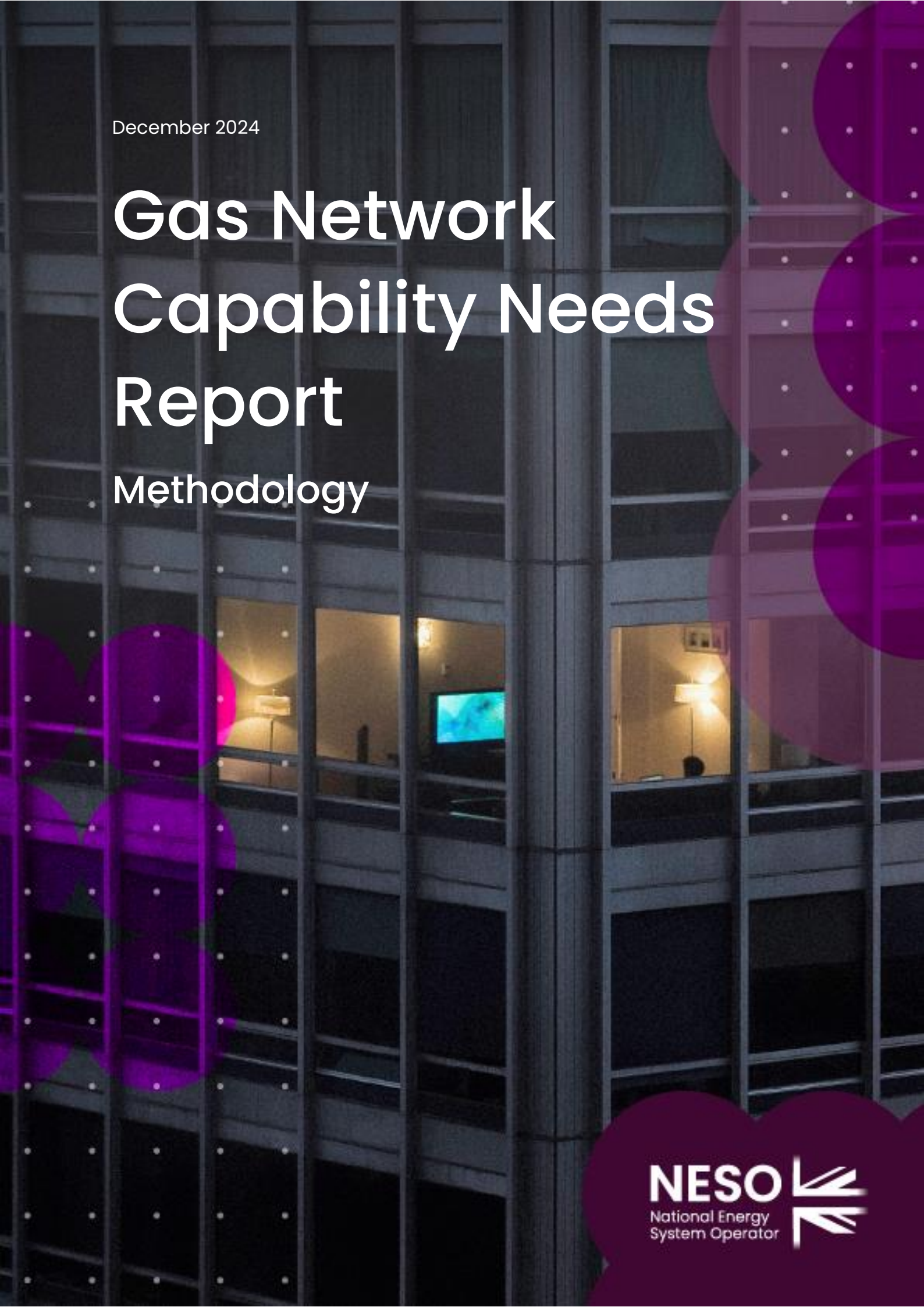


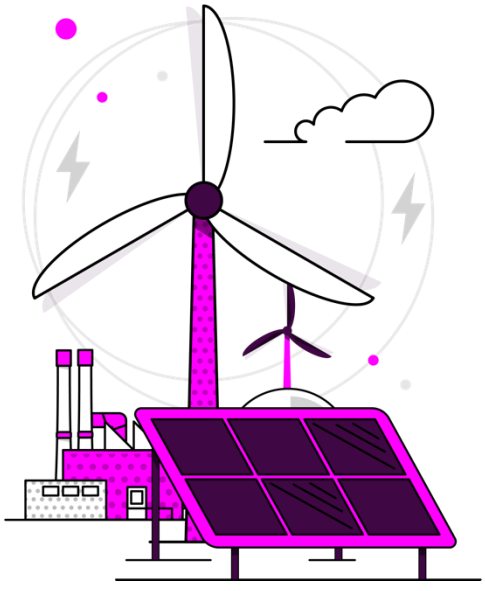
December 2024

Gas Network Capability Needs Report

Methodology

NESO
National Energy System Operator

Contents



Introduction

About our new licence condition

About the Gas Network Capability Needs Report

Introduction

The National Energy System Operator (NESO) is an independent, public corporation at the centre of the energy system taking a whole system view to create a world where everyone has access to reliable, clean, and affordable energy.

As a strategic advisor to the Office of Gas and Electricity Markets (Ofgem) and the Government, NESO's advice will be impartial, accelerating energy system decision making in the best interest for consumers. Our primary duties are:

Net Zero
Enabling the Government to deliver on its legally binding emissions targets.

Efficiency & Economy
Promoting efficient, co-ordinated and economical systems for electricity and gas.

Security of Supply
Ensuring security of supply for current and future customers of electricity and gases.

About our new licence condition

NESO now has a gas system planner licence[1] in addition to our electricity system operator licence. Within Annex G, condition C8 relates to gas strategic network planning of the gas National Transmission System (NTS).

The NTS is made up of around 7,660 km of pipeline, 24 compressor sites, 8 gas terminals and over 350 above ground installations, and is owned and operated by National Gas Transmission (NGT).

As NESO, we have taken on certain responsibilities in respect of planning the NTS which has been set out in our Independent System Operator and Planner licence.

This document sets out the methodology used to produce the Gas Network Capability Needs Report (GNCNR), which is one of our new licence obligations.

[1] assets.publishing.service.gov.uk/media/66e1baa93b0c9e88544a0052/gsp-licence-terms-and-conditions-decision.pdf

