

April 2026

Centralised Strategic Network Plan

Methodology



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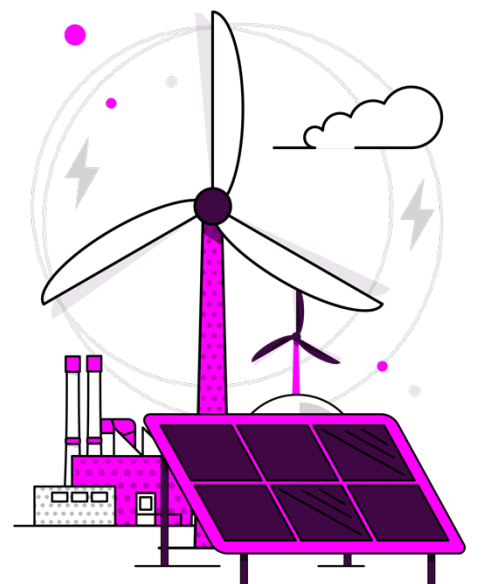
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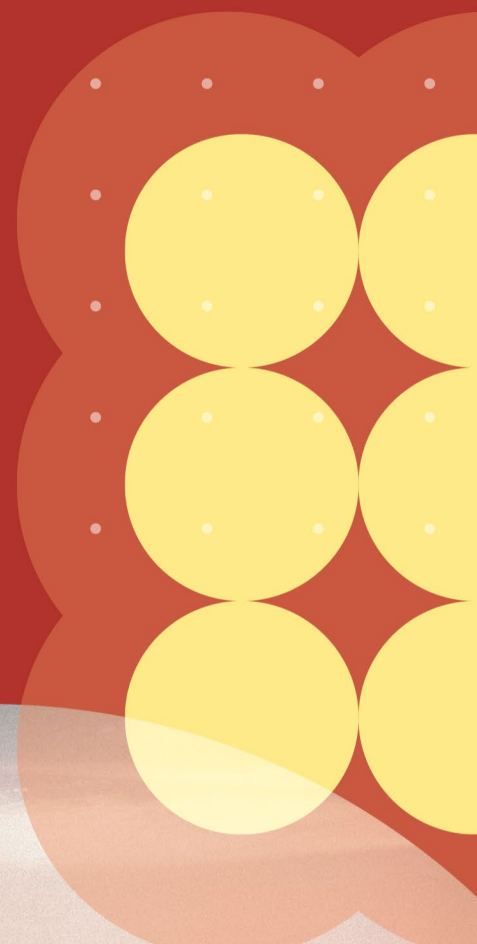
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1. Section 1: Introduction

Executive summary

Structure of this document





Executive summary

The Centralised Strategic Network Plan (CSNP) will provide an independent, long-term approach to energy network planning, which will support Great Britain (GB) in delivering a clean, affordable and secure energy system.

This is a groundbreaking approach, as for the first time in GB, a single framework will propose the transmission energy networks of the future. This is a whole-system perspective, one we are uniquely placed to deliver, that strategically considers where energy is being generated and the interactions between electricity, gas (methane) and hydrogen networks.

NESO is responsible for whole energy system planning. Whole energy system planning means planning systems together to ensure interactions are captured, for an efficient, cost-effective and rapid transition to net zero rather than planning components like overhead power lines or gas pipes separately. Through NESO's Spatial Strategic Energy Plan (SSEP) and then the CSNP, we will plan strategically, allowing for the integration of different energy sources and technologies in the future, enhancing the resilience of the network. This coordinated approach also creates clearer, more coherent investment frameworks, contributing to economic growth, energy security and a sustainable energy future.

In the past, GB's energy transmission networks – the energy 'motorways' – have been planned separately. In the future, a decarbonised energy system could see electricity and hydrogen networks working closely together. Sometimes, electricity could be used to make hydrogen, and at other times, hydrogen could be used to make electricity. This means both systems should be planned together, which is a key part of the SSEP¹. The gas network will also remain important, helping to secure electricity supplies and acting as a supply to the hydrogen system, as well as continuing its traditional role in keeping us warm at home and serving industries.

As part of our strategic planning² role, the CSNP builds on the SSEP. It is the role of the CSNP to identify the energy networks needed to transport this energy.

As GB progresses towards its decarbonisation targets and to enable future economic growth, major investment is needed across its energy networks. The CSNP will ensure our network planning approach is appropriate given the level of change anticipated. It will build on existing plans and provide a 25-year independent view of network requirements, accelerating delivery of the energy transmission networks that GB requires.

In this methodology, we present our approach. By its nature, it is detailed and uses technical language to explain our approach accurately.

¹ NESO, [neso.energy/what-we-do/strategic-planning/strategic-spatial-energy-planning-ssep](https://www.neso.energy/what-we-do/strategic-planning/strategic-spatial-energy-planning-ssep)

² NESO, [neso.energy/what-we-do/strategic-planning](https://www.neso.energy/what-we-do/strategic-planning)



This document covers the planning of the wider onshore and offshore electricity transmission networks including cross-border (international) electricity interconnectors, the gas transmission system and the future hydrogen transportation and storage systems.

This methodology applies a consistent approach across the three energy networks using the following steps:

- **Drive** – The CSNP will use analysis from the SSEP to plan the energy networks required to transfer electricity, gas and hydrogen. This analysis is based on the selected pathway chosen by the UK Secretary of State for Energy Security and Net Zero³ and will be supplemented with the Future Energy Scenarios (FES)⁴ supply and demand projections for gas planning.
- **Identify** – The CSNP will provide a view of the current capability and future needs of the networks to inform network options development for each energy type.
- **Develop** – Considering the system requirements for each network, a range of reinforcement options will be identified and proposed by network owners, NESO and broader parties, as appropriate.
- **Appraise** – Options will be assessed across multiple assessment criteria to determine the best GB network design for each energy type. Required network reinforcements will progress into the delivery phase.
- **Deliver** – A draft plan will be published for public consultation with the environmental assessments. This will provide an opportunity for stakeholders to shape the final CSNP. After the draft plan has been consulted on, it will be refined again using the feedback received. The final plan will be submitted to the Office of Gas and Electricity Markets (Ofgem⁵) for approval before being published. Following publication of the CSNP, the required reinforcements will progress through detailed design, consenting and delivery stages. An ongoing change control process will ensure delivery in line with the plan (applicable for electricity and gas networks).

While a whole-system perspective is essential, the technical requirements and scale of transformation will vary across different energy systems. These differences will shape the specific planning expectations and are explained in the different sections in this document.

Our approach to delivering the CSNP includes extensive stakeholder engagement and will be overseen by a multi-tiered governance approach which includes GB transmission licensed parties, industry experts, government (central and devolved) and Ofgem.

³ UK government, [gov.uk/government/ministers/secretary-of-state](https://www.gov.uk/government/ministers/secretary-of-state)

⁴ Ofgem, Future Energy Scenarios are called Future Energy Pathways in licence conditions C15 of the Electricity System Operator Licence and C10 of the Gas System Planner Licence: [ofgem.gov.uk/sites/default/files/2024-03/Annex%20E%20-%20Electricity%20System%20Operator%20Licence%20Conditions.pdf](https://www.ofgem.gov.uk/sites/default/files/2024-03/Annex%20E%20-%20Electricity%20System%20Operator%20Licence%20Conditions.pdf)

⁵ Ofgem, [ofgem.gov.uk/about-us](https://www.ofgem.gov.uk/about-us)



Structure of this document

An overview of the structure of the CSNP methodology is provided, describing the content and purpose of the key features of the document.

This document is structured into six sections.

Section 1 – includes the **executive summary** and provides an explanation of the document structure.

Section 2 – outlines the **common high-level framework** undertaken across our strategic network planning activities. It defines the principles and processes that will be applied to generate the CSNP. There are technical reasons why there could be different approaches for each energy network and, where this is the case, these differences are highlighted.

Section 3 – describes the **methodology for electricity transmission** which will identify, support and enable regulatory approvals to accelerate network delivery.

Section 4 – explains the **methodology for planning the gas transmission network**, which accommodates our existing gas transmission network planning methodology.

Section 5 – sets out the approach that we propose to adopt for planning the **hydrogen transport and storage system**.

Section 6 – provides an overview of the **consultation, refinement and publication** of the final CSNP.

The **appendices** to this document expand on the sections with relevant contextual information, reasoning and references.

2. Section 2: CSNP

Methodology

Planning the future energy networks

Methodology steps

Governance of the CSNP

Stakeholder engagement

Environmental assessments

Plan timelines

Status of the methodology





Planning the future energy networks

CSNP is one of our strategic energy plans, setting out the future of GB's energy networks. This chapter sets out the legislative framework which underpins our role in whole system energy planning. We set out the purpose and aim of the CSNP.

Legislative framework and our primary duties

The Energy Act 2023⁶ set the legislative framework for an independent system operator and planner to help accelerate GB's energy transition, leading to the establishment of the National Energy System Operator (NESO).

Our duty, set out in the Energy Act 2023, describes the need for us to consider the impact on the wider energy system when carrying out our planning activities. This involves not just the systems described in the Gas Act 1986⁷ and the Electricity Act 1989⁸, but more broadly, including "an activity that is connected with the production, conveyance, storage or supply of energy".

We are an independent public corporation at the centre of the energy system and take a whole-system view to guide GB to a future where everyone has access to reliable, clean and affordable energy.

Our primary duty⁹ is to promote three objectives:

- **Efficiency and the economy** - promoting efficient, coordinated and economic electricity and gas networks.
- **Net zero** - enabling the UK government to deliver on its legally binding emissions target.
- **Security of supply** - ensuring security of supply for current and future consumers of electricity and gas.

We also must have regard to the facilitation of competition and innovation and consider impacts on consumers and the whole system.

⁶ UK government, legislation.gov.uk/ukpga/2023/52

⁷ UK government, legislation.gov.uk/ukpga/1986/44/contents

⁸ UK government, legislation.gov.uk/ukpga/1989/29/contents

⁹ NESO, neso.energy/what-we-do

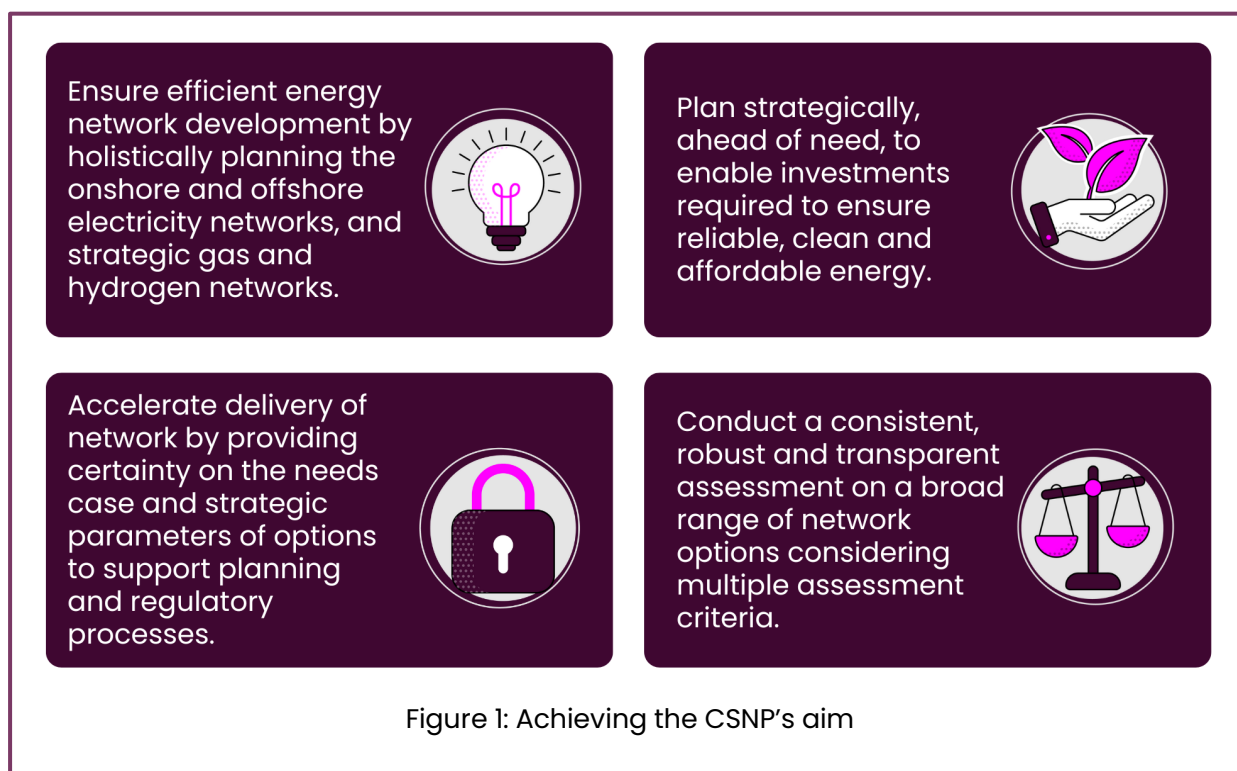


We operate under both the Electricity System Operator (ESO) licence and the Gas System Planner (GSP) licence. This CSNP methodology has been developed in line with both ESO licence condition C17¹⁰ and GSP licence condition C12¹¹.

