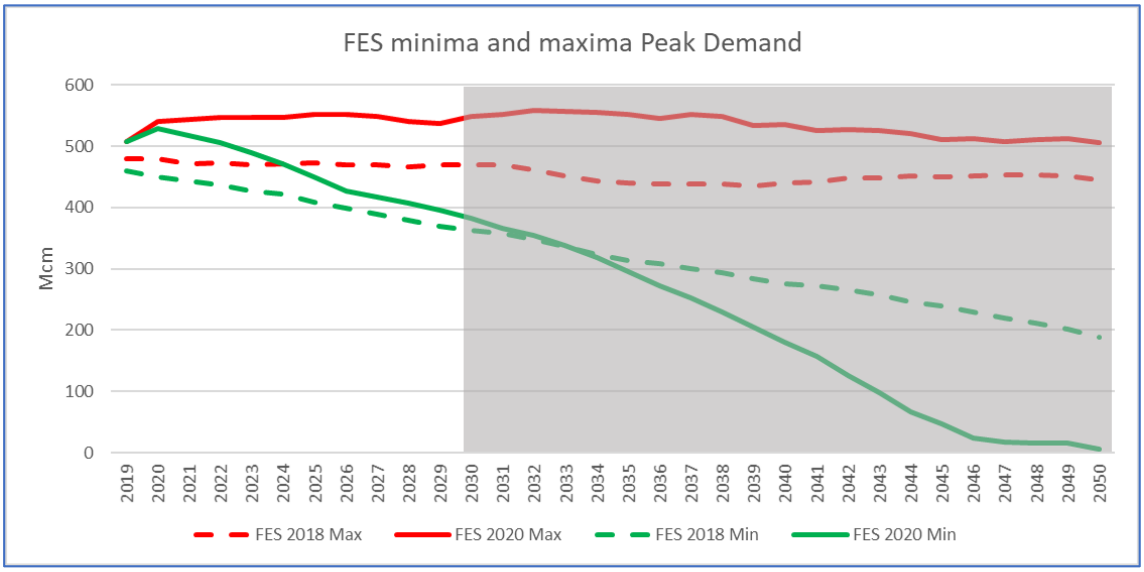
Within FES no individual scenario is given more weighting than another – they are all plausible. In order to illustrate how FES's evolution has altered the gas landscape Figure 1 and Figure 2 illustrate the range of possibilities (maximum and minimum) for Annual Demand and Peak Day.

Figure 1 Minima and maxima Gas Annual Demands for FES 2018 and 2020 with ANCAR's 10-year time-frame highlighted



[3] https://www.nationalgrideso.com/future-energy/future-energy-scenarios/fes-2020-documents
[4] https://www.nationalgrideso.com/future-energy/future-energy-scenarios/fes-documents-archive#tab-2

Figure 2 Minima and maxima Gas Peak Demand for FES 2018 and 2020 with ANCAR's 10-year time-frame highlighted



For both Annual Demand and Peak Demand the spread of potential values have increased within FES 2020, but remain broadly similar over a 10 year horizon.

The maximum values, for both annual and peak demands, in FES 2018 and FES 2020 come from the Steady Progression scenarios. In both annual and peak demand, the FES 2020 maxima values have seen an increase to the FES 2018 values[5]. However, for the Steady Progression values, the level of demand remains relatively constant.

Annual Demand's minimum values see FES 2018's values fall below FES 2020's in 2023, but no significant deviation between the two is seen until after 2030. For the minimum values in Peak Demand this divergence occurs in 2034.

Consequently, for the next ten years, as regards annual gas supply and demand, there are no fundamental changes in the FES ranges between the 2018 and 2020 scenarios. After this period, it is only the minimum level predictions which deviate significantly.

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[5] These changes in the FES' outlooks will be discussed in more detail in the ANCAR

4 Network Capability visualisation

4.1 Zones

The national gas transmission network is a complex system. In order to make analyses much less complex we split the network into seven zones based upon the predominant flows of gas and infrastructure. Figure 3 gives a simplified view of the network and the zones

Figure 3 Gas network zones used in network capability analysis[6]

The zones equate to the regions as follows:

[6] In the diagrams that head the sections, it is the blue line that define the zone under consideration.

- Zone 1 Scotland and The North
- Zone 2 North West
- Zone 3 North East
- Zone 4 South Wales
- Zone 5 South West
- Zone 6 East Midlands
- Zone 7 South East.

4.2 Creating the Flame Charts

The Flame part of the flame chart takes FES data as its input. For each chosen year, for every day, we apply different weather variables to the distribution network offtakes, we randomise the demand from power stations and we use regression analyses on the effects of weather on interconnectors, storage and direct connect industrial sites. The result is 980 data points covering the range of potential demands for each day. For a year, there are 357,700 unique supply and demand patterns. These daily flow patterns are represented by the individual dots seen on the following charts.

4.3 Entry

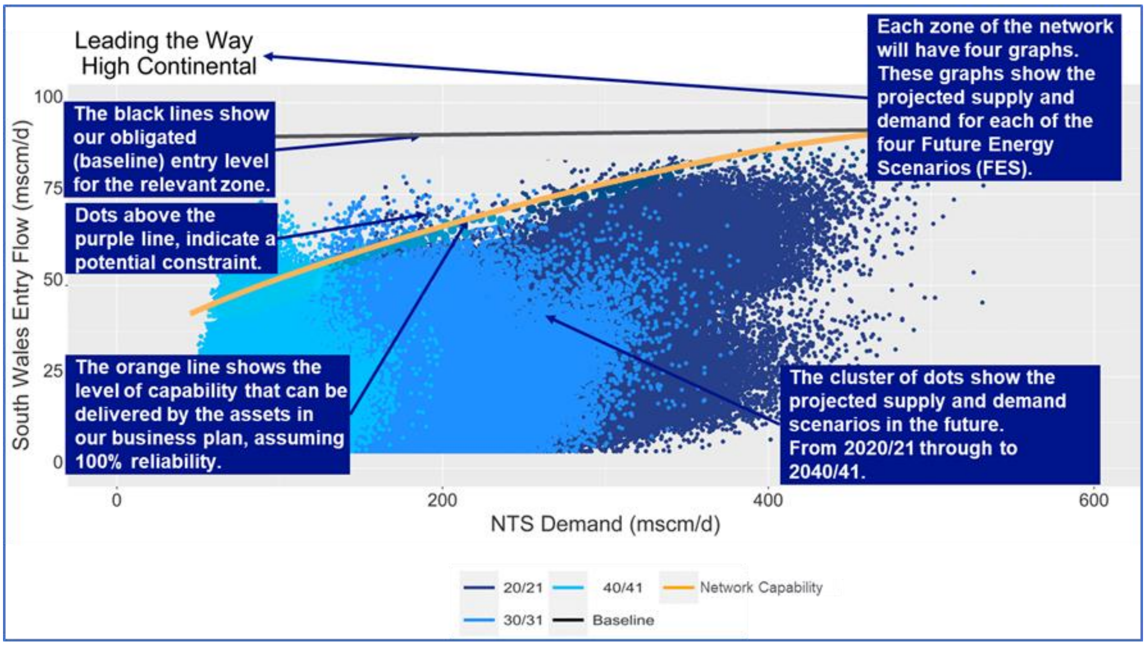
Entry points are those points that supply gas into the NTS, such as beach terminals, interconnectors, storage sites and LNG importation facilities.

The flame chart visualisation is an evolving attempt to explain network capability and its future requirements.

We analyse capability at different demand levels covering the range between Summer (low demand) and Winter (high demand). By interpolating these points, we create network capability curves. Figure 4 illustrates and explains the principles of the Entry Network Capability diagrams. The vertical axis is the level of entry flow for the zone under consideration. The horizontal axis shows the level of national demand.

These network capability curves are combined with the flame charts to allow a comparison of network capability to forecasts of customers' flows.

Figure 4 Entry Network Capability visualisation



Each day has about 980 dots that represent the range of potential flows. So, a small number of dots above the capability line still represents a low likelihood of a requirement beyond the network's physical capability, that it is 'constrained'. Should constraints occur, there are commercial tools that are used to manage flow levels. However, a large number of dots above the orange line could mean the cost associated with these commercial solutions are not an efficient solution and physical alternatives may be necessary.

4.4 Exit

Exit points are those points where gas is taken off the NTS, such as distribution network offtakes, large industrial sites, power stations, storage sites and interconnectors.