About the Gas Network Capability Needs Report

The GNCNR is a gas strategic network planning responsibility for NESO, as per licence conditions where we are required to present our view of physical network capability and needs for the NTS in relation to the natural gas supply and demand from the Future Energy Scenarios (FES) 2024 net zero pathways and the Counterfactual[2] every two years.

The first GNCNR published by the end of 2024, outlines the network capability on the NTS in relation to the natural gas supplies and demands from the FES 2024 pathways the Counterfactual. Based on the GNCNR, NGT will develop Strategic Planning Options Proposal (SPOP). NESO will then review and report on these options in a Gas Options Advice Document (GOAD), which will be provided to Ofgem and the NTS System Operator at the end of 2025.

Prior to publication, a draft was provided to Ofgem for their review. Additionally, we have collaborated closely with key stakeholders and will continue to do so to ensure that important insights are shared in advance for their review and consideration. We have also actively worked with NGT and will maintain this collaboration to ensure that the outputs from the document align with their gas network planning process stages.

[2] neso.energy/publications/future-energy-scenarios-fes

NESO GNCNR methodology

- Stakeholder engagement
- Modelling principles
- Modelling methodologies
  - Supply and demand forecasting
  - Flame charts
  - Network analysis
    - Entry capability
    - Exit capability
    - High resilience capability
- Publication

NESO GNCNR methodology

The GNCNR is intended to inform the industry of the current capability of the NTS and to compare this to the markets' future needs for NTS capability. In this context, capability relates to the maximum amount of gas that the network can physically flow at specific locations without going outside any of its pressure obligations, or equipment's safe operational tolerances.