Throughout the course of developing and delivering the CSNP, where relevant, we will also work with stakeholders to ensure we consider how our activities affect people with different protected characteristics. We will have due regard to the objectives of the Public Sector Equality Duty¹², ensuring we reflect on its objectives where required.

Aim of the CSNP

The aim of the CSNP is to deliver a whole-system view of electricity transmission, gas transmission and hydrogen transportation and storage systems. It will provide a 25-year blueprint of where the network infrastructure will be needed to transport energy around GB.



The CSNP will consider the anticipated changes of each network as the energy transition continues. It will be updated every three years, balancing the needs of consumers, investors, communities and the environment. The CSNP will provide details on specific

¹⁰ Ofgem, [ofgem.gov.uk/sites/default/files/2024-03/Annex%20E%20-%20Electricity%20System%20Operator%20Licence%20Conditions.pdf](https://www.ofgem.gov.uk/sites/default/files/2024-03/Annex%20E%20-%20Electricity%20System%20Operator%20Licence%20Conditions.pdf)

¹¹ Ofgem, [ofgem.gov.uk/sites/default/files/2024-03/Annex%20G%20-%20Gas%20System%20Planner%20Licence%20Conditions.pdf](https://www.ofgem.gov.uk/sites/default/files/2024-03/Annex%20G%20-%20Gas%20System%20Planner%20Licence%20Conditions.pdf)

¹² UK government, [gov.uk/government/publications/public-sector-equality-duty-guidance-for-public-authorities/public-sector-equality-duty-guidance-for-public-authorities](https://www.gov.uk/government/publications/public-sector-equality-duty-guidance-for-public-authorities/public-sector-equality-duty-guidance-for-public-authorities)



projects and will show geographical areas where transmission network infrastructure is needed in GB.

For electricity, it will consider the onshore and offshore transmission networks needed, including cross-border interconnectors and offshore hybrid assets. In line with Ofgem's Decision Document¹³ and the Transmission Acceleration Action Plan (TAAP)¹⁴, the CSNP will provide certainty on why the network investment is required, streamlining regulatory approvals and accelerating network delivery. Timely delivery of projects will enable generation and demand customers to connect to the network quickly and will help ensure consumer energy costs are efficient.

For gas, whilst the gas transmission network is not expected to grow significantly, National Gas Transmission (NGT) is required to maintain the network pursuant to its safety case. The CSNP aims to ensure clarity and transparency on relevant asset investment decisions. If there is a need or an opportunity to repurpose gas transmission assets to hydrogen duties, these will be considered in the CSNP.

For hydrogen, the CSNP will provide an understanding of the options that deliver the hydrogen infrastructure that might be required by the nascent hydrogen market, mindful of the strategic requirements for the whole energy sector. The early stages of developing hydrogen systems in GB will involve specific government support mechanisms across the vertical hydrogen supply chain, so decisions on providing support will be made by the UK government through the relevant hydrogen business models.

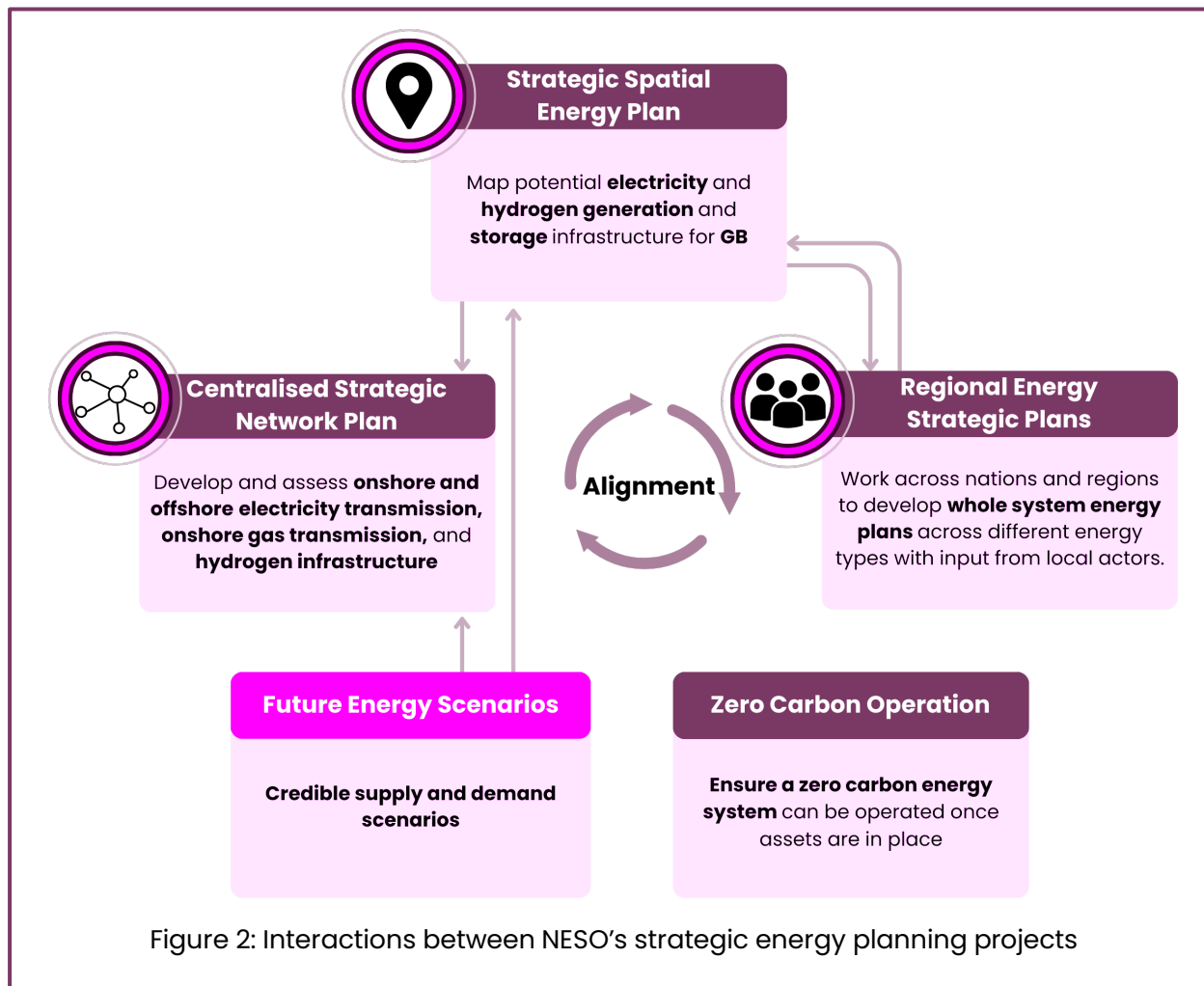
¹³ Ofgem, [ofgem.gov.uk/decision/decision-framework-future-system-operators-centralised-strategic-network-plan](https://www.ofgem.gov.uk/decision/decision-framework-future-system-operators-centralised-strategic-network-plan)

¹⁴ UK government, [gov.uk/government/publications/electricity-networks-transmission-acceleration-action-plan](https://www.gov.uk/government/publications/electricity-networks-transmission-acceleration-action-plan)



Our role in whole energy system planning

We are delivering integrated Strategic Energy Planning (SEP) outputs, which, when combined, will form a set of activities each taking place every three years to create a whole-system energy plan for GB, as shown in Figure 2.



The integrated SEP outputs will lead to three core outputs, delivering the following:

- The SSEP¹⁵ which will provide more certainty on the location of electricity and hydrogen generation and storage infrastructure based on demand projections provided by the UK government's Department of Energy Security and Net Zero (DESNZ), while accounting for complex system interactions and trade-offs across location, utility, impact, time and certainty. As a primary input into the CSNP, the SSEP will assess trade-offs between different energy types, allowing the CSNP to focus solely on how energy needs to be transferred across GB.
- The Regional Energy Strategic Plans¹⁶ (RESPs) which will bring together nations and regions to develop a shared view of how the distribution energy systems should

¹⁵ NESO, neso.energy/what-we-do/strategic-planning/strategic-spatial-energy-planning-ssep

¹⁶ NESO, neso.energy/what-we-do/strategic-planning/regional-energy-strategic-planning-resp



evolve to meet local priorities and national objectives. Through enabling whole-system planning, RESP will support investment in distribution level infrastructure.

- The CSNP which will use data from the SSEP, Future Energy Scenarios (FES)¹⁷, RESPs and relevant industry stakeholders. The CSNP will be a network plan with specific information released for stakeholders across the three-year cycle to support the final publication. It will look at the long-term future of the networks and make decisions now, instead of building incrementally without a long-term plan benefiting consumers as GB moves to net zero.

The CSNP, SSEP and RESPs will also interact with, and consider wider policies, regulations and planning frameworks set at national, regional and local levels.

Our SEP outputs are underpinned by our ongoing Zero Carbon Operation¹⁸ strategy, which is set out in the annual Operability Strategy Report¹⁹. This ensures that our SEP outputs, combined with other planning activities, deliver the necessary capability to operate the GB transmission system into a clean power system now and towards a net zero future.

NESO manages these programmes through our internal governance frameworks. Where there is a material impact of another programme to the CSNP, this will be flagged through the CSNP governance and appropriate communication mechanisms.

NESO's role in overall security and resilience of the energy system

NESO has a critical role in overall security and resilience of the energy system. We provide whole-system coordination and analysis to strengthen system resilience across GB's energy industry. We identify threats and vulnerabilities and undertake assessments to support a secure, resilient and adaptable energy system. The Critical National Infrastructure²⁰ (CNI) framework aims to improve the security and resilience of the most important parts of the energy system.

These frameworks, alongside other design standards, set the basis for how options should be designed in the CSNP.

Any changes to the CNI or broader resilience frameworks will be considered as part of the next CSNP cycle where applicable. Any changes within a CSNP cycle will be considered within CSNP governance, as to whether it is possible to adopt them sooner and consider the impact that changes would have on the CSNP timescales.