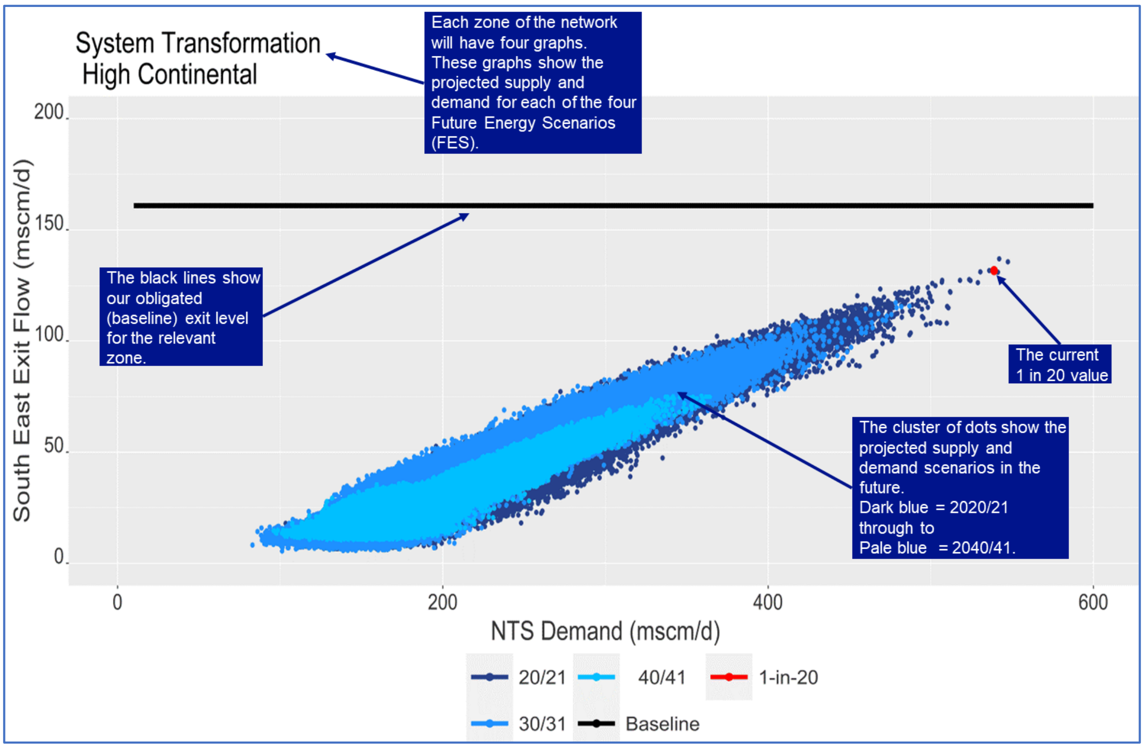
We use the 1 in 20 demand value as an Exit Capability proxy. The 1 in 20 figure is the maximum demand that we are obliged, under our licence, to deliver. It represents the coldest winter in 20 years and one which we are unlikely to experience; it is a high impact, low probability event. We validate that the network can meet this requirement every year during August and September.

In the case of Exit Capability, the vertical axis reflects the level of exit flow for the specified Exit Zone and the horizontal axis shows the national demand. Figure 5 illustrates and explains the principles of the Exit Network Capability diagrams.

Exit Capability can include a small number of datapoints (980 data points are equivalent to 1 gas day) where the exit flow is above the 1 in 20 level. Our modelling takes account of historic site flows, where network conditions allow, some sites are allowed to flow at levels above the firm capacity release obligation. These flows do not form part of our 1 in 20 obligation and would be reduced to their firm capacity obligation if it was expected to create a network constraint.

A simple example of this is Grain Power Station which holds no firm release obligation. If there were no constraints on a high demand day, it could flow if local supplies allow. On a constrained day, Grain Power Station would not be able to flow as it would be restricted to its firm release obligation.

Figure 5 Exit Network Capability visualisation



5 Network Capability - Early Indications

Significant changes occur to the demand and supply flows after 2040, principally as a result of Net Zero. As this is outside of our planning horizon and is highly uncertain, we have limited this analysis to the period out to 2040. The uncertainty post 2040 is not driving any decisions that incur stranding asset which might risk supplies to consumers. To enable this, we will require some no-regrets investments, for the next 10 years, to ensure the system remains safe and operable.

5.1 Overview 2020 to 2040

The capability boundary line is based on the current network and any confirmed changes, that is the network as laid out in our Business Plan[7]. In some zones, changes in supply and demand show that we no longer need all the capability provided by some of our compressors. Over the next 10 years it is proposed that our compressor fleet will reduce from 72 to 52 operational units. For a full account of this reduction see our Compressor Emissions Compliance Strategy document[8]. This reduction includes both the closure of sites, which reduces Network Capability, and reduction in the number of operational units at some sites, which reduces resilience (i.e. the amount of time we can achieve full capability).

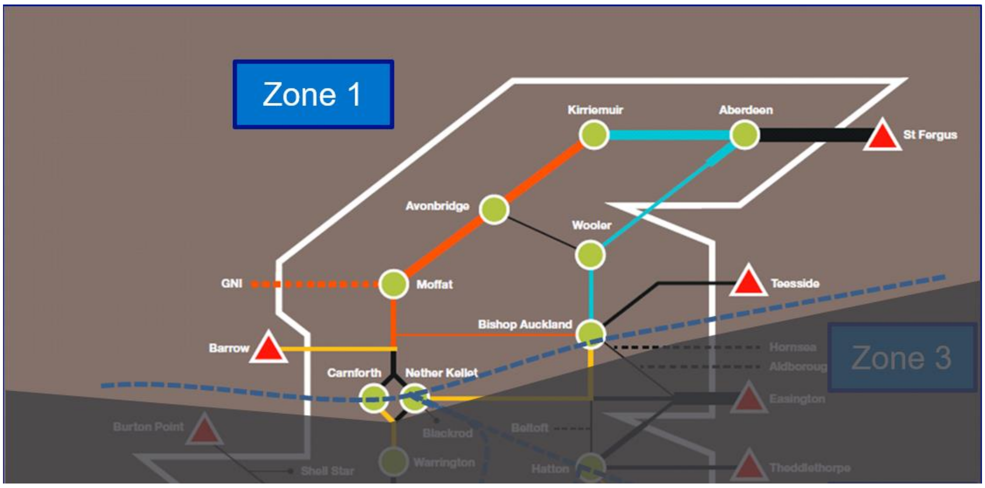
An important assumption we have made in these visualisations, is that all commissioned compressors are available when we assess the network capability; that is, there are no outages or trips of any of the compressors. See section 6.1 for more information on asset availability.

Some more central zones show an apparent surplus of capability, but a function of some compressors is to move gas from one zone to another rather than to directly support entry and exit capability within that zone. In these cases, the gas flowing into or out of adjacent zones could be considered as an additional Entry or Exit capability requirement but is not currently reflected in our visualisations (see section 6.3). Within all zones our investment and maintenance decisions are under continuous review to ensure they are resilient and deliver value to customers and stakeholders. We take a 'least regrets' type approach to ensure that decisions are made at the optimal time.

The baselines, which are the levels of flow we are obliged to be able deliver, is based on our current obligation levels. We have recently reviewed the current baseline levels and in RIIO-2 two will be reduce. We will also conduct a comprehensive review of all the baselines levels in light of the diversification of our entry flows as agreed by Ofgem[9].

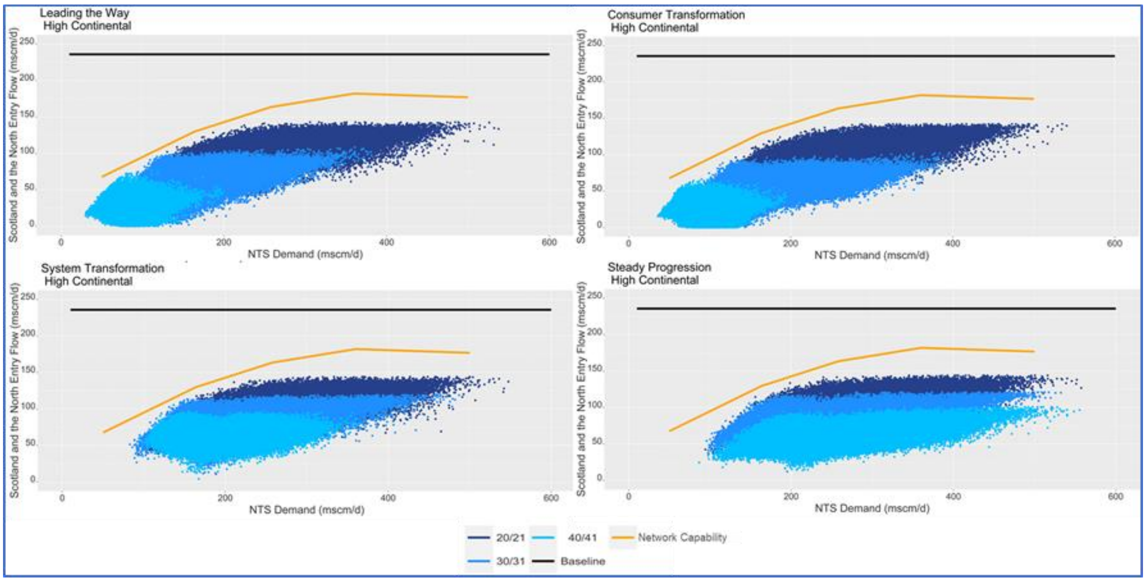
[7] https://www.nationalgridgas.com/document/129311/download
[8] https://www.nationalgrid.com/uk/gas-transmission/document/128991/download
[9] https://www.ofgem.gov.uk/system/files/docs/2021/02/final_determinations_-_nggt_annex_revised.pdf

5.2 Scotland and The North.



5.2.1 Scotland and The North Entry

Figure 6 Scotland and The North (Zone 1), Entry



The Entry Capability for this region includes supply points at St Fergus, Teesside and Barrow. Figure 6 shows that in all four scenarios the supplies entering the zone are declining with the more extreme cases being Leading the Way and Consumer Transformation.