The scope of the GNCNR is similar to the scope of NGT's Annual Network Capability Assessment Report (ANCAR) which was a report stating current and future capability requirements of the NTS. We have reviewed the methodology used by NGT for producing the ANCAR and changed some elements in producing this methodology. The changes are intended to provide greater transparency on the results of the analysis.

We will continue to review the GNCNR methodology for future iterations of the report.

Stakeholder engagement

Stakeholder engagement is used throughout the gas network planning process. As we have carried out our analysis and developed the GNCNR, we have engaged with stakeholders across three categories to best suit their anticipated needs, as shown in Figure 1.

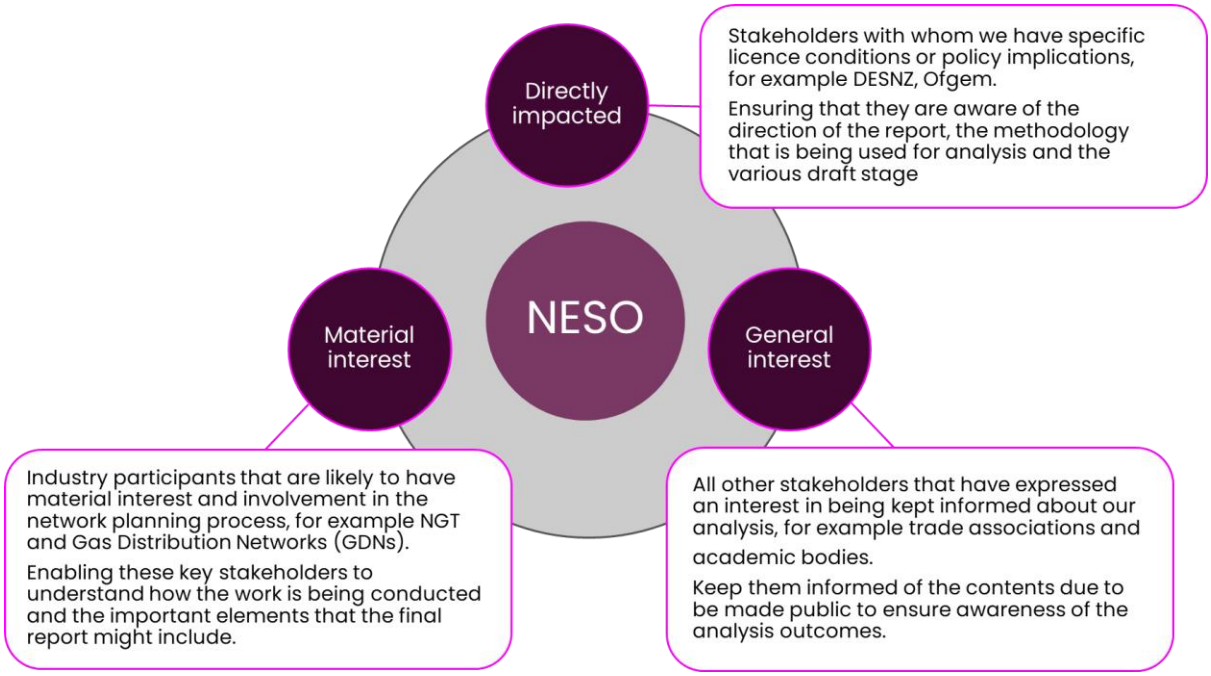


Figure 1 Stakeholder categories

Modelling principles

At NESO, we use a software called SIMONE, provided via LIWACOM[3], to analyse the gas network. SIMONE can simulate complex gas transmission networks under different conditions for both steady state (constant timing known as end of day rate) and transient (varying time known as within day profiling). It helps us understand how the network performs. This analysis is crucial for planning the current and future needs of the gas network.

NTS capability is defined as either physical entry capability (the amount of gas that can be supplied into NTS) or exit capability (amount of gas that can be delivered off NTS to customers), to analyse this the NTS is split into zones (shown in Figure 2).