Future expected needs case of the networks

We expect future energy demand to rise to support economic growth and enable continued decarbonisation for electrifying aspects of our everyday life, such as heating, transport and industry. This creates an even greater need for clean electricity. To enable

¹⁷NESO, [neso.energy/publications/future-energy-scenarios-fes](https://www.neso.energy/publications/future-energy-scenarios-fes)

¹⁸ NESO, [neso.energy/energy-101/net-zero-explained](https://www.neso.energy/energy-101/net-zero-explained)

¹⁹ NESO, [neso.energy/publications/system-operability-framework-sof](https://www.neso.energy/publications/system-operability-framework-sof)

²⁰NPSA, [npsa.gov.uk/about-npsa/critical-national-infrastructure](https://www.npsa.gov.uk/about-npsa/critical-national-infrastructure)



this transition, the electricity transmission network will require significant investment to ensure power can get from areas where it is generated to where it is used.

Whilst the electrification of heating will drive lower volumes of gas, the electricity system will continue to have some reliance on gas-fired power generation to ensure security of electricity supply for years to come. New technologies, such as carbon capture and storage (CCS), enabled gas-fired generation and hydrogen production using thermal reformation techniques, will also continue to rely on the gas network to some extent. Although the gas network is not expected to expand to accommodate demand increases, it might be required to ensure security of supply for gas supplies to penetrate into the network where local demand diminishes.

Decarbonisation will require an increase of low-carbon hydrogen above the current levels, although the volumes are still uncertain. There are clear use cases in specific heavy industries and the potential for it to play a role in producing high temperature heat. Beyond this, hydrogen could be an important form of whole-system flexibility. Hydrogen can be produced via electrolysis, when there is an abundance of renewable power generation, stored and then used to produce electricity flexibly when other sources of clean power generation are unavailable. In this role, particularly where energy storage is required over longer timescales such as between seasons, hydrogen could offer significant value to the whole energy system.

These disparate but connected situations require complex, strategic planning across GB to determine how to expand the wider capability of the network and ensure access to reliable, clean and affordable energy for all consumers.

The requirements of the electricity, gas and hydrogen networks will change as we use energy differently to meet future energy needs. Overall, we expect that:

- **Electricity networks will need to continue to grow.** There is a significant increase in the amount of zero-carbon electricity that needs to be generated and transported across the network to reach net zero by 2050²¹, as outlined in FES²² and the Climate Change Committee's Progress in Reducing Emissions Report²³. As outlined in our previous network plans, Clean Power 2030²⁴ and Beyond 2030²⁵, it is likely that more investment will be required to meet this change.
- **The use of the gas networks will change.** The use of methane gas for electricity, heating and industrial processes is expected to significantly reduce in the future. The priority of this network is one of safe operation whilst it is still required, and then a change in use to potentially hydrogen, biogas or carbon capture, usage and storage (CCUS). Additionally, there may be potential for non-gaseous uses for the network and where repurposing is not possible, network decommissioning could be considered.

²¹ Scottish Government 2045 net zero targets, [gov.scot/policies/climate-change/](https://www.gov.scot/policies/climate-change/)

²² NESO, [neso.energy/publications/future-energy-scenarios-fes](https://www.neso.energy/publications/future-energy-scenarios-fes)

²³ CCC, [theccc.org.uk/publication/progress-in-reducing-emissions-2025-report-to-parliament/](https://www.theccc.org.uk/publication/progress-in-reducing-emissions-2025-report-to-parliament/)

²⁴ NESO, [neso.energy/publications/clean-power-2030](https://www.neso.energy/publications/clean-power-2030)

²⁵ NESO, [neso.energy/publications/beyond-2030](https://www.neso.energy/publications/beyond-2030)



- **Hydrogen networks may begin to emerge.** There is currently no hydrogen network outside small private industrial examples. Hydrogen has the potential to play a key role in the net zero scenarios of the future, as a store of energy and as a fuel for industrial processes. The questions for hydrogen-specific planning are: how much network and storage are required? When is it needed? How much of this can be met by repurposing of gas network assets? How much brand-new network is required?

Role of the CSNP in whole energy system planning

We will produce a CSNP that covers GB's electricity transmission, gas transmission and hydrogen transportation and storage systems. The wider energy system, including distribution networks, heat networks, carbon capture, demand-side flexibility and consumer behaviours, is considered within the CSNP through the foundations that underpin the related strategic energy plans such as the SSEP and the RESP.

At the GB transmission level, which is the focus for the CSNP, there are some linked trade-offs across gas, hydrogen and electricity which need to be considered in planning. These are:

- interaction of hydrogen and electricity production and consumption
- interaction of gas and hydrogen pipelines
- interaction of gas and electricity
- other considerations for whole-system energy planning

Interaction of hydrogen and electricity production and consumption

The link between hydrogen and electricity system planning is complex. Traditionally, we use economic modelling tools that mimic the market's balance of supply and demand. Generation investment is identified and/or generation dispatched so that supply of electricity meets a demand, usually at the lowest overall cost. These models help predict or forecast electricity prices and identify the marginal generation technology for a specific period. Historically, demand has been considered as a fixed input to these models. However, in the future the electricity system will rely on renewable energy technology, such as wind and solar, which cannot be controlled in the traditional way.

Electrolysis, a way to produce hydrogen using electricity, might generate hydrogen when there is plenty of renewable energy. Additionally, hydrogen might be used as a fuel for electricity generation when renewable energy is not available. This creates a complex interaction between electricity and hydrogen systems in the economic modelling tools used to project investment needs across these systems.

The SSEP is the plan where these complex trade-offs are considered. The economic modelling that underpins the SSEP will consider the trade-offs between:

- electricity network and hydrogen network - moving the energy through space



- different hydrogen and electricity storage technologies - moving the energy through time
- different hydrogen production technologies - electrolysis and methane reformation
- flexible generation technologies, such as hydrogen-fuelled, carbon capture storage-enabled and fossil-fuelled

Interaction of gas and hydrogen pipelines

Our gas network planning activity considers whether the gas network is sufficient to meet the needs of consumers. It will work out if the gas network has sufficient entry or exit physical capability. Our plan will identify where the network needs to be bigger or could be reduced, although we will not be attempting to identify an optimal network sizing strategy. This is a complex topic that would need to consider the approach to, and costs of, decommissioning against the costs of maintaining the asset for gas duties or suspending the asset. We note that:

- Compared to other gas transmission assets, the costs of decommissioning pipeline assets are high, and the costs of maintenance are low.

There is no urgency to make decisions in this space, as there are credible pathways that see continued reliance on gas into the foreseeable future.

There might be opportunities for establishing hydrogen pipeline transportation systems through the repurposing of gas pipelines. Alongside proposals for new-build hydrogen pipeline systems, we will consider relevant opportunities and would expect relevant gas transporters (transmission and distribution) to propose options for developing hydrogen pipelines through repurposing gas pipelines. The impact of repurposing gas (methane) network to hydrogen would need to be considered in both the gas and hydrogen elements of the CSNP.

Interaction of gas and electricity

The economic modelling in the SSEP shows small changes in gas (methane) demand compared to the international market's overall and supply balance. Therefore, the SSEP does not include methane gas sourcing decisions in its economic modelling and uses fixed gas prices instead. The model assumes that an infinite volume of gas is available at the same price and that gas is infinitely flexible and completely reliable. Where appropriate, the reliability and flexibility of a gas consuming plant may be constrained.

Other considerations for whole energy system planning

All other elements of the whole energy system are indirectly integrated into our planning activities. For example:

- The electricity demand projections used as the basis for the SSEP include assumptions about heating electrification in buildings, which will have considered electricity distribution network costs. These are provided by DESNZ.
- Hydrogen demand projections from the selected SSEP pathway will be complemented by insights from industrial decarbonisation pathways, including transitions to other energy types, current gas-usage patterns, and site level data.

2. Section 2: CSNP Methodology



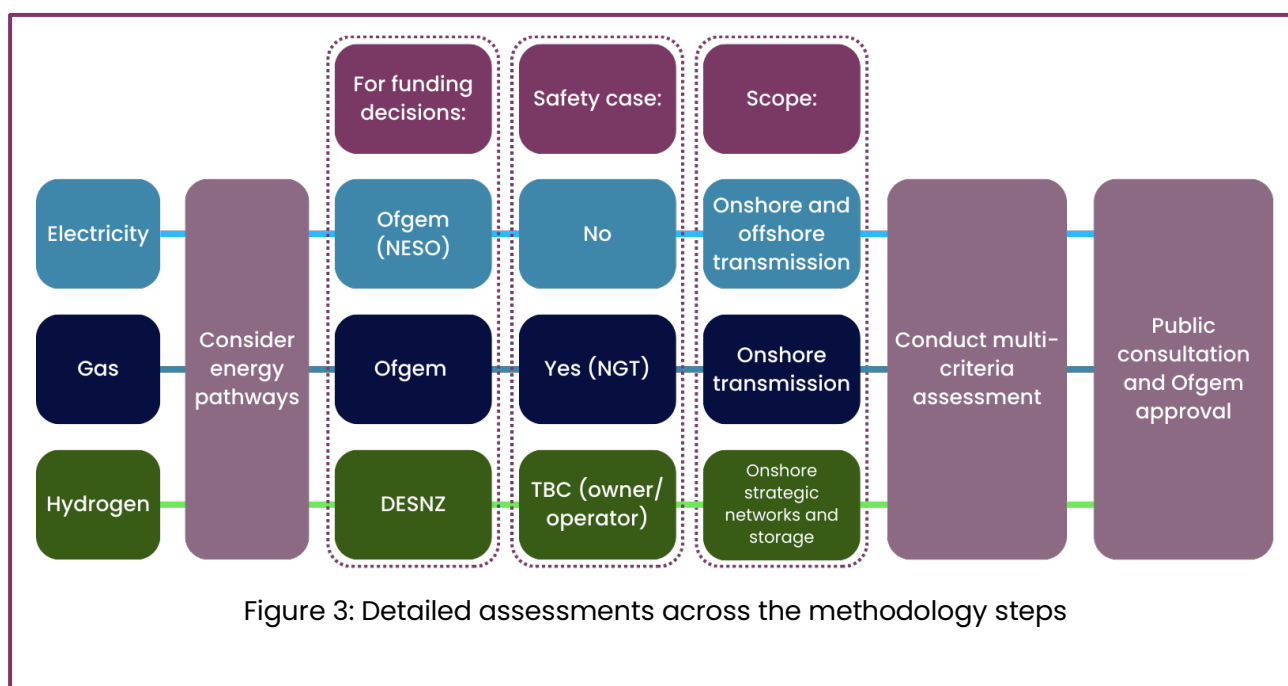
- Gas transmission network analysis assumes within-day gas profiles that reflect the agreed within-day patterns of offtake by gas distribution networks.
- FES considers developments in district heating networks and how they are fuelled, which feed through to FES gas demand projections.



Methodology steps

The CSNP methodology steps will enable successful delivery of the CSNP for electricity, gas and hydrogen, starting with Drive and finishing with Deliver.

Whilst a whole-system perspective is essential, the technical requirements and scale of transformation will vary across the energy networks, meaning the approaches taken within each step could vary across the energy types. This is outlined in Figure 3, which highlights how funding decisions, safety case requirements and scope are unique to the three networks.



Drive

For the CSNP to identify how the electricity transmission, gas transmission and hydrogen systems will need to evolve, the CSNP will use energy pathways to set the future requirements of the energy networks.

SSEP

The SSEP is a GB-wide plan, mapping potential zonal locations, quantities and types of electricity and hydrogen generation and storage. To support the energy transition efficiently and securely, the plan will be optimised for cost across demand and high-level network needs, as well as environmental, societal and other spatial interests. As the SSEP uses zones, not locations, it will not identify or recommend specific projects to be delivered. In the future, the SSEP's scope could broaden to incorporate other energy types.



The SSEP will provide the UK, Scottish and Welsh governments, and Ofgem, with a plan they can endorse. It will:

- provide a consistent strategic approach to spatial planning across GB that becomes part of the framework of planning systems across England, Scotland and Wales
- sit alongside government policy and, through further iterations, respond to future policy decisions and market-led interventions

The SSEP will firmly set the context for the nation's energy requirements. This will increase certainty and confidence for industry and investors by having a plan that considers societal and community voices and interdependencies earlier in the infrastructure development process.