5.2.2 Scotland and The North Exit

Figure 7 Scotland and The North (Zone 1), Exit

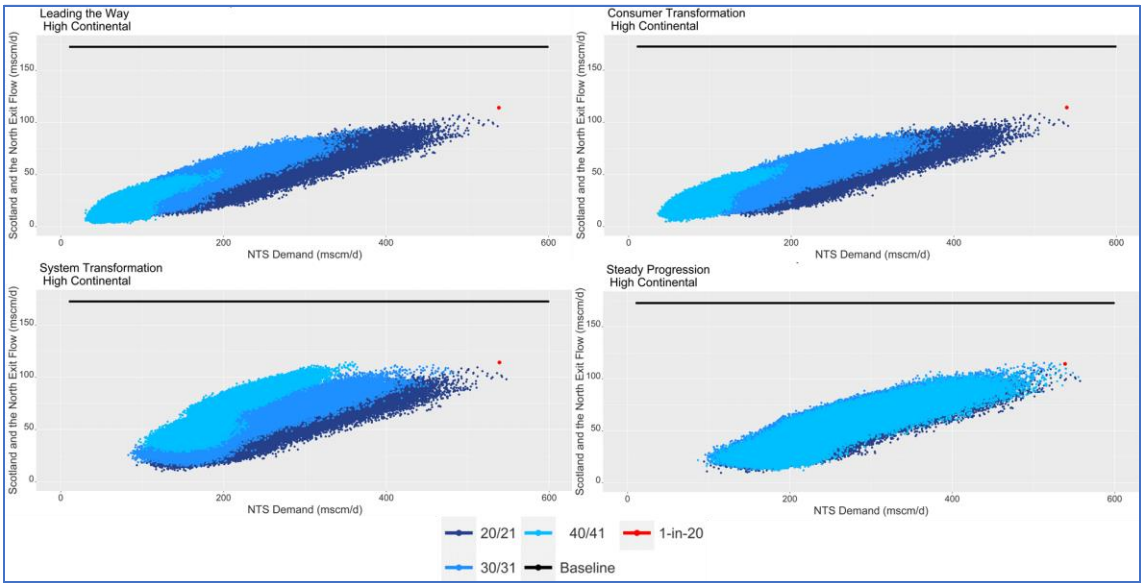


Figure 7 shows demand is declining in the zone for Leading the Way and Consumer Transformation scenarios, but not as fast as the supplies. In the System Transformation Scenario demand increases as Steam Methane Reformation (SMR) plants are connected to the NTS in order to produce hydrogen. In the Steady Progression scenario demands remain at levels similar to those seen today.

5.2.3 Proposed developments

The new charts continue to support the decisions we published in our Business Plan as part of our RIIO-2 submission.

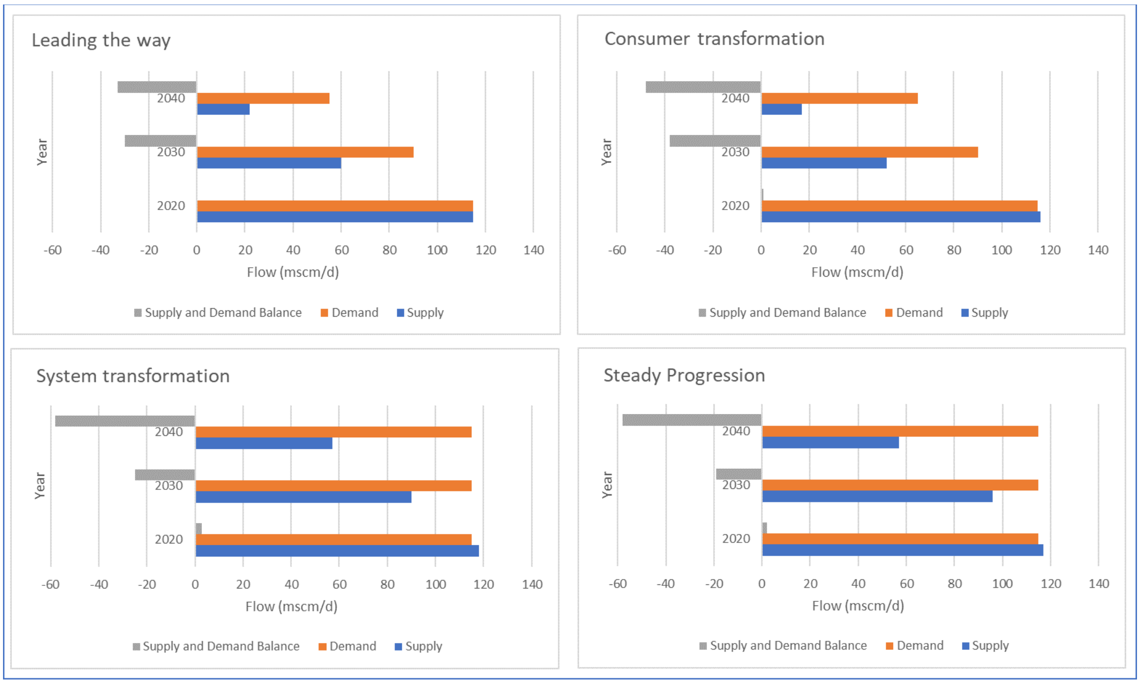
Within this zone, we propose to decommission three compressor units during RIIO-2 and a further three units in RIIO-3[10]. Due to a significant reliance on compression to deliver this zone's capability, there are planned investments during RIIO-2 to improve the reliability of key units in the zone that continue to provide the network capability required over the next ten years.

We have prioritised our investments in the units that we forecast have the highest utilisation. Lower levels of investment are put into units with fewer run hours, e.g. those units which we retain for resilience reasons. The final decision on the units to be decommissioned will be reviewed during the RIIO-2 period with a proposal being put forward in our RIIO-3 business plans.

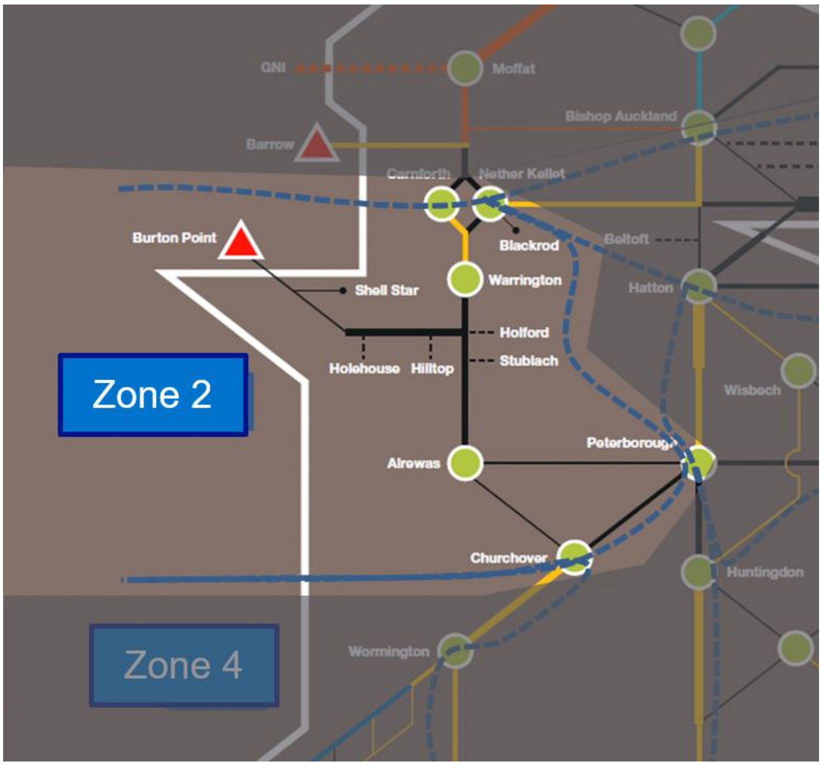
Historically, entry flows into the region have far exceeded local demand with the requirement to move the excess gas to the high demand areas further South. Figure 8 shows the average supply level expected on a peak day and how the balance in supply and demand is changing over time. In the diagram, where a flow has a negative value (the grey bars) then gas needs to be moved into the region. In 2020, at peak demand, supply approximately matches demand but in all four scenarios peak demand will exceed supply at some point in the future. Currently all the compression in the zone is designed to move gas south, to the rest of Britain. We will continue to review our forecasts to identify the optimum time to deliver changes to reconfigure some compressors sites to support flows from south to north when the depleting local supplies cannot support peak local demand. For more detail see GTYS section 4.3.1.