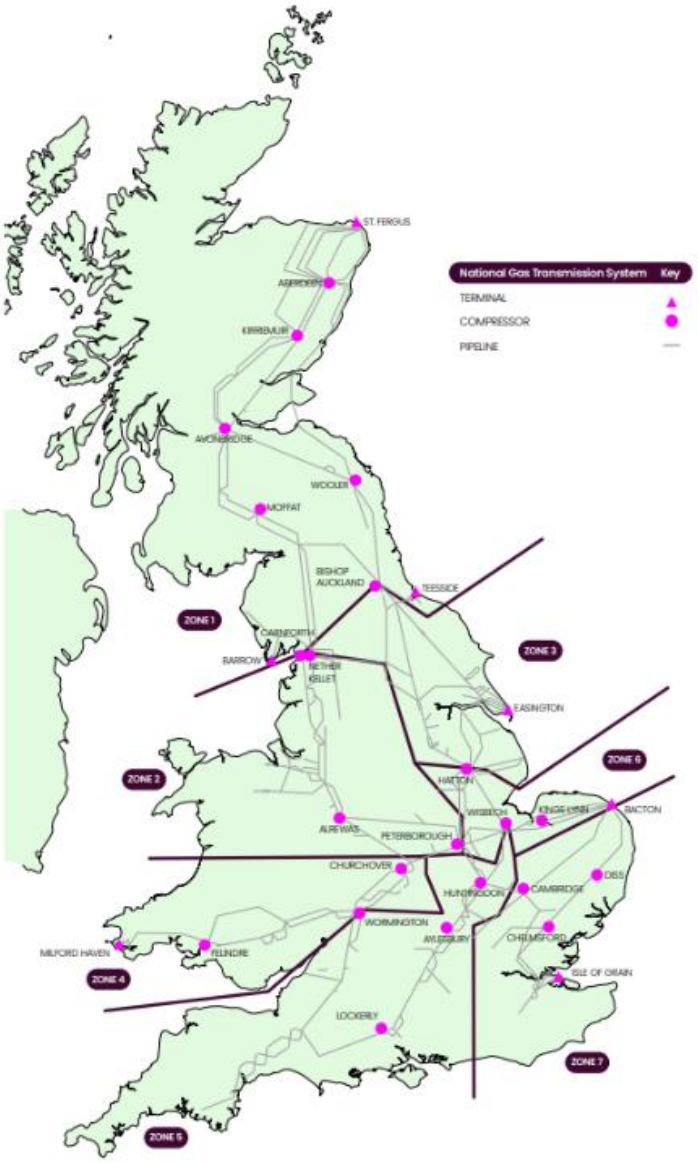


Figure 2 NTS map split into RIIO Zones

[3] liwacom.com/index.php

The zones are defined by NGT as per the obligations to their licence[4]. The definition of these zones can be changed by NGT but only where the change is approved by Ofgem. They are generally referred to as 'RIIO Zones'. NGT's licence conditions result in NGT having commercial entry and exit flow obligations which, if they cannot be met, could be potentially managed through commercial actions, where appropriate. Commercial actions are the rules and tools available to NGT via its licence condition for entry and exit constraint management. The potential requirements for commercial action can be estimated using these RIIO Zones.

In addition, there is also a requirement for NGT to design the NTS as stated in their Transmission Planning Code (TPC) [5], where entry and exit capability gaps on the NTS will be further assessed as part of the GOAD process via NGT's SPOP submission.

[4] https://www.ofgem.gov.uk/sites/default/files/2023-04/National%20Gas%20Transmission%20Plc%20-%20NTS%20-%20Consolidated%20Special%20Conditions%20-%20Current%20Version.pdf
[5] nationalgas.com/sites/default/files/documents/TPC%202023%20v0.4.pdf

Modelling methodologies

Supply and demand forecasting

A key element in the gas network planning process is forecasting future customer-led flows of gas onto and off the NTS. It is these flows against which the capability of the NTS is assessed. The future supply and demand of gas is uncertain, especially with the goal of achieving a secure network while meeting net zero carbon targets in a cost-effective way.

The starting point for the forecasts is the FES. The FES 2024 net zero pathways and the Counterfactual were used to provide four separate views of supply and demand across Great Britain for each year from now until 2050.