FES

FES²⁶ explores strategic ways in which energy demand, supply and flexibility can develop out to 2050 to achieve GB's net zero target and enable economic growth. It considers the development of low-carbon technologies, exploring the impact on energy demand and supply alongside the role of flexibility and consumer engagement. The FES analysis is underpinned by an extensive programme of stakeholder engagement, incorporated in its outputs alongside analysis and research. It will also consider a wide range of potential high-impact, low-probability (HILP) events.

FES provides four separate views of supply and demand across GB out to 2050 through four datasets: three pathways which meet net zero by 2050 and one which does not meet net zero by 2050.

Pathway usage

For electricity and hydrogen, the SSEP pathway will be the central view that underpins infrastructure development supplemented by FES. For gas transmission planning, the aspects that will be included from SSEP are modelled gas demand for power generation and for hydrogen production, but with the wider supply and demand inputs driven by FES.

FES 2025's pathways extend from 2025 to 2050, while the SSEP will provide a pathway from 2030 to 2050. The CSNP time horizon considers both as inputs to develop a network plan. Where data is required beyond 2050, but the input data is limited, we will extrapolate ongoing costs and benefits beyond 2050 where necessary.

Identify

Using the energy pathways in the SSEP and FES, we will assess a range of future network requirements for the electricity, gas and hydrogen networks. This will be based on the pathways and will be undertaken through power flow analyses or gaseous hydraulic

²⁶ NESO, [neso.energy/publications/future-energy-scenarios-fes](https://www.neso.energy/publications/future-energy-scenarios-fes)



analyses, as appropriate, of expected future network conditions against different demand and weather conditions.

The analysis we undertake across all three energy types will consider factors including:

- the need for the networks to facilitate the bulk transfer of energy throughout the system
- the network's requirement to operate securely throughout the year based on different weather, supply, demand and market conditions
- the need to provide additional services such as:
 - stability and voltage needs on the electricity network
 - linepack (gas stored within pipelines by virtue of its pressure) on gaseous networks to facilitate compliance with the safety cases that are, or might be, required for gas transportation and any hydrogen networks

We will publish our system requirements to signal to stakeholders the future network requirements, against which options should be developed and submitted into the CSNP process.

Develop

The CSNP will depend on receiving a variety of options, which should be designed to meet the stated system requirements in different ways. These will then be assessed as part of the options assessment step of the methodology.

Options can be developed and submitted into the CSNP process by licensed transmission parties (for example, transmission owners for electricity, the NTS System Operator for gas), third parties and by NESO.

There are numerous ways to expand the future capability of the UK's energy networks. A range of options need to be considered, including, but not limited to, upgrades to the existing network infrastructure and new infrastructure. A summary of potential option types is outlined in Table 1. These will be identified by NESO, the licence owners and third parties.



Table 1: Potential types of options

Network option type	Description
Network management	Manage energy flows within the existing network, such as with electricity quadrature boosters, reactive compensation or by reconfiguring substations or by installation of flow control equipment or boundary pressure management systems on the gas system.
Network upgrades	Improve the capability of existing network by replacing existing components or add new assets, increasing the capacity of the system by increasing voltage (electricity) or pipeline uprating and compressor re-wheels (gas/hydrogen).
New network	Provide additional capacity, with the development of network routes linking strategic parts of the network. For electricity, this will consider both onshore and offshore strategic routes. For gas and hydrogen, this will include new compressors, new compressor motive power and new pipelines. For hydrogen, this may include the repurposing of existing gas pipelines.

Appraise

The options will be considered against the five assessment criteria outlined in Table 2, from a GB-wide perspective. The CSNP will compare the GB-wide network options that deliver the individual energy type needs as identified in the earlier steps of the CSNP process. As the SSEP will have already assessed the trade-offs between the types, the CSNP does not need to consider inter-energy trade-offs.

Table 2: Assessment criteria

Criteria	Description
Economic	The CSNP will assess costs to determine a network design that is economic, efficient and coordinated.
Environment	<p>The plan will consider high-level environmental spatial constraints in considering environmental impacts.</p> <p>Statutory Environmental Assessments will be undertaken for all energy types. This will include:</p> <ul style="list-style-type: none"> • Strategic Environmental Assessment (SEA) • Habitats Regulations Assessment (HRA) • Marine Conservation Zone (MCZ)/Marine Protected Areas (MPAs) Assessment



Community	The CSNP will also evaluate community impacts relevant to the strategic plan through desktop appraisals.
Deliverability	The plan will ensure practical delivery by considering supply chains and technology readiness.
Operability	To ensure the final plan is operable, the assessment will consider operational needs and complexity.

Deliver

Plan publication

A draft plan will be published for public consultation along with environmental assessments. This will provide an opportunity for stakeholders to shape the final CSNP publication. After the draft plan has been consulted on, it will be refined again using the feedback received. The final plan will be submitted to Ofgem for approval before being published.

Delivery of network

The energy industry will take forward options included in the CSNP, developing them further, carrying out a detailed design process that includes detailed routing, the consenting process and extensive stakeholder engagement.

For electricity, we will provide a clear signal on which reinforcement options to take forward for delivery. Reinforcement options selected for delivery will not be reassessed in future CSNPs unless there are substantial changes to the reinforcement option or needs case. In this case, the change control will be initiated. We will also identify reinforcement options that could be put out to tender so that other parties, as well as incumbent transmission owners, can own, operate and maintain parts of the electricity transmission system.

We will continue to work closely with NGT following the publication of our recommendations on gas network reinforcements. Following agreement to progress recommendations, Ofgem will decide whether and how it is funded through the regulatory price control (RIIO²⁷) framework.

For hydrogen, we will evaluate options and identify optimal network solutions as part of our whole energy system planning approach, but we will not include formal recommendations for specific hydrogen projects and delivery timescales. We are working with DESNZ and Ofgem to develop the preferred process in this area.

²⁷ Ofgem, [ofgem.gov.uk/energy-regulation/how-we-regulate/energy-network-price-controls](https://www.ofgem.gov.uk/energy-regulation/how-we-regulate/energy-network-price-controls)



Governance of the CSNP

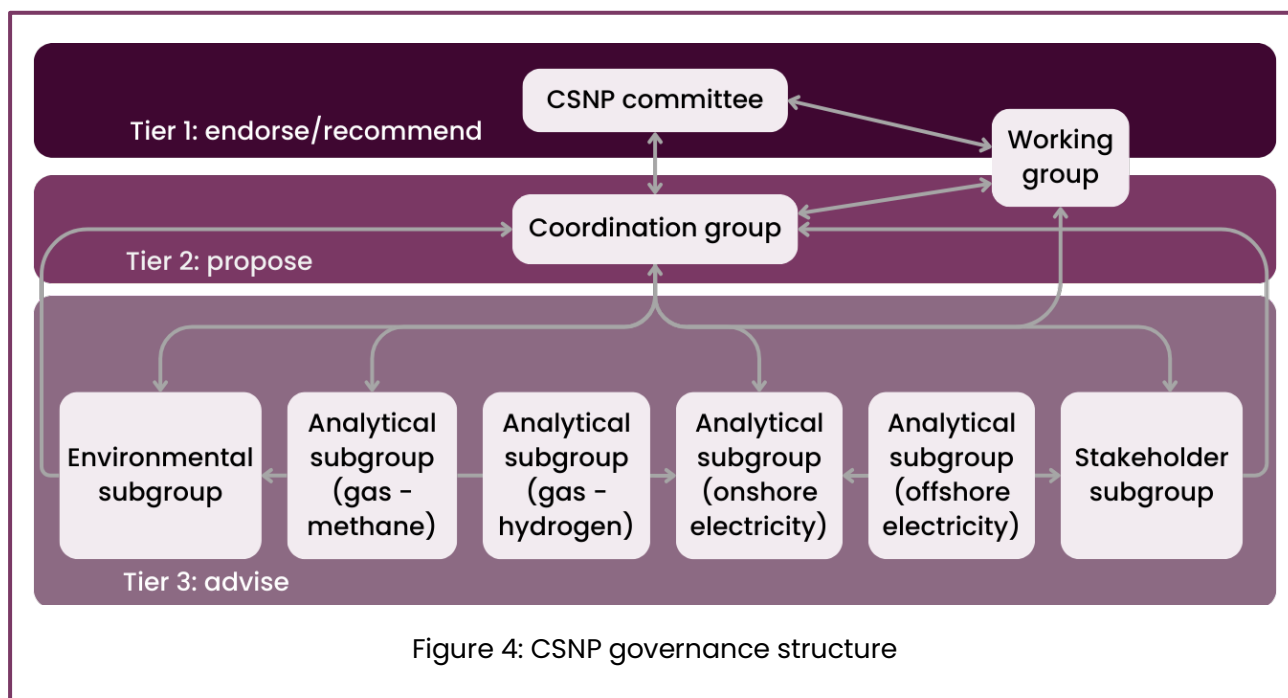
The governance structure for the CSNP has a key role in ensuring accountability and successful delivery of the plan. Our governance approach will ensure that throughout the process, we will engage with central and devolved governments, Ofgem, industry experts and key stakeholders, ensuring the right decisions are made to deliver a clean, affordable and a secure energy system for GB.

CSNP governance structure

The governance structure will ensure that, throughout the process, we have engaged with our stakeholder groups. The governance meetings will provide advice and guidance to NESO, ensure oversight and accountability and facilitate stakeholder insight and feedback. [Appendix B](#) provides more information on the governance structure.

Overall, NESO is accountable for the delivery of the CSNP under our licences. We will seek the endorsement/recommendation of the CSNP committee at various stages throughout the process, including ahead of the final plan being submitted to Ofgem. However, the final decision sits with NESO.

We have developed a three-tier governance structure consisting of a committee, a coordination group and subject matter group subgroups, as outlined in Figure 4:



CSNP committee

The CSNP committee will be responsible for providing strategic direction and advice on the development and production of the CSNP. The output of this committee will cover all CSNP stages and associated key milestones.



It will be chaired by NESO with senior representatives from NESO, Ofgem, central and devolved governments and the transmission licensed parties.

Coordination group

The coordination group is a collaborative forum which will gather inputs and outputs from the various subgroups throughout the entire CSNP process and then present them to the committee. This will ensure oversight and assurance of the entire CSNP process.

The coordination group will be chaired by NESO with representation from NESO, Ofgem, central and devolved governments, transmission licenced parties and a subgroup representative. It will also include an external expert appointed by NESO to provide an independent perspective.

Secretariat working group

The CSNP secretariat working group supports the CSNP committee and coordination group. It will manage risks and actions and ensure both groups interact effectively with the other governance groups.

Subgroups

The subgroups, chaired by NESO, will comprise of subject matter experts and will report to the coordination group. The subgroups will have regular engagement at the appropriate level with the transmission network owners, Ofgem, central and devolved governments. The subgroups will focus on the following subject matter areas:

- **Environmental** – this subgroup will provide subject-matter expert guidance on the approach and methodology for assessing the risk of impact of the CSNP on the environment.
- **Analytical** – these groups will provide advice on the technical (engineering), modelling and economic analysis which the CSNP will use. There will be four analytical subgroups: electricity, onshore and offshore, gas and hydrogen.
- **Stakeholder** – this subgroup will provide insights and expertise from the energy industry, which will help inform the outputs of the CSNP.

Themes to be incorporated

We intend to use existing NESO working groups to make effective use of stakeholders' time where possible. These include working groups from our other strategic planning activities such as SSEP. Feedback/insights gathered from these will be considered in the relevant governance groups.

Discussion points will include:

- **Methodology** – proposed future changes to the CSNP methodology (updated every three years) will be discussed prior to a public consultation and require submission to Ofgem for approval.
- **Electricity offshore design** – the development and selection of the indicative offshore transmission electricity design.