[10] The RIIO periods are price control periods that are as follows: RIIO-1 (2013 to 2021), RIIO-2 (2021 to 2026) and RIIO-3 (2026 to 2031)

Figure 8 Supply and demand balance in Scotland and The North (Zone 1)

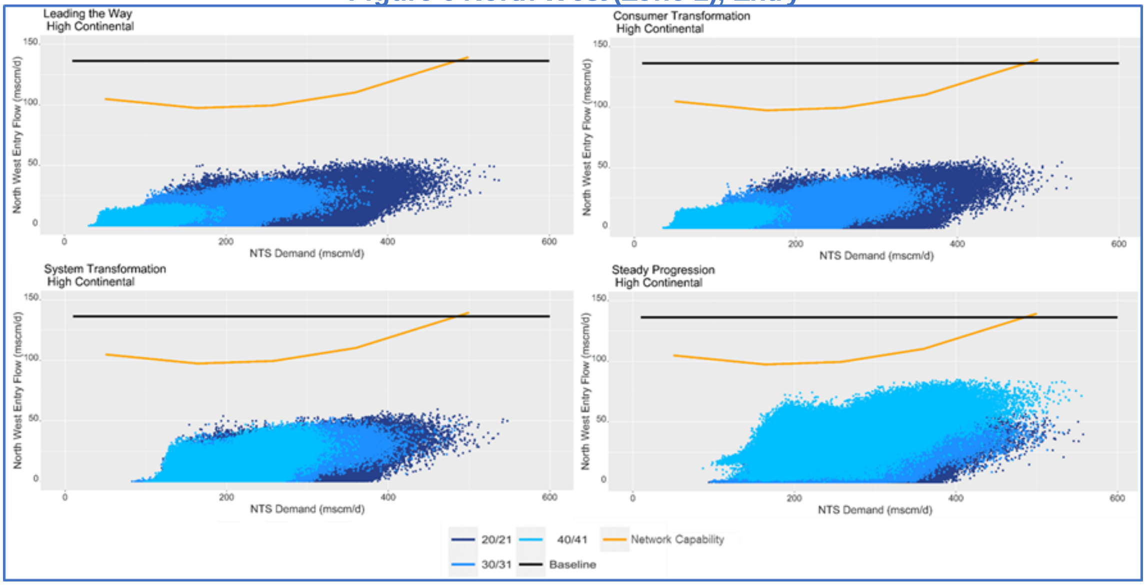


5.3 North West



The Entry and Exit Capabilities for this region are sufficient to meet the needs put upon it now and in the FES scenarios' futures.

Figure 9 North West (Zone 2), Entry

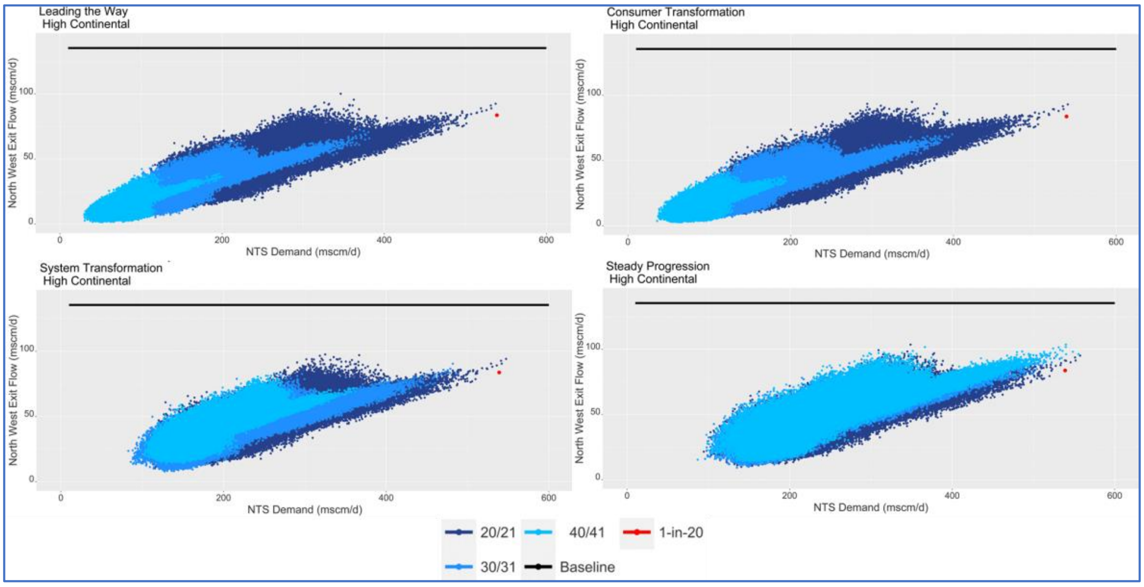


Some of the apparent excess Entry Capability in the North West, Figure 9, is caused by it being a transit zone for gas moving down from Scotland and The North to the southern zones. It requires compressors to facilitate this interzonal movement. This interzonal flow is not reflected in the Entry Capability charts which currently display supply point entry capabilities (see section 6.3 for a discussion on interzonal flows). Consequently, these charts only illustrate part of the functional requirements of the assets.

The development of new gas sources, post 2030 in Steady Progression, may require a future reconfiguration of the network. As this potential source of gas evolves, we will be monitoring its development in order to gain more insights so that we will be able to better review the NTS to ensure it can accommodate any required changes.

5.3.1 North West Exit

Figure 10 North West (Zone 2), Exit



The North West Exit Capability charts, Figure 10, include a few datapoints where the exit flow is above the 1 in 20 level (the red dot on the charts), these are predominantly around a 300 mscm/d national demand level as a result of modelled storage behaviour. For an explanation of why these outliers can occur see Section 4.4.

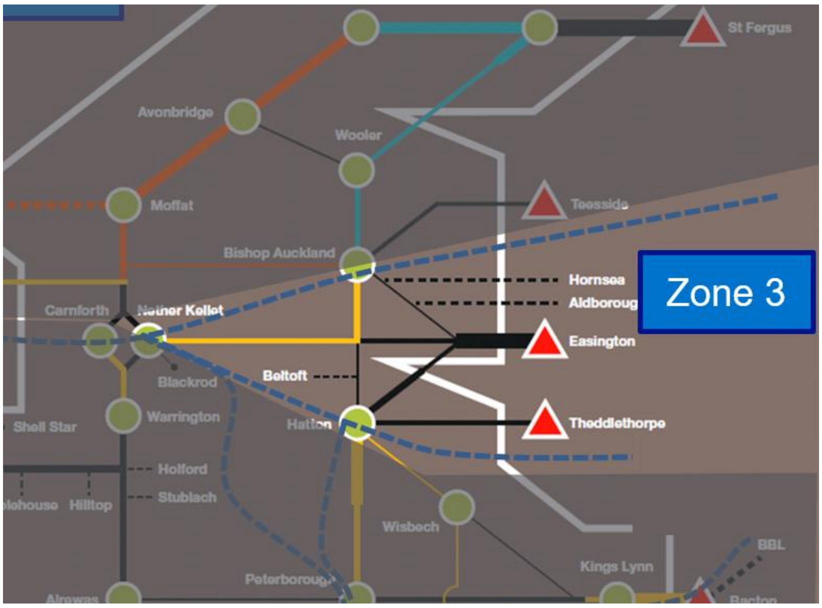
The unevenness of the flow patterns, seen in the all the North West's exit charts, is predominately a function of our storage site modelling that changes within day supply and demand flow patterns onto the NTS, as national demand changes.

5.3.2 Proposed developments

The new charts continue to support the decisions we published in our Business Plan as part of our RIIO-2 submission.

During RIIO-2 it is proposed to decommission two compressors in this zone, with a further four proposed during RIIO-3. The final decision on the units to be decommissioned in RIIO-3 will not be made until nearer the time and will be under review during the RIIO-2 period. These decisions reflect the reducing need to transport gas from the north to the south due to declining UK Continental Shelf (UKCS) supplies.

5.4 North East



The Entry and Exit Capabilities, Figure 11 and Figure 12, for this region are above the expected flows in all the scenarios. There is some unused capability due to the closure of Rough Storage. Additionally, the North East Zone is used both to move large volumes of gas from Scotland and Northern England to the South and to store linepack that can be utilised to respond to within day network events. Therefore, its capability is above the level that is required to provide purely for local Entry and Exit.

Figure 11 North East (Zone 3), Entry

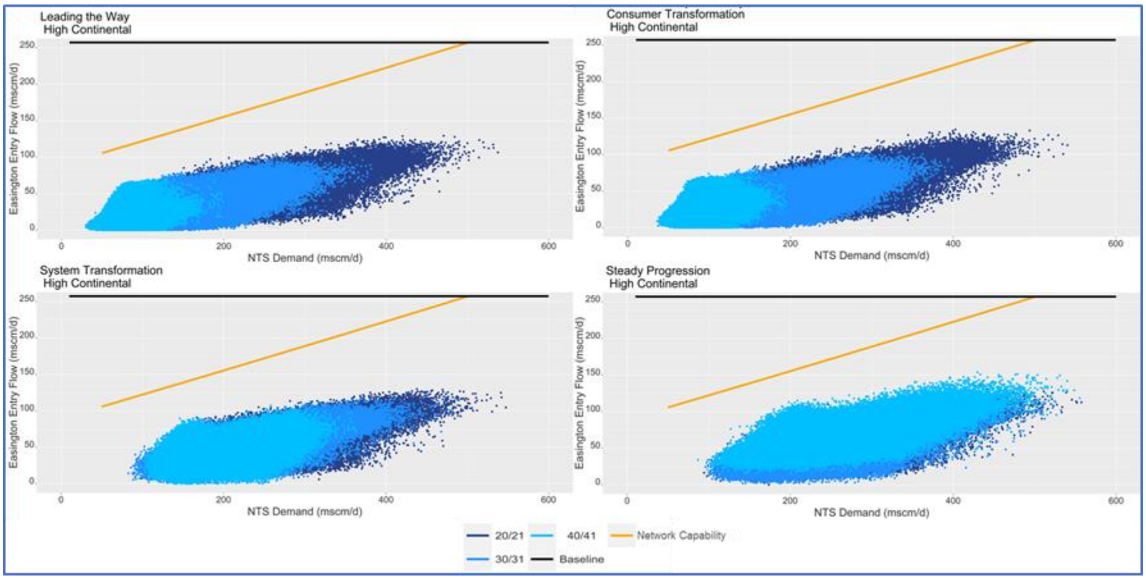
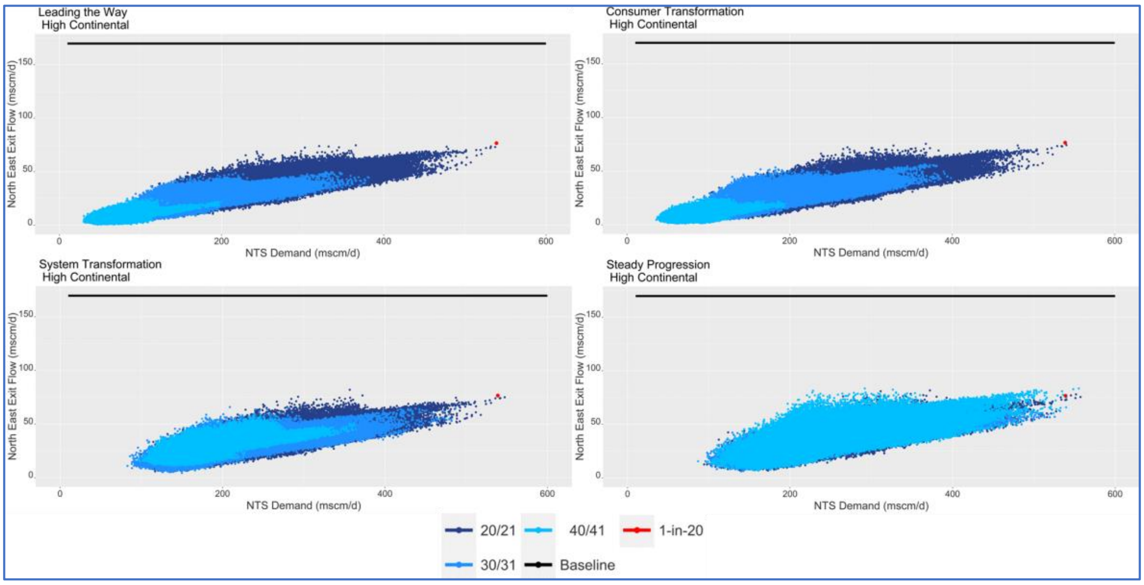