We created a range of possible supplies and demands based on each of these four views. This range considered uncertainties such as weather, the day of the week and historical data. This helped us determine the credible supplies and demands for the NTS for each year, against which we assessed capability needs.

The four datasets from FES 2024 are the three pathways which meet net zero by 2050 and the Counterfactual which does not meet net zero by 2050. We modelled each of these separately to identify the different NTS capability needs.

Flame charts

To illustrate the capability needs within each network zone, we created flame charts. These charts utilised data from our network analysis to showcase the network's capability across various national demand levels within each zone. Additionally, we incorporated possible supply and demand data, derived from FES 2024 pathways and the Counterfactual, for each network zone.

The flame charts demonstrate the network capability for two conditions: an intact network, where all compressors are available for use, and a condition where some compressors are unavailable. The methodology employed by NGT to develop these 'resilience' capabilities was utilised. Figure 3 shows an example of a flame chart.

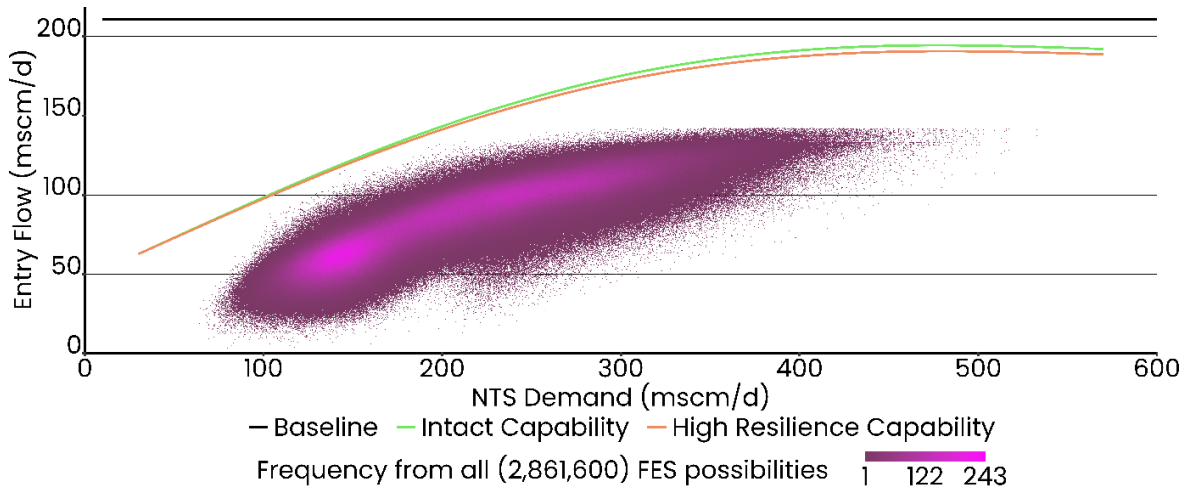


Figure 3 Example of draft flame chart with NESO data

To enhance understanding regarding the network's capability to meet a range of supply and demand forecasts, we presented the supply and demand data separately for the FES 2024 pathways and the Counterfactual. This approach aimed to provide a clearer understanding of the potential outcomes.

Network analysis

For the GNCNR, we analysed the physical capability of NTS entry and exit points in each RIIO Zone. The analysis varied because some zones do not have entry points, and in some cases, exit analysis alone is not meaningful. In North West and North East, we only assessed entry capacity. In South West and East Midlands, we only assessed exit capacity. For Scotland and the North, South Wales, and South East, we assessed both entry and exit capacities.

RIIO Zone			
Entry RIIO Zone	**NTS Area**	**Exit RIIO Zone**	**NTS Area**
1	Scotland and The North	**1**	Scotland and The North
2	North West	**4**	South Wales
3	North East	**5**	South West
4	South Wales	**6**	East Midlands
7	South East	**7**	South East

Table 1 Entry and exit capability RIIO Zones

The types of network analysis that were undertaken within GNCNR were as follows:

1. Entry capability: assessment on physical entry capability of relevant NTS RIIO Zones.
2. Exit capability: assessment on physical exit capability of NTS RIIO Zones.
3. Resilience: assessment of impact on NTS capability if only a subset of compressor units was available. This subset was chosen to have a 99% probability of being available.