- **System requirements** – the development and results of the network system requirements analysis, including the associated external publication.
- **Options development** – the development of individual options which have been considered and received to meet the system requirements.
- **GB options assessment** – consideration of the options against the assessment criteria from a GB-wide perspective.
- **Draft CSNP publication** – the draft CSNP, along with environmental reports, will be reviewed by the CSNP committee prior to public consultation.
- **Final CSNP publication** – on completion of the SEA, HRA, MCZ assessments and a public consultation, the final CSNP will be reviewed prior to submission to Ofgem and publication.

Data and publications

The CSNP process requires the exchange of data between NESO and licensed parties, third parties, Ofgem and the UK Government. All parties submitting data into the CSNP process are responsible for the integrity of the data they submit. NESO is responsible for the integrity of that data through the CSNP process, as well as for any output data that we create. Data held by NESO will be handled in accordance with our data policies.

When publicly published, data will be published without identifying the sources, unless the party agrees to their data being identified. This means, by default, that options will be presented without identifying the party who submitted the option.

Dispute resolution

All parties responsible for the development of the CSNP are expected to participate in the CSNP process in a meaningful, transparent and collaborative manner. However, it is recognised that differing views, disagreements or disputes may arise.

When a disagreement occurs, such parties will be expected to resolve the matter through informal discussions in the first instance. When a resolution cannot be reached, the disagreement will be escalated and managed through the CSNP governance process. Any party can escalate a disagreement – firstly to the Coordination Group – and NESO is responsible, as secretariat, for recording disputes and managing them through the governance process. The Coordination Group will consider the dispute, taking information from the parties involved in the dispute and advice from other parties involved in the governance (such as Ofgem and DESNZ) to form a recommendation on the way forward. If a resolution is not reached, the CSNP Committee will consider the dispute and form a recommendation on the way forward. Ultimately, NESO will decide on how to proceed with the CSNP process.

For disagreement on a data matter, (for example, if NESO disagrees with a date provided by a network owner for an input option), every effort will be made to reach agreement through informal routes, and this will include seeking further justification and justification of both positions to try and reach an agreed position. If a resolution cannot be found, the governance process will consider the justification and the governance will provide a recommendation on the outcome of the dispute – this could include using the original



data, using a substitute data or considering both in the analysis. NESO will take this recommendation into account when deciding on how to proceed with the CSNP process.

The CSNP process requires the exchange of data between NESO and transmission licensed parties, third parties, Ofgem and the UK government. All parties submitting data into the CSNP process are responsible for the integrity of the data they submit and they remain the owner of that data. NESO is responsible for the integrity of that data through the CSNP process, as well as any output data that we create. Data will be handled in accordance with our data policies

These provisions do not affect any other dispute resolution mechanisms defined in any applicable industry codes. Similarly, this governance and dispute process does not override Ofgem's statutory role as the regulator.

Interaction with industry codes

This methodology sits alongside industry codes. The CSNP is designed to encompass a wider range of parties than those covered the industry codes and, therefore, we have set out the governance for the CSNP distinct to industry code arrangements.

We recognise that the industry codes currently contain elements related to network planning, which needs updating. For example, the System Operator – Transmission Owner (STC) Code²⁸ covers elements of electricity network planning, has specific clauses and procedures to deliver the previous Electricity Ten Year Statement (ETYS) and Network Options Assessment (NOA) process, which will require updating.

Therefore, NESO will propose changes to the industry codes through the standard code change process, to bring alignment with this methodology and in some cases provide further detail (see [Appendix B](#)). For example, the alignment between the CSNP methodology and the STC will provide clarity on matters such as defining data exchange between NESO and the transmission owners.

Assurance

Due to its complexity and the potential impact of the results, the CSNP will be subject to high levels of assurance across all aspects of the programme. This will encompass both programme delivery and technical assurance, which will be delivered by a 'four lines of defence model', described in [Appendix E: Assurance](#). These will show the boundaries between different roles and responsibilities in the delivery of assurance and risk management.

²⁸ NESO, [neso.energy/industry-information/codes/system-operator-transmission-owner-code-stc](https://www.neso.energy/industry-information/codes/system-operator-transmission-owner-code-stc)

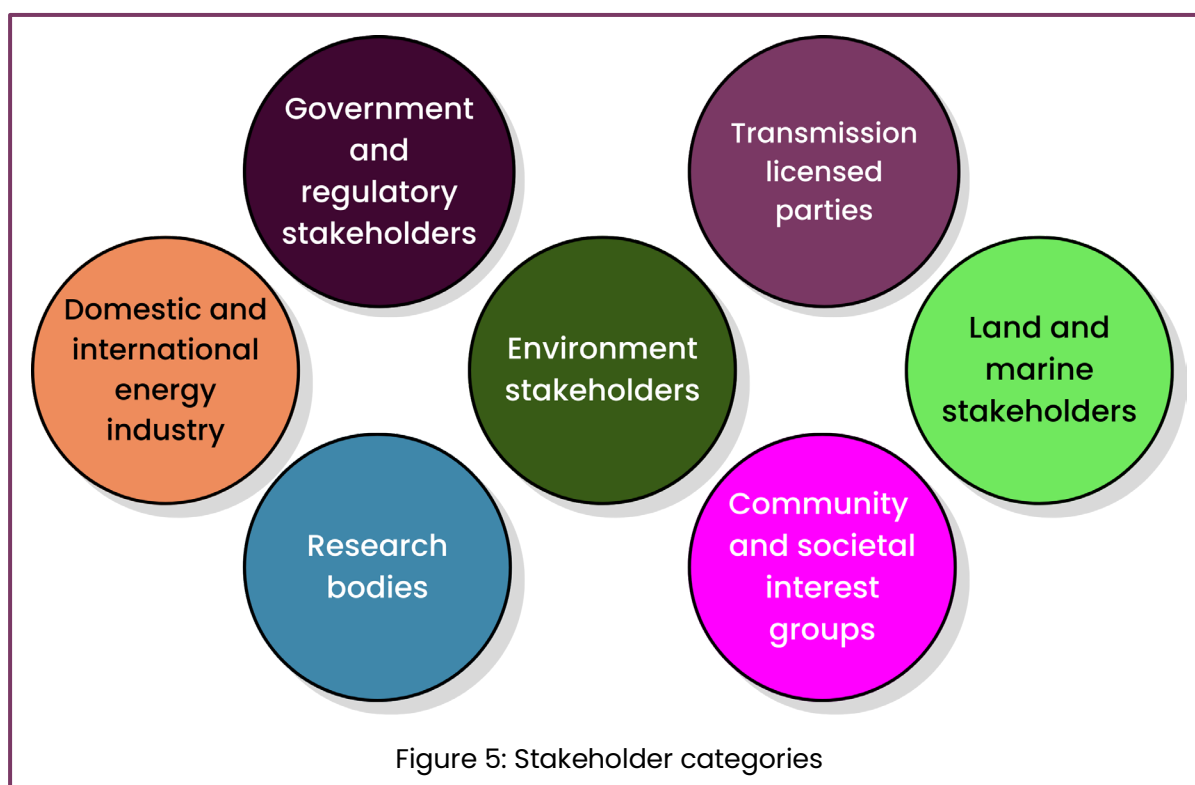


Stakeholder engagement

Extensive and accessible engagement with a range of stakeholders is critical to ensure the CSNP considers the views of experts and key stakeholders across GB.

Who are our stakeholders?

We expect to engage with the stakeholder categories shown in Figure 5 throughout the CSNP cycle. Definitions for the categories are included in [Appendix A](#). Some stakeholders may fit into one or more category.



As there are different regulatory requirements for the electricity, gas and hydrogen networks, there are some stakeholders who have specific transmission network planning obligations. The following text outlines the interactions with these stakeholders for each energy network. It also describes how other stakeholders can shape the CSNP and our high-level engagement approach with our European counterparts.

Electricity network

The high-voltage electricity transmission onshore network²⁹ in GB is owned and maintained by the three licensed onshore transmission owners:

- National Grid Electricity Transmission plc (NGET)

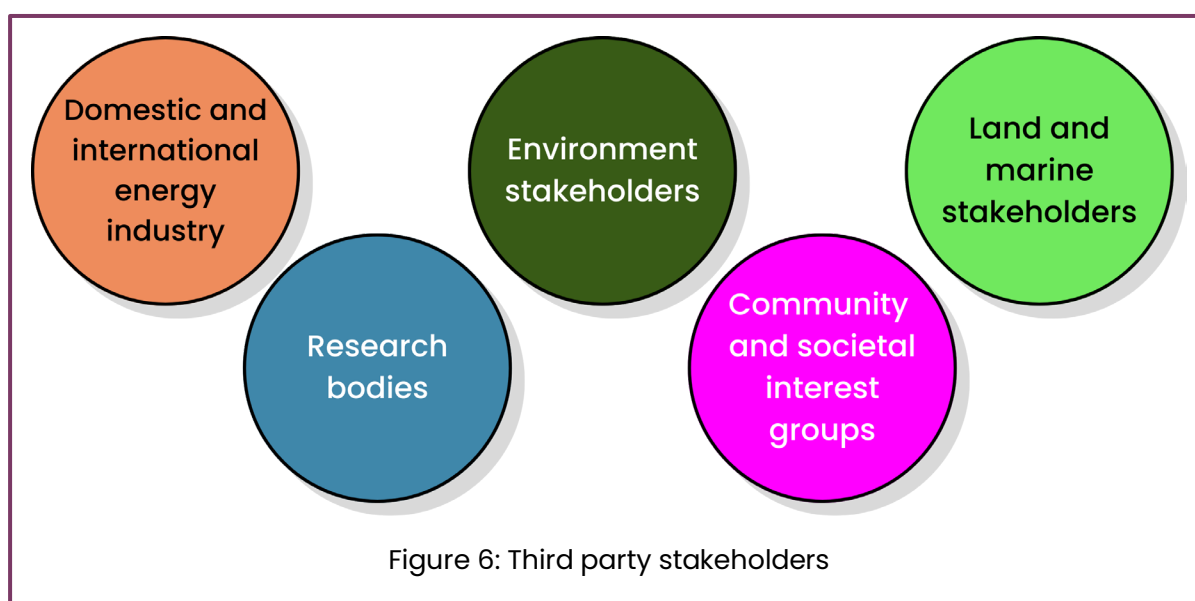
²⁹ Network voltages which are 275 kV or more in England and Wales and 132 kV or above in Scotland.



- Scottish Power Transmission plc (SPT)
- Scottish and Southern Energy Networks Transmission plc (SSEN Transmission)

The incumbent onshore transmission owners have a licence requirement to provide reinforcement options into the network planning process based on the needs provided by the SSEP and CSNP.

There will also be opportunities for other stakeholders to submit electricity transmission network proposals into the CSNP. We refer to these stakeholders as ‘third parties’. We define third parties as stakeholders who participate in the CSNP who do not own a GB transmission network licence. Third parties may come from one or more of the categories as indicated in Figure 6. For more details and to understand how third parties will be involved in the transmission network planning process, please refer to the [Develop step](#) in this document.



European engagement

As part of our electricity offshore design process, we engage multilaterally with European transmission system operators (TSOs). We contribute to the Offshore Transmission System Operator Collaboration (OTC) group. Outputs from the group help inform our view of cross-border opportunities in the future. We also engage bilaterally with individual European TSOs to refine our planning assumptions.

Gas network

The licensing requirements for the gas system distinguish between national transmission³⁰ and distribution networks³¹ by specifying a licensed gas transporter, National Gas Transmission (NGT), as the National Transmission System (NTS) System Operator.

³⁰ Pressures over 38 bar

³¹ Pressures below 38 bar



Under their licence, NGT is required to produce a Strategic Planning Options Proposal (SPOP) that sets out the licensee's best view of any options in response to the system needs that are set out in our Gas Network Capability Needs Report³² (GNCNR). Our gas network planning activities are primarily bilateral in nature. Nonetheless, we will endeavour to involve interested stakeholders throughout the gas network planning process and the development of the CSNP.