Figure 12 North East (Zone 3), Exit



5.4.1 Proposed developments

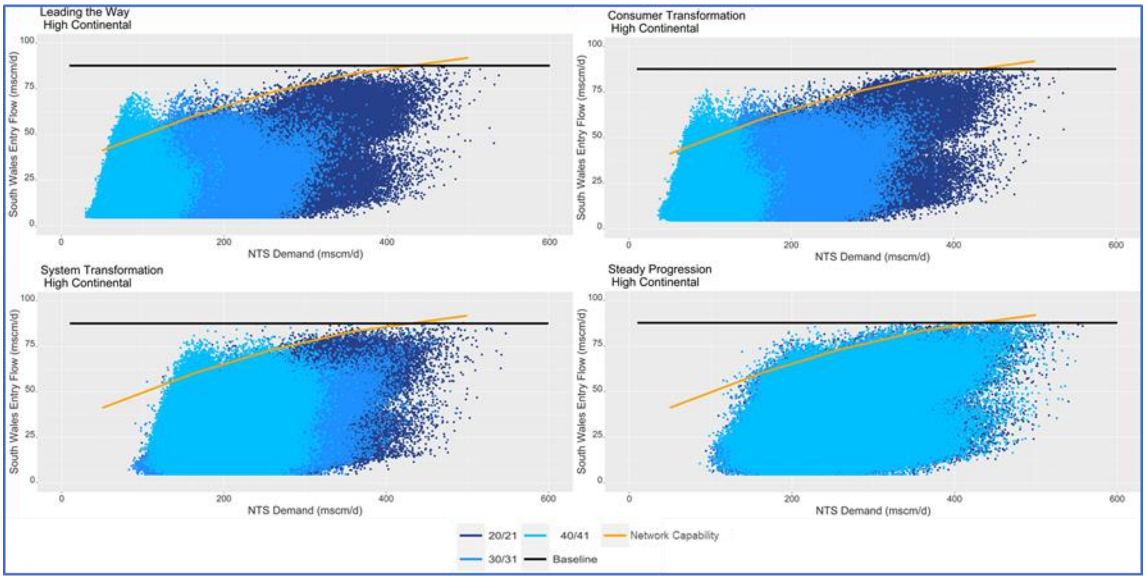
The new charts continue to support the decisions we published in our Business Plan as part of our RIIO-2 submission.

During RIIO-2 we will be decommissioning two units in this zone following the commissioning of one new unit to ensure the required capability is maintained. This reflects the importance of retaining interzonal capability in this zone, especially when linked to the aforementioned loss of capability in the North West region.

5.5 South Wales

5.5.1 South Wales Entry

Figure 13 South Wales (Zone 4), Entry

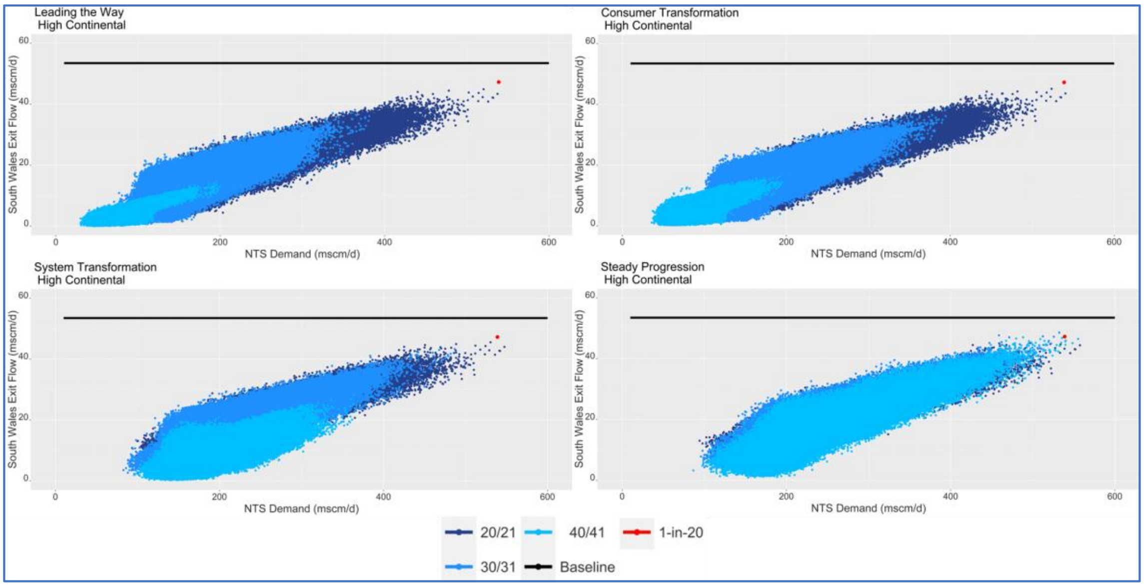


The Entry Capabilities for South Wales (Figure 13) shows the strongest indication of all the zones for long term retention of capability.

The entry flows in Leading the Way and Consumer Transformation show a greater number of potential constraints in later years at lower demand levels. Although national demand will decrease this is not matched by the decrease in the regional entry flows as LNG dependence increases. As both local and national demand decreases, the current capability may not be sufficient to support all the potential flows in future years at lower national demand levels. A similar, if less pronounced, situation occurs in System Transformation. Steady Progression continues to experience demand flows like those of today.

5.5.2 South Wales Exit

Figure 14 South Wales (Zone 4), Exit



For Exit Capability, the network is at the appropriate level to meet the needs put upon it now and in the FES scenario futures. South Wales exit capability is highly influenced by local entry flows, we will continue to review the Exit Capability in line with any changing peak day demands.

5.5.3 Proposed developments

The new charts continue to support the decisions we published in our Business Plan as part of our RIIO-2 submission.

During RIIO-2 two new compressors will be installed to replace units impacted by emissions legislation. This shows the importance of retaining entry capability in this zone as UKCS supplies from the north decline. Once the new units are fully commissioned the two old units will be decommissioned in RIIO-3.

5.6 South West

5.6.1 South West Entry

There are no large Entry sites in the South West (local storage contributes less than 5% of winter supply).