To ensure a consistent approach to the network analysis, the following assumptions were considered:

1. Supply/demand scenarios:
   1.1. Peak day, high winter, average winter, and summer demand days were assessed to ensure a wide range of scenarios are analysed.
   1.2. High methane FES scenario for assessing maximum NTS capability, with flame charts being produced for all FES 2024 net zero pathways and the Counterfactual.
2. Entry and exit rebalancing to analyse RIIO Zone sensitivities complying with NGT's network analysis assumptions, where deemed appropriate that are shared annually with NESO, as per new licence conditions[6].

[6] https://www.ofgem.gov.uk/sites/default/files/2023-04/National%20Gas%20Transmission%20Plc%20-%20NTS%20-%20Consolidated%20Special%20Conditions%20-%20Current%20Version.pdf

3. All other network analysis assumptions and tools supplied by NGT as per new licence conditions.

Entry capability

Entry capability is the assessment to understand the physical amount of gas that can enter the NTS within a RIIO Zone.

We assessed the maximum physical capability of a RIIO Zone for each supply/demand scenario day to create a capability curve. This curve was then compared to supply and demand forecasts, known as flame charts, to identify potential constraint days. A constraint day occurs when supply or demand exceeds the physical NTS capability.

Exit capability

Exit capability was the assessment to understand the physical amount of gas that can leave the NTS within a RIIO Zone.

We assessed the maximum physical capability a RIIO Zone can deliver for each supply/demand scenario day to create a capability curve. This curve was then compared to supply and demand forecasts.

The capability curve was then assessed against supply and demand forecasting known as flame charts that can analyse the potential amount of constraint days, where a constraint was determined as a supply/demand day that is above the physical NTS capability.

High resilience capability

High resilience capability analysis involves assessing the maximum physical entry and exit capacity a RIIO Zone can deliver for each supply/demand scenario day, using a subset of compressors needed for full availability. This subset was calculated using the mathematical combinations technique and probability theory. Once determined, the units from the zone were assessed based on individual unit and station availability.

The subset of units was selected based on the following rules in the stated order:

1. All units at compressor stations with overall station availability less than 50% were considered unavailable.
2. High availability (or reliability) units were selected first up until subset total is reached.
3. Where possible, at least one unit from each compressor station was to be selected. It may not be possible all the time if the subset was reached by selecting higher availability units from other stations or overall station availability is low.
4. Priority was given to units in compressor stations with higher availabilities where a choice was to be made between two units of the same availability.

This capability curve was analysed in the same entry or exit capability flame chart that can analyse the potential amount of constraint days, where a constraint was determined as a supply/demand day that is above the physical NTS capability (as shown in Figure 3).

Publication

Our licence requires us to publish the GNCNR by the end of 2024, and every other year thereafter. Alongside the GNCNR we also published a data workbook to make all relevant modelling data as transparent and accessible as possible.

Glossary

Acronym	Description
ANCAR	Annual Network Capability Assessment Report
FES	Future Energy Scenarios
GNCNR	Gas Network Capability Needs Report
GOAD	Gas Options Advice Document
ISOP	Independent System Operator and Planner
Ofgem	Office of Gas and Electricity Markets
NESO	National Energy System Operator
NGT	National Gas Transmission
NTS	National Transmission System
RIIO	Revenue = Incentives + Innovation + Outputs
SIMONE	Simulation and Optimization on Networks
SPOP	Strategic Planning Options Proposal
TPC	Transmission Planning Code

Contact details

For further information, queries and views relating to gas network planning, please contact us via email at box.gas.networkplanning@nationalenergyso.com and one of our team members will be in touch.

National Energy System Operator
Faraday House
Warwick Technology Park
Gallows Hill
Warwick
CV34 6DA

box.gas.networkplanning@nationalenergyso.com

www.neso.energy