Hydrogen network

Hydrogen network planning does not have an established regulatory structure and is therefore not a licensed activity assigned to a set of organisations. While we will deliver the first tangible outputs of our hydrogen strategic planning role through the SSEP and the CSNP (with DESNZ remaining the decision maker for awarding business model support to hydrogen transmission and storage projects), it is our expectation that the parameters of this role will reflect the approach we outline in this methodology.

The UK Government's support mechanisms currently fund the development of four business models for hydrogen covering its production, transport, storage and use for power generation. The transport and storage of hydrogen will be considered within the CSNP and as these areas develop, we will seek to engage parties who may also become involved in these planning processes.

We anticipate that regulated energy sector organisations with current interests may be involved in the planning processes in the future and we will engage with these organisations as the regulatory and planning regime develops.

The role of hydrogen and how it is applied in the energy transition is still being explored. Strategic stakeholder engagement and collaboration are crucial for overcoming challenges and realising the potential of hydrogen. We continue to work with stakeholders across the value chain to enable the successful integration of hydrogen into network planning to deliver optimal whole-system outcomes.

Our engagement approach

Our engagement strategy is driven by the dynamic nature of the CSNP and the need to adapt to changing circumstances. Flexibility allows us to respond to new information, environmental shifts and emerging challenges with agility. Therefore, our communications plan does not sit in this methodology. This enables our strategic engagement plan to be updated frequently, reflecting the current landscape and aligning to our organisation's and, where relevant, stakeholder goals. This adaptability is crucial for producing a robust CSNP. However, a summary of the key engagement touchpoints during the process is outlined in Section 5 of this document.

Outside of this methodology, our engagement approach begins with:

- raising awareness of the CSNP and its links to wider SEP plans

³² NESO, [neso.energy/what-we-do/strategic-planning/gas-network-capability-needs-report-gncnr](https://www.neso.energy/what-we-do/strategic-planning/gas-network-capability-needs-report-gncnr)



- informing stakeholders of its objectives
- explaining why the CSNP is relevant to our stakeholders and outlining key stages where we will require stakeholder input

We will do this by aligning to wider SEP engagement activities. This allows us to reach a diverse range of stakeholders, integrate national and regional insights into the plan as early as possible and understand the most effective communication mechanisms. As the plan evolves, we will seek out appropriate channels and mechanisms to engage with step-specific engagement requirements.

Aligning our engagement activities across SEP will ensure a cohesive and effective communications strategy for delivering the CSNP successfully.

SEP working groups

We will continue to engage with our stakeholders through the established SEP working groups. The groups will provide industry steer, expertise and feedback as the CSNP develops. In addition, they will help us to:

- inform stakeholders of the CSNP and its objectives and why they are relevant to them, and why it matters
- provide updates on the process and how one step (and outputs from it) feeds into the next
- signal input required from stakeholders
- challenge, discuss and review our outputs
- test understanding
- gather data
- help to ensure whole-system deliverable outputs are achieved
- facilitate networking and innovation among members

More details about the groups can be found in [Appendix A](#).

SEP societal forums

There are 14 different SEP societal forums, designed to ensure a range of stakeholders are involved in and are aware of the development of our strategic energy plans early in their lifecycle.

These interest groups can support the development of CSNP, either by providing their diverse perspectives on the energy sector or by representing a wide cross-section of communities across GB. These groups all have an interest in the energy transition and experience it in different ways, so it is important that we listen. We will seek to understand what they perceive to be of most value and consider how that should influence the development of the CSNP.

Balancing the views of experts, key stakeholders across all energy types and society will require thoughtful consideration of a range of perspectives. In the CSNP process, we will



weigh different opinions carefully, using our experience, expertise and professional judgement as the independent system operator and planner to determine how views should be balanced and incorporated into whole-system decision-making. In doing so, we will consider the different expertise and unique insights different stakeholders have.

More details about the SEP societal forums can be found in [Appendix A](#).

Stakeholder engagement principles

As mentioned, there will be various engagement touchpoints throughout the CSNP cycle linked to the process steps. A summary of these can be found in [Appendix A](#). Throughout the course of our engagement activities, we will align to NESO's strategic energy planning (SEP) principles as set out below. They define our stakeholder engagement approach and ensure a consistent method is applied, where possible, across the SEP plans.

Timely and transparent

We will aim to engage as early as possible, with a transparent stakeholder approach. We will make it clear to stakeholders how we will consider their feedback when it is sought and how they can shape the plan, while appropriately respecting the confidentiality of the work.

Proactive engagement

When appropriate, we will work with a range of stakeholders with interest or expertise in energy planning and with the representatives of communities that may experience development of energy infrastructure in the future. Their engagement will help us develop the plan and make sure it considers a broad range of regional views. We will proactively update our stakeholders on new and changing information via our range of regular stakeholder groups and forums, alongside public communications.

Action feedback and inform stakeholders

We will consider all feedback from our stakeholders during engagement activities. Once all feedback has been analysed, we will group it under themes and share how we have considered and addressed these themes. An example of this is in [Appendix A](#), where a summary of responses from our summer 2025 consultation on the draft methodology has been included. We will manage stakeholders' expectations and explain where we will not be able to take on board all views and the reasons why. This could be for a variety of reasons, including that some views will be conflicting or not aligned with the aims of the plan. Finely balanced trade-offs will need to be made by policy and supporting information where possible, to inform decisions made where there are conflicting views.

Coordinated engagement

Where we can, we will align stakeholder engagement activity across our strategic energy planning activities and with other relevant organisations. We aim to be as efficient as possible with stakeholders' time.



Tailored engagement

Although what we do is technical in nature, we want to ensure our engagement and communications are accessible and at the right level for our diverse range of stakeholders, who all have different experiences of the energy sector and network planning. We will present information in different ways, such as using diagrams, worked examples and digital platforms where possible. We will regularly seek feedback from our stakeholder groups throughout the process in order to understand how well the engagement is working for them so that we can enhance our approach.



Environmental assessments

The activities associated with the environmental assessments will run in parallel and interact with each of the CSNP steps. This section explains how the environmental assessments will be established and undertaken and how they interact with the CSNP development process.

Whole-system approach

An integral part of the CSNP will be environmental plan-level assessments that will enable us to evaluate the potential impact that investment proposals could have on the environment, as well as to compare options based on their relative impact. We will undertake the following assessments on a consistent basis across gas, electricity and hydrogen where possible:

- Strategic Environmental Assessment (SEA)³³
- Habitats Regulations Assessment (HRA), known as Habitats Regulations Appraisal in Scotland³⁴
- Marine Conservation Zone Assessment (MCZ)³⁵
- Marine Protection Area (MPA) in Scotland³⁶

These plan-level environmental assessments will be undertaken by NESO and will comply with the relevant legislative requirements to assess the potential environmental impacts of proposed policies, plans and programmes, such as the CSNP. They are required to ensure that plans are designed and implemented in a way that minimises negative environmental effects, promotes sustainability, provides opportunity for stakeholder and public consultation and provides us with necessary information to make informed choices. Figure 7 and Table 3 show how we propose the various stages of these environmental assessments integrate into the CSNP.

We will work with environmental stakeholders to define the scope and develop the methodology for these consultations, helping to ensure key issues are identified and that environmental considerations underpin the process. The information used to undertake these assessments (spatial envelopes, environmental and community constraint maps

³³ UK government, [gov.uk/guidance/offshore-energy-strategic-environmental-assessment-sea-an-overview-of-the-sea-process](https://www.gov.uk/guidance/offshore-energy-strategic-environmental-assessment-sea-an-overview-of-the-sea-process)

³⁴ UK government, [gov.uk/guidance/habitats-regulations-assessments-protecting-a-european-site](https://www.gov.uk/guidance/habitats-regulations-assessments-protecting-a-european-site)

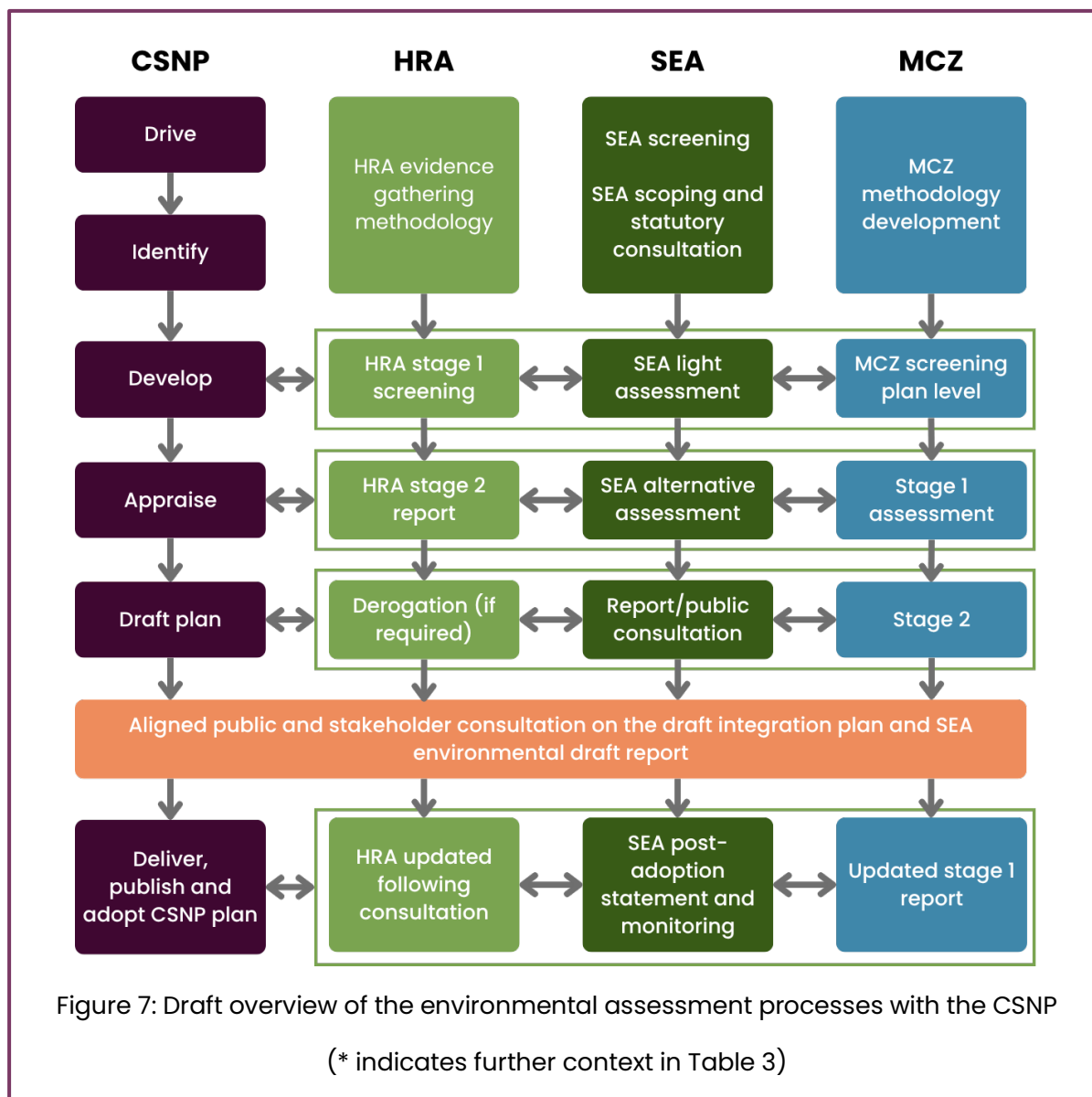
³⁵ UK government, assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/259972/pb14078-mcz-explanatory-note.pdf

³⁶ Scottish Government, [gov.scot/policies/marine-environment/marine-protected-areas/](https://www.gov.scot/policies/marine-environment/marine-protected-areas/)



and narratives) will be produced during the reinforcement options development process by the options developer, such as a transmission owner.