5.6.2 South West Exit

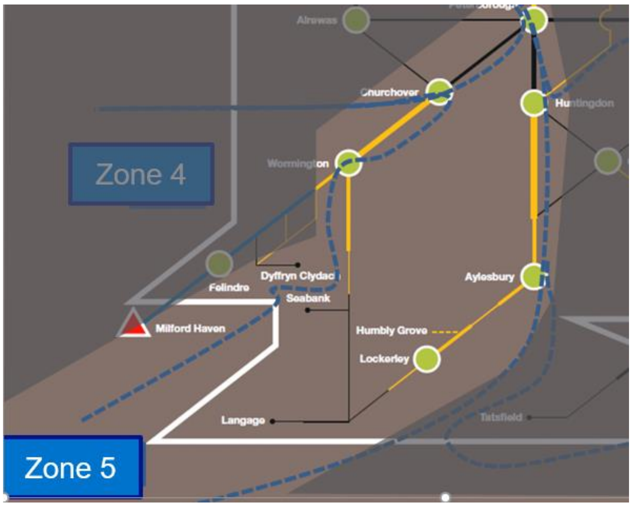
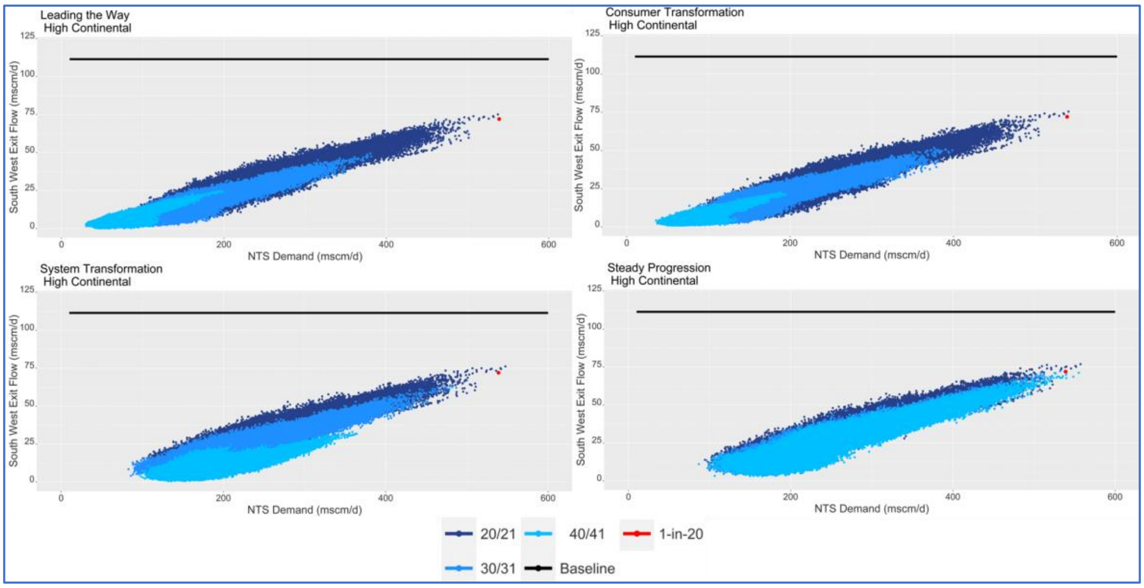


Figure 15 South West (Zone 5), Exit



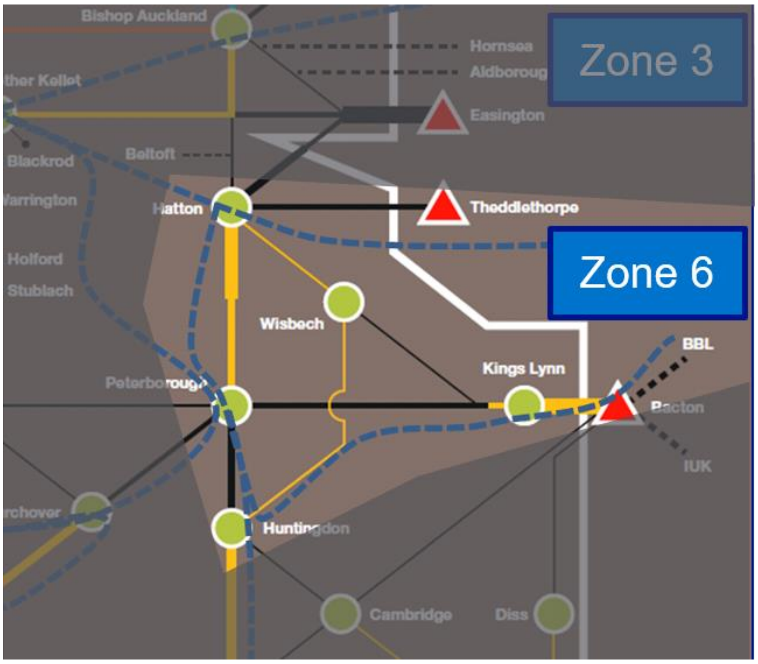
For Exit Capability (Figure 15) the 1 in 20 capability is at an appropriate level to meet the needs put upon it now and in the FES scenarios. We will continue to review the Exit Capability in line with any changing peak day demands.

5.6.3 Proposed developments

The new charts continue to support the decisions we published in our Business Plan as part of our RIIO-2 submission.

During RIIO-2 we will complete the installation of two new compressors as part of emissions legislation. Once completed we will decommission the two units they replace. Maintaining capability highlights the importance of retaining exit capability in this zone based on the least regret[11] principle for the Steady Progress scenario.

5.7 East Midlands



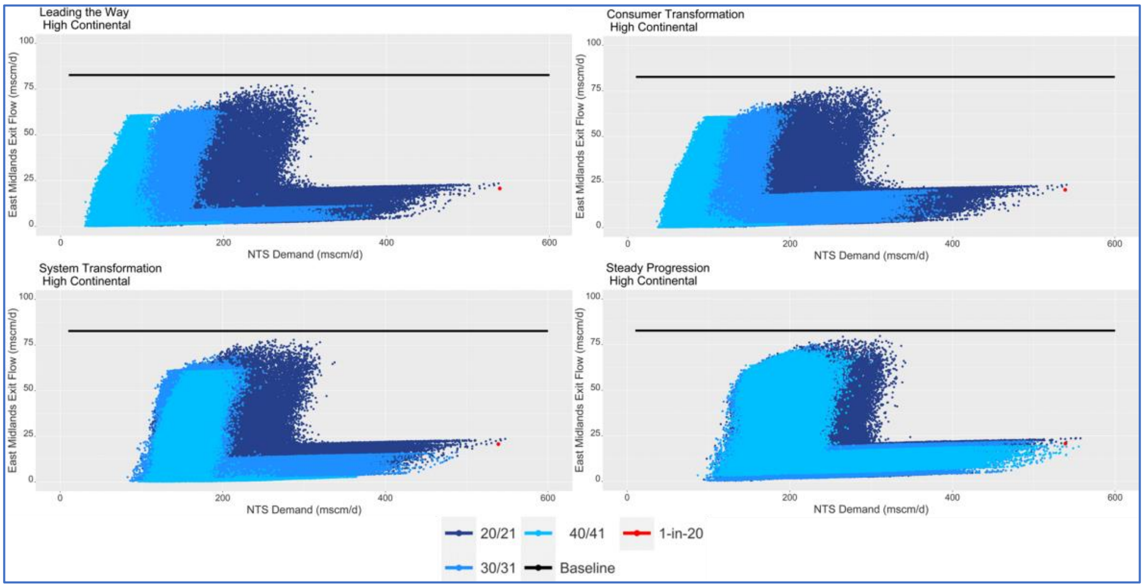
5.7.1 East Midlands Entry

There are no entry sites in the East Midlands zone. Bacton is considered as being in the South East for entry purposes as the majority of imported gas goes on to supply the South East region. But it is considered as being in the East Midlands when it is exporting as nearly all that gas flows from the East Midlands.

[11] In this context, "regret" is the difference in cost to the consumer between the decision that allows the efficient development of the network against all scenarios and the decision that would best meet one of the scenarios specific needs.

5.7.2 East Midlands Exit

Figure 16 East Midlands (Zone 6), Exit



For Exit Capability, the 1 in 20 capability is sufficient to meet the needs put upon it now and in the FES scenario futures.

The plateau shape, present in all the charts, is caused by the assumed transition of interconnection flows from Exit to Entry (via Bacton) as national demand levels increase. Bacton is considered as an exit point for the East Midlands, as the gas it exports, via the interconnectors, is supplied by moving gas through the East Midlands and using the King's Lynn's compressor station. However, Bacton is an entry point for the South East Zone (see the South East, section 5.8).

5.7.3 Proposed developments

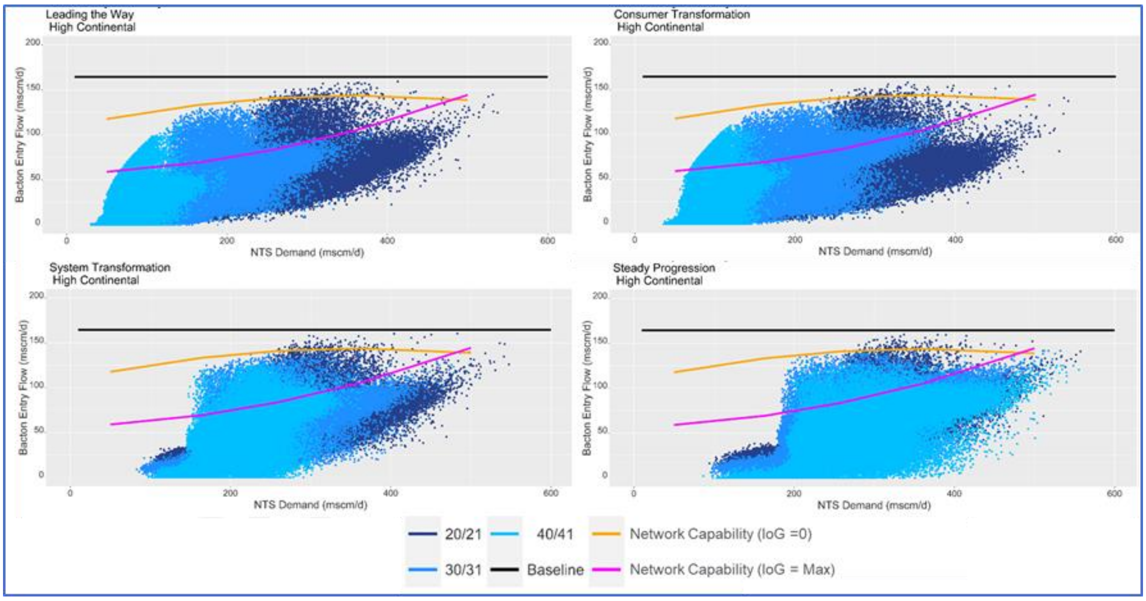
The new charts continue to support the decisions we published in our Business Plan as part of our RIIO-2 submission.

During RIIO-2 we will assess the compression requirement in this zone, specifically at King's Lynn, with the proposal to install two new compressors during RIIO-3 and decommission three others. These reflect the importance of supporting exit capability at Bacton during the summer and entry capability in the South East Zone.

5.8 South East

5.8.1 South East Entry

Figure 17 South East (Zone 7), Entry



There are two entry sites in the South East which interact, Bacton and the Isle of Grain. The Entry Capability charts show the capability of Bacton in two situations: maximum flow from Isle of Grain (the pink line) and no flow from Isle of Grain (the orange line). Together these two lines are intended to indicate the overarching entry capability of the NTS in the South East.

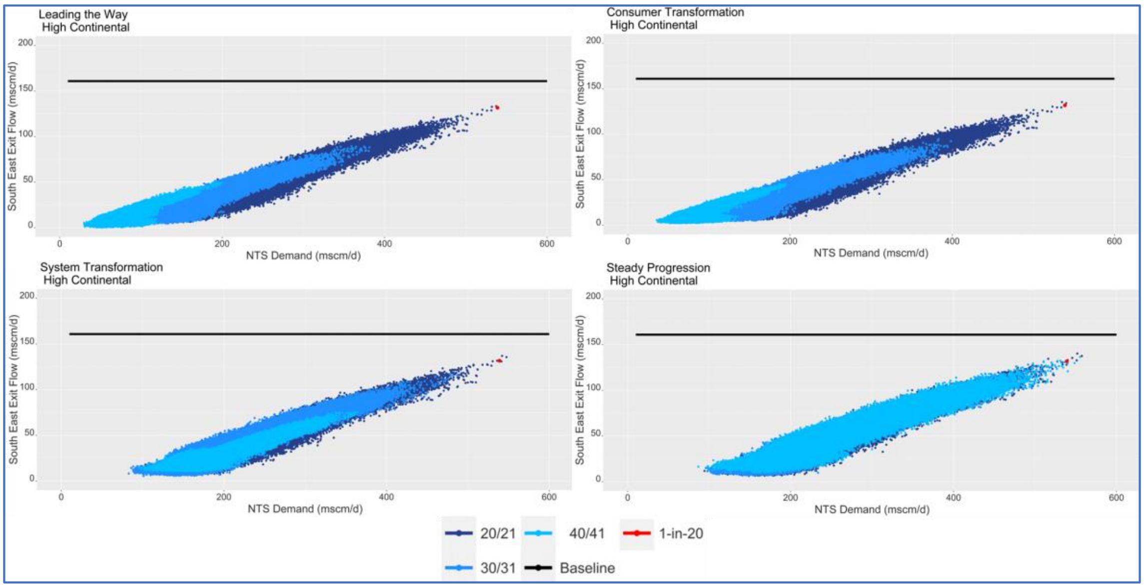
When Bacton is acting as a net entry point, gas is primarily directed into two pipelines that support South East's demand, through Diss and Cambridge. Any additional gas is moved west, via the King's Lynn and Peterborough compressors to support the demand from the South, via the Southern Feeder route. For this reason, Bacton entry primarily supports South East's demand and is included in the South East Zone, alongside the Isle of Grain.

We currently consider co-incidental high flows from LNG and interconnector to be less likely. So, in order to have an efficient system to meet such events, we rely on commercial solutions rather than building assets.

The step effects seen in System Transformation and Steady Progression scenarios' Entry Capability Charts, are a result of increased flows of gas into Britain, from the interconnectors, at times of higher national demand.

5.8.2 South East Exit

Figure 18 South East (Zone 7), Exit



For Exit Capability, the network is able to meet its obligation. We will continue to review the Exit Capability in line with any changing peak day demands.

5.8.3 Proposed developments

The new charts continue to support the decisions we published in our Business Plan as part of our RIIO-2 submission.

During RIIO-3 it is proposed we decommission three units in this zone. The final decision is yet to be made and the future compression requirements will be decided during RIIO-2, depending on how supplies and demands change in this zone.

6 Network Capability assessment developments

6.1 Asset availability

All the charts that we have presented here are based on the assumption that all the compressors and other assets required to deliver maximum capability are available. This is an idealised position, in reality compressors have outages due to planned maintenance and unforeseen trips (stoppages and failures to start).

How often a compressor is unavailable depends on several factors including how it is used, how often it is used, what type of compressor it is and how old it is. Compressor unavailability is currently well managed, and we take steps to minimise its effects and maximise availability, matched to anticipated need. One of the most obvious ways to maintain high levels of site capability is by having additional compressors available to provide additional resilience.

Currently, most compressor sites have at least one ‘resilience’ compressor unit meaning there is typically cover for maintenance or trips when the site is needed. Simplistically, at a two-unit site, if there is a 90% chance of any one compressor being available then the likelihood of at least one of the two units being available would be 99%. But compressor sites have different numbers of units, with potentially a mixture of compressor types that have different performance characteristics, a combination of which are used on various days and times of day.

Figure 19, Figure 20 and Figure 21 are examples of how we could begin to display relative compressor availability data. We have used Wormington as an example site as it is in a relatively self-contained part of the NTS and all the compressor units are an equivalent size. Within this site two of the three units are required to deliver 100% of site capability. The impact of reducing from three to two units, where both are required, is explored.

Figure 19 illustrates the compression that is available to South Wales in a circular format. The left-hand chart is the current compressor reliability. The outer ring indicated that 100% of the Network Capability can be assumed available 271 days and the eighth ring indicates that 30% of Network Capability is available for the full 365 days, given reliability and maintenance needs. The right-hand chart shows similar information except in a scenario where one Wormington compressor is excluded.

Figure 19 Example circular chart, showing compression availability in South Wales Zone with two or one compressors available at Wormington

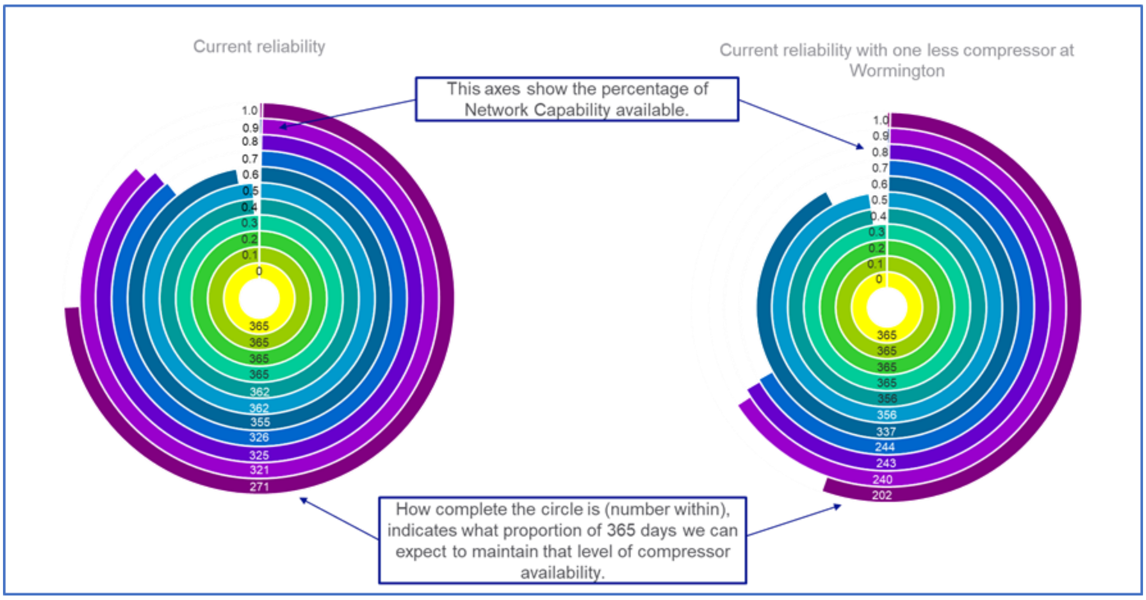


Figure 20 shows the same information as Figure 19 except in a more conventional histogram format. Therefore, the two left-hand bars illustrate that one can assume 100% of the capability is available on 271 days per year for the current compressor configuration and 202 days for the same configuration without a resilience unit at Wormington.