Due to the strategic GB-wide nature of the CSNP, the plan-level assessments will be considered at national level. The requirements will be identified during the SEA scoping and HRA and MCZ/MPA assessment evidence gathering stages. We will coordinate with other plan-level assessment owners within NESO, such as the SSEP, during the early stages of the CSNP to make sure our approaches are coordinated and consistent. We will consider identifying requirements with respect to the Environmental Principles Policy Statement³⁷ (EPPS), including those which may follow from the SSEP and impact the CSNP.



³⁷ UK government, [gov.uk/government/publications/environmental-principles-policy-statement/environmental-principles-policy-statement](https://www.gov.uk/government/publications/environmental-principles-policy-statement/environmental-principles-policy-statement)



Table 3: Expanded definitions of steps in Figure 7

SEA	HRA	MCZ/MPA
SEA screening: determine the need for an SEA.	HRA evidence gathering methodology sets out methodology for HRA and approach to use of zones of influence in assessment.	MCZ/MPA screening plan level: identify sites that could have their conservation objectives hindered by the impact pathways associated with CSNP developments and need to be taken forward to stage 1 assessment.
SEA scoping and statutory consultation: set out baseline, identify issues, develop framework, prepare scoping report.		
SEA alternative assessment: identify and assess reasonable alternatives of GB design.	HRA stage 1 screening: likely significant effects on short-listed options to identify any of particular concern (if any).	Stage 1 assessment: statutory nature conservation consultation.
SEA adoption and monitoring: monitor the significant effects of the plan.	HRA stage 2: appropriate assessment, develop report and undertake Statutory Nature Conservation Bodies (SNCB) consultation.	Stage 2: consider if public benefit outweighs the risk of damage to the environment.

Strategic Environmental Assessment (SEA)

The SEA is a systematic process for evaluating the environmental implications of a proposed plan such as the CSNP. It provides a means for looking at the cumulative effect and appropriately mitigating at the earliest stage of decision-making, alongside economic and social considerations.

The SEA will assess the extent to which the CSNP:

- will provide a response to environmental and climate change-related challenges
- may adversely affect the environment and climate resilience

Compared with a project level Environmental Impact Assessment (EIA), an SEA provides recommendations at a strategic level and considers the cumulative effects of multiple and combined options. It also allows for monitoring of environmental effects and that any mitigation measures are effective.

The aim of an SEA is to ensure that environmental considerations are integrated into the outputs of the CSNP. The SEA process implicitly operates to prevent the selection of projects or policies without sufficient information about alternatives being appropriately considered and assessed.



The SEA for the CSNP will meet SEA requirements in England, Wales and Scotland³⁸. These comprise of:

- **England** – Environmental Assessment of Plans and Programmes Regulations 2004
- **Wales** – Environmental Assessment of Plans and Programmes (Wales) Regulations 2004
- **Scotland** – Environmental Assessment (Scotland) Act 2005

Where applicable, we will also consult with other administrations, such as those in Northern Ireland, the Republic of Ireland or the Isle of Man.

Habitats Regulations Assessment (HRA)

The HRA refers to the several distinct stages of assessment which must be undertaken to determine if the CSNP is likely to have a significant effect on a European site or a European offshore marine site, also known as the National Site Network (either alone or in combination with other plans or projects) before deciding whether to undertake, permit or authorise it.

European sites are protected by the Conservation of Habitats and Species Regulations 2017 as amended (England and Wales) and Conservation (Natural Habitats, &c.) Regulations 1994 (Regulation 48) (Scotland), known as the Habitats Regulations³⁹.

All plans and projects (including planning applications) not directly connected with, or necessary for, the conservation management of a habitat site, require consideration of whether the plan or project is likely to have significant effects on that site.

The HRA screening stage will consider the potential effects of the CSNP proposals in combination with other non-electrical plans or projects. Where an adverse effect on the site's integrity cannot be ruled out, and where there are no alternative solutions, the plan or project can only proceed if there are imperative reasons for over-riding public interest and, if necessary, compensatory measures can be secured.

If a proposed plan or project is considered likely to have a significant effect on a protected habitats site, then an appropriate assessment of the implications for the site, in view of the site's conservation objectives, must be undertaken. If an adverse effect on the site integrity cannot be ruled out, then the derogation route should be followed (if required).

Marine Conservation Zone (MCZ)

An MCZ assessment (or Marine Protected Area (MPA) in Scottish waters) will consider the potential for the CSNP to impact the conservation objectives of these sites in GB waters. Assessing an MCZ and MPA in the formulation of the CSNP will allow the plan to demonstrate how the CSNP will avoid or compensate (where necessary) for effects on nationally designated marine conservation sites. The process and methods are similar to a HRA, but a separate and parallel process that considers different designated sites and designated features, underpinned by different legislation.

³⁸ UK government, legislation.gov.uk/ukxi/2004/1633/contents/made

³⁹ UK government, legislation.gov.uk/ukxi/2017/1012/contents



MCZs in English, Welsh and Northern Irish territorial and offshore waters are designated under the Marine and Coastal Access Act 2009 (MCAA)⁴⁰, which provides protection for a range of important marine habitats, species and geological formations. In conjunction with other existing international and national designations, these sites contribute to an ecologically coherent network of MPAs in the Northeast Atlantic and North Sea. MPAs in Scottish territorial waters are designated under Section 1 of the Marine (Scotland) Act 2010 and under the MCAA 2009⁴¹. Highly Protected Marine Areas (HPMAs) in England and Wales have also been designated under the Marine and Coastal Access Act 2009 (HM Government, 2023)⁴². These sites provide ecosystem-wide protection and recovery of all species, habitats and processes within their boundaries. They intend to prevent all activities considered damaging, depositional or extractive.

⁴⁰ UK government, legislation.gov.uk/ukpga/2009/23/contents

⁴¹ Scottish Government, gov.scot/publications/environmental-report-changes-marine-conservation-order-provisions-under-marine-scotland-act-2010/pages/4/

⁴² UK government, gov.uk/government/publications/highly-protected-marine-areas/highly-protected-marine-areas-hpmas

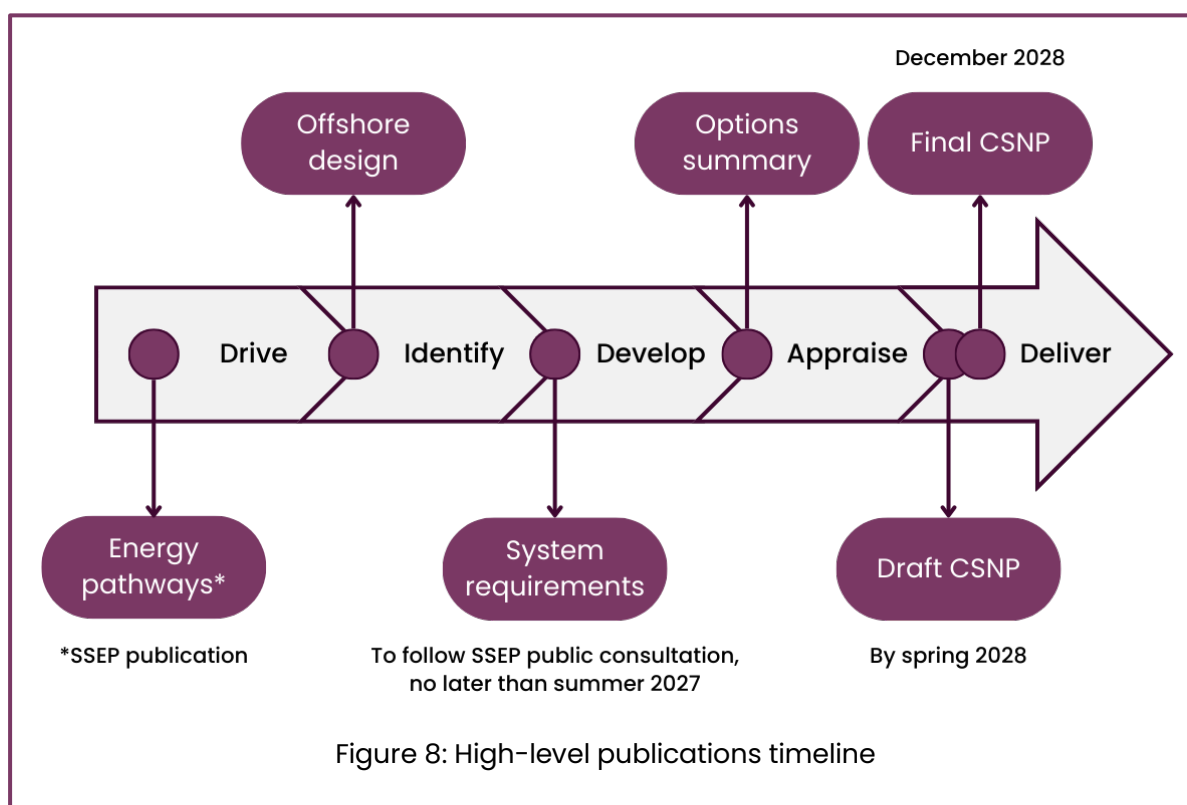


Plan timelines

The CSNP will follow the publication of the Spatial Strategic Energy Plan and will be published every three years.

Following a public consultation, the first CSNP will be published by the end of 2028⁴³. Our priority is to deliver a comprehensive network plan that meets the requirements of our stakeholders where possible. The CSNP will produce various outputs across the 3-year cycle. Where we can, we have proposed timings for key publications in Figure 8⁴⁴. More precise timings, including for other specific activities/workstreams, will be communicated once the scope and requirements are fully validated outside of this methodology, which could require further stakeholder engagement. This will ensure the plan is delivered successfully without avoidable rework or possible delays.

Given the interdependencies with our other strategic energy planning (SEP) programmes, changes to timings could occur. As some of such timings are defined in our licence: any changes would require a decision from Ofgem and/or a change in the licence conditions.



⁴³ NESO neso.energy/news/neso-outlines-new-timelines-strategic-energy-plans

⁴⁴ Timings NESO expects, although subject to change, particularly if impacted by matters outside of NESO's control.



Status of the Methodology

This methodology was submitted to Ofgem for approval by 31 January 2026, in accordance with their direction⁴⁵ and licence conditions C17⁴⁶ of our Electricity System Operator (ESO) licence and C12⁴⁷ of our Gas System Planner (GSP) licence⁴⁸.

It builds on Ofgem’s Centralised Strategic Network Plan guidance⁴⁹, which was consulted on by Ofgem and published in November 2025.

Extensive stakeholder engagement has helped develop this document, including two public consultations. Our first consultation took place from December 2024 to January 2025 on the high-level principles designed to underpin the methodology for the CSNP⁵⁰. At this stage, this was an electricity plan.

Using the feedback from this first exercise, the approach evolved. We consulted for the second time during summer 2025⁵¹, bringing together gas, hydrogen and electricity networks. The outputs of these exercises, combined with wider stakeholder engagement, has helped shape this final document. This methodology will be updated every three years where relevant, as per Ofgem’s CSNP guidance document⁵² and licence conditions.

In [Appendix A](#) of this document, we have provided a summary of the feedback themes from the draft methodology consultation. This outlines how we have improved the CSNP approach using stakeholder feedback and where we did not make updates before submitting the document to Ofgem in January, with the reasons why.