Figure 20 Example histogram showing compression availability in South Wales Zone with two or one compressors available at Wormington

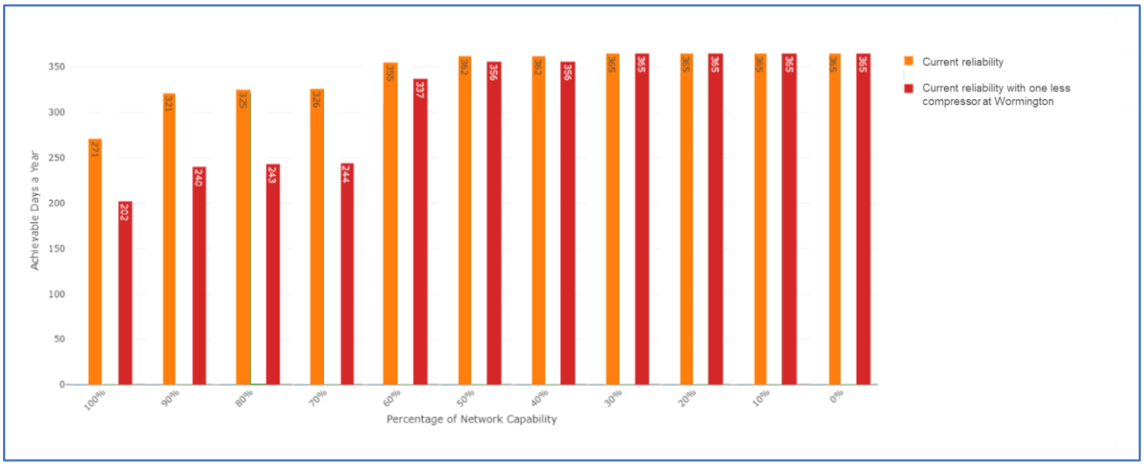
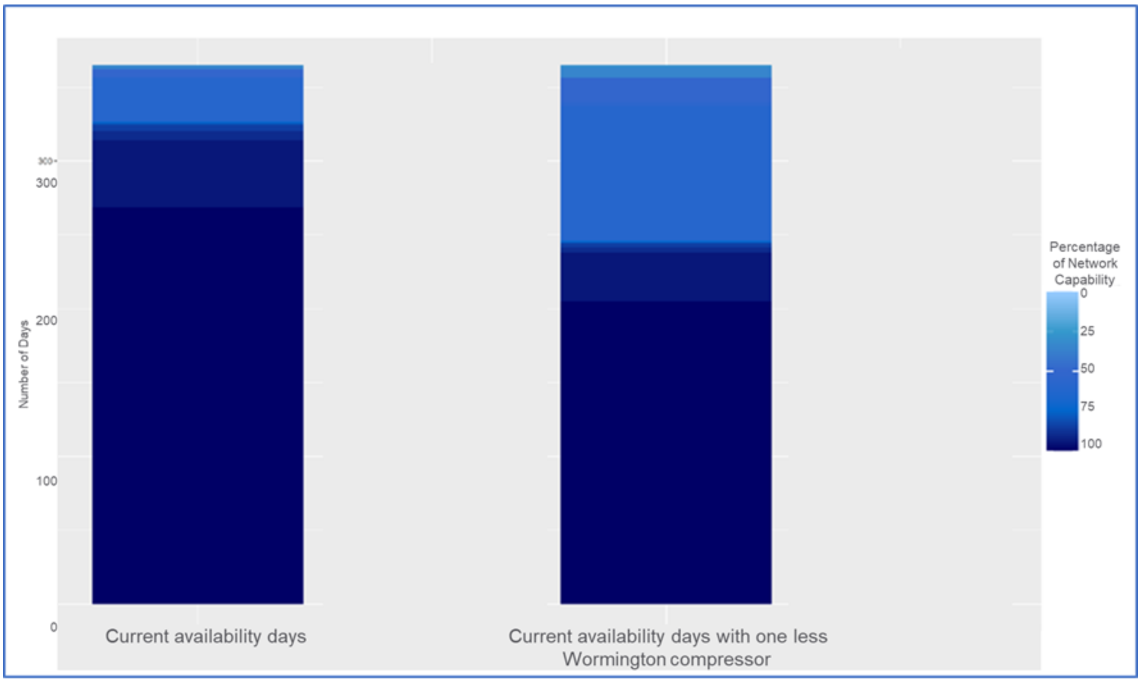


Figure 21 shows a third way of displaying the data but in more of a stacked histogram format.

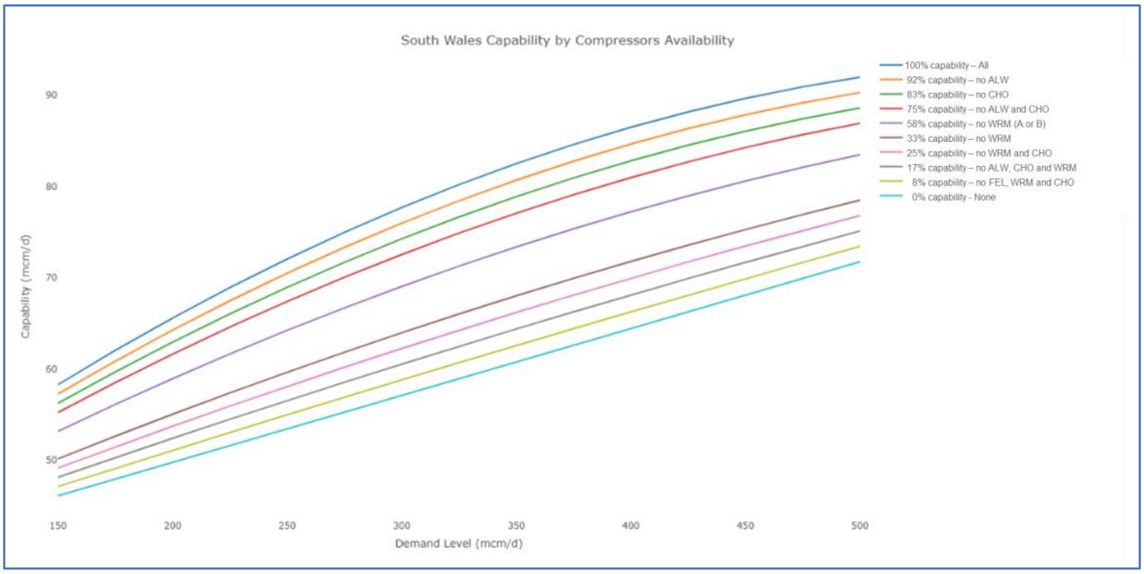
Figure 21 Example stacked histograms showing compression availability in South Wales Zone with or without a resilience compressor available at Wormington



The complexity of compressor outages and the impact these have on the capability of the network is something we are keen to share, but in a digestible format. With 71 compressors across the NTS, this is not always straight forward. How we eventually do this must complement the capability charts so that the increased risk of constraints associated with asset availability and changes to the provision of resilience can be understood.

Figure 22 attempts to show a simplified effect on the South Wales Zone with different compressor stations combinations unavailable. These lines are not as granular as showing the effects of the potential loss of individual compressor units; detailed analysis for all compressors and their interactions is very resource intensive, but it can be closely approximated for illustration purposes.

Figure 22 Hypothetical data showing the potential effects on capability with the loss of compressor sites



6.2 1 in 20 values

The 1 in 20 Exit *Capability* is not exactly the same as the 1 in 20 *demand*, there are subtle differences in values. The Exit Capability is highly dependent on local supply flows. How much gas comes into an area of the system will affect how far gas flows throughout the network. If local gas supplies are low, then the volume of gas transported into that area to meet demand is increased. This means more compression is needed if local supply flows are low, and exit capability is also reduced.

We must make some assumptions for the appropriate supply flow rate when we conduct Exit Capability analyses. We currently assume local gas supplies are low and we do this so that we can manage a suitably challenging scenario of low supplies and high demand. This reduces the risk of us not being able to maintain the required system exit pressures when meeting an extreme event, under foreseeable circumstances, in line with our Pipeline Security Standard.

We could assume higher supply flows and so reduce our compressor requirement and increase capability, but this would increase the risk of the system not being to meet a 1 in 20 demand level should it coincide with lower local supply flows. How we assess the appropriate level of supply flow is something we would welcome discussions on.

6.3 Interzonal linepack movement

Interzonal linepack transfer capability has been raised as an important issue at our stakeholder meetings. This is because it is an essential part of the capability we use to operate the gas transmission network. It is not necessarily directly linked to any specific capacity requirements that our customers ask for. Active linepack movement is needed as flows are not always at a constant rate throughout the day. Facilitating changes to customer flows as they optimise their commercial position, in response to within day market and physical changes, is a key benefit of an integrated gas transmission network and driver of active linepack management.

Zonal transfer involves actively moving gas between zones to mitigate planned and unplanned changes to supply and demand profiles and may involve actively depleting the amount of gas in one zone to manage a risk in another. As such we have been investigating how to measure and define the need for this, but we are not yet at a stage where we can bring forward proposals for metrics in this area.

Our current charts do not reflect the need for zonal transfer capability. This means that some of the charts in this annex seem to indicate that capability is higher than stakeholder need. This applies in particular to the North East and North West Zones. However, the pipes and compressors in these zones are used for the bulk transportation of gas and movement of linepack from the zone in Scotland to the south and, as such, support both Scottish Entry Capability and southern Exit Capabilities.

We are actively considering what data stakeholders will find beneficial and how we can display it in an assessible manner, but it is a complex subject. Therefore, we do request any stakeholder, whom has views on the subject, to contact us with any suggestions on how we could advance these considerations (see also section 2.3).

7 Next steps

As has been suggested throughout this document we are keen to hear stakeholders' comments on the following:

The capability of the network:

- What are the perceived implications of the network capabilities that have been presented in this annex?

The process:

- What level of supply flows should we assume when calculating our 1 in 20 values?
- What areas of network capability should we further develop to make the process more transparent?
- What additional network capability information, and at what granularity, should the ANCAR contain?

The document:

- How could this document be improved?
- How can we best display asset availability information that would be meaningful?
- How could we best display interzonal linepack movement?

We will be engaging with stakeholders at a variety of forums and bi-laterals; but we would also encourage suggestions to be submitted to: **Box.OperationalLiaison@nationalgrid.com**

Ultimately any feedback will influence the more detailed content of the ANCAR, which is due to be published in June 2021.