⁴⁵ Ofgem, [ofgem.gov.uk/sites/default/files/2025-12/Direction-to-NESO-on-Network-Options-Assessment-and-Centralised-Strategic-Network-Plan-Methodology.pdf](https://www.ofgem.gov.uk/sites/default/files/2025-12/Direction-to-NESO-on-Network-Options-Assessment-and-Centralised-Strategic-Network-Plan-Methodology.pdf)

⁴⁶ Ofgem, [ofgem.gov.uk/sites/default/files/2024-03/Annex%20E%20-%20Electricity%20System%20Operator%20Licence%20Conditions.pdf](https://www.ofgem.gov.uk/sites/default/files/2024-03/Annex%20E%20-%20Electricity%20System%20Operator%20Licence%20Conditions.pdf)

⁴⁷ Ofgem, [ofgem.gov.uk/sites/default/files/2024-03/Annex%20G%20-%20Gas%20System%20Planner%20Licence%20Conditions.pdf](https://www.ofgem.gov.uk/sites/default/files/2024-03/Annex%20G%20-%20Gas%20System%20Planner%20Licence%20Conditions.pdf)

⁴⁸ We expect to deliver our C8 (Gas System Planner) licence obligations as part of delivering the CSNP.

⁴⁹ Ofgem, [ofgem.gov.uk/guidance/centralised-strategic-network-plan](https://www.ofgem.gov.uk/guidance/centralised-strategic-network-plan)

⁵⁰ NESO, [neso.energy/document/349136/download](https://www.neso.energy/document/349136/download)

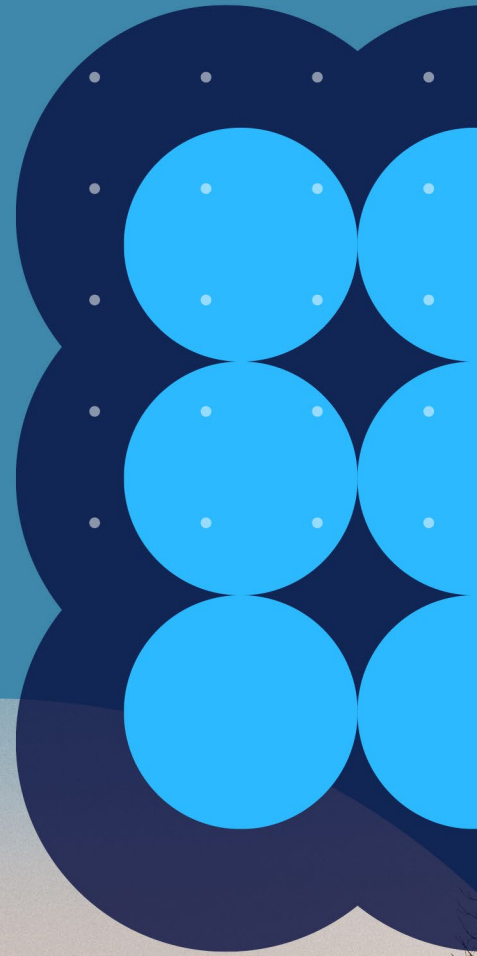
⁵¹ NESO, [neso.energy/document/363521/download](https://www.neso.energy/document/363521/download) and [neso.energy/document/363526/download](https://www.neso.energy/document/363526/download)

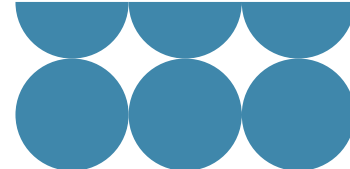
⁵² Ofgem, [ofgem.gov.uk/guidance/centralised-strategic-network-plan](https://www.ofgem.gov.uk/guidance/centralised-strategic-network-plan)

3. Section 3: Electricity – Overview

Plan introduction

Context





Plan introduction

For the electricity transmission systems, the CSNP will plan onshore and offshore networks, including wider reinforcements and offshore infrastructure, to create a coordinated network design across GB.

This part of the methodology sets out our approach for electricity network planning. For each of the five key steps, we explain how these will be considered from an electricity network perspective.

Key steps



Drive

Using the SSEP pathway, the network design standards and principles, and an initial offshore design, we will define a baseline for the network. Network development and optimisation will be based on this baseline through the subsequent steps.



Identify

We will identify what the system needs are to enable power to get to where it is needed to ensure continued access to reliable, clean and affordable electricity. This will form the basis for options development.



Develop

A range of reinforcement options will be developed by NESO, transmission owners and third parties to satisfy identified requirements and will be assessed in the Appraise step.



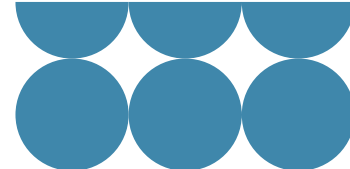
Appraise

Using the network reinforcement options, created through the Develop step, multiple GB network designs will be assembled. Each GB network design will be appraised against the following five criteria: economic and efficient, environmental impacts, community impact, operability and deliverability.



Deliver

We will consult on and publish our findings, including the chosen network design. A subset of reinforcement options from the chosen network design will enter the delivery pipeline. We will manage the change process to facilitate delivery of required network reinforcement options.



Context

Scope

In scope

The CSNP will plan the onshore and offshore electricity transmission network. This includes wider reinforcements on the Main Interconnected Transmission System (MITS) and offshore infrastructure to facilitate transmission, offshore generation and interconnection.

Wider reinforcements support transmission between different areas across GB to meet system needs. To assess reinforcement options and bulk power flows, boundaries will be used. These split the transmission system into multiple parts crossing critical circuits that carry power between areas where power flow limitations may occur. Additional insight on thermal loading limitations at specific circuits across the year will also be provided.

Alongside wider reinforcements, the CSNP will design the offshore network needed to connect the offshore generation and interconnection in the selected SSEP pathway. These will be planned together to ensure an efficient transmission system.

The final plan will determine a network design of wider reinforcements and offshore infrastructure that is efficient, coordinated and economical, considers impacts and benefits to the environment and communities and is deliverable and operable. It will also follow relevant policy and standards, like the Security and Quality of Supply Standard (SQSS)⁵³.

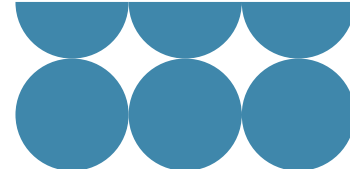
Key terms

- System needs present our view of where additional network capability, services and control are needed on the transmission network to ensure reliable, clean and affordable electricity.
- Reinforcement options are individual options to meet system needs, including, but not limited to, offshore proposals, network management, network upgrades or new onshore circuits.
- Network designs are combinations of reinforcement options and offshore infrastructure that together form a coordinated plan across GB.

As part of the CSNP, residual needs relevant to industry standards, including stability and voltage, will be identified. This analysis will be conducted on an annual basis to ensure the safe, reliable operation of the transmission system. Residual needs may be met through Network Services⁵⁴ tenders alongside consideration of transmission owner (TO) assets.

⁵³ NESO, [neso.energy/industry-information/codes/security-and-quality-supply-standard-sqss](https://www.neso.energy/industry-information/codes/security-and-quality-supply-standard-sqss)

⁵⁴ NESO, [neso.energy/industry-information/balancing-services/network-services](https://www.neso.energy/industry-information/balancing-services/network-services)



Out of scope

The CSNP will not plan individual customer connections or non-load related investments, such as the replacement of ageing assets. These could interact and be considered where a customer connection investment forms part of a reinforcement option. The plan will establish the offshore network needed to connect future offshore generation, but will not form the connection offers, which remains part of the Connections⁵⁵ process.

As a strategic plan, the CSNP will determine a network design through desktop appraisals. It does not cover the activities undertaken once a project is in the delivery pipeline, including route design, land planning and consenting and construction. These stages will be the responsibility of the delivery body. The delivery body could be an incumbent transmission owner, a competitively appointed transmission owner (CATO) or an offshore developer. The scope of plan development is summarised in Table 4.

Table 4: Scope of plan development

Strategic plan (in scope)	Delivery pipeline (out of scope)
The plan will determine the strategic parameters of reinforcements, such as the technology type, strategic design and spatial envelope.	In the delivery pipeline, reinforcements will undergo design and development within the strategic parameters. This will be completed by the delivery body.
The CSNP will appraise broad spatial envelopes to consider risks to the environment and communities.	The siting of assets and routing of infrastructure will be decided by the delivery body in the delivery pipeline.
The plan may consider strategic mitigation, such as undergrounding where justified, in line with relevant policy and principles.	The delivery body will conduct surveys and design work to inform localised mitigations, building on strategic mitigation identified at plan level. The delivery body will also undertake engagement and consultation activities (in line with relevant consenting frameworks).
The plan will include a Strategic Environmental Assessment, Habitats Regulations Assessment and Marine Conservation Zone/Marine Protected Area assessment.	The delivery body will undertake on the ground surveys and project level environmental assessments.

Key interactions

The scope of the CSNP for electricity and its interactions with other relevant plans, processes and policies is illustrated in Figure 9.

⁵⁵ NESO, [neso.energy/industry-information/connections](https://www.neso.energy/industry-information/connections)

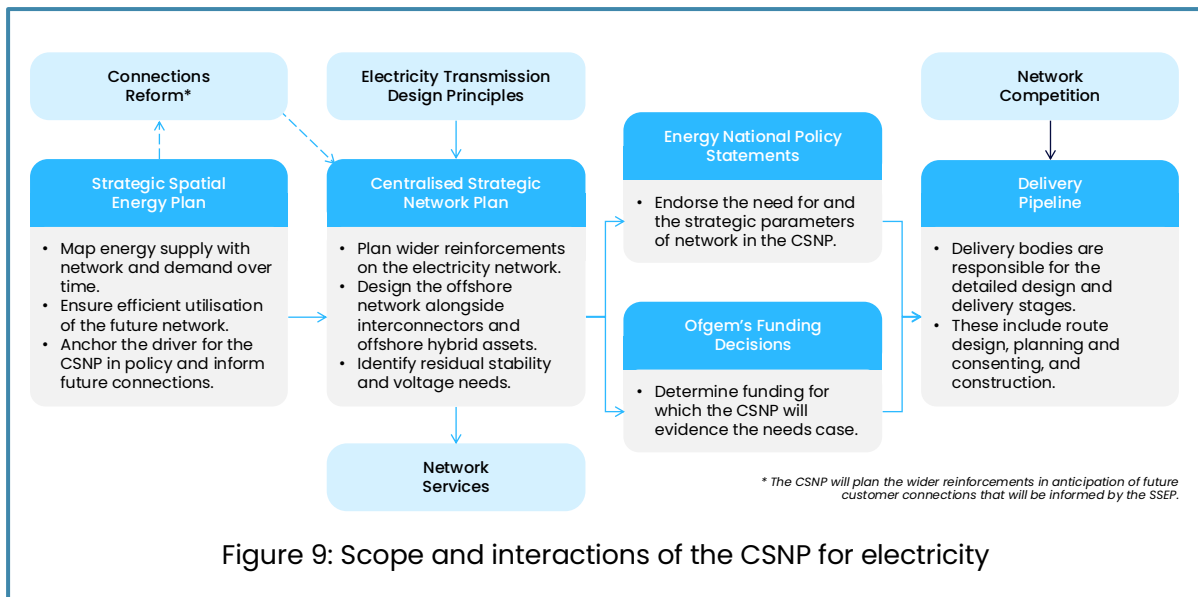
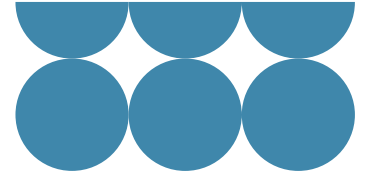


Figure 9: Scope and interactions of the CSNP for electricity

Planning framework

A range of different reinforcement options will be developed for implementation over a 25-year period before a network design is proposed in the Appraise step.

A subset of reinforcement options and offshore infrastructure in the chosen network design will progress into a delivery pipeline. In the long term, due to uncertainty about system needs, reinforcement options and offshore infrastructure will be considered for potential investments in the CSNP funnel. This framework is illustrated in Figure 10, with an explanation of the terms provided after it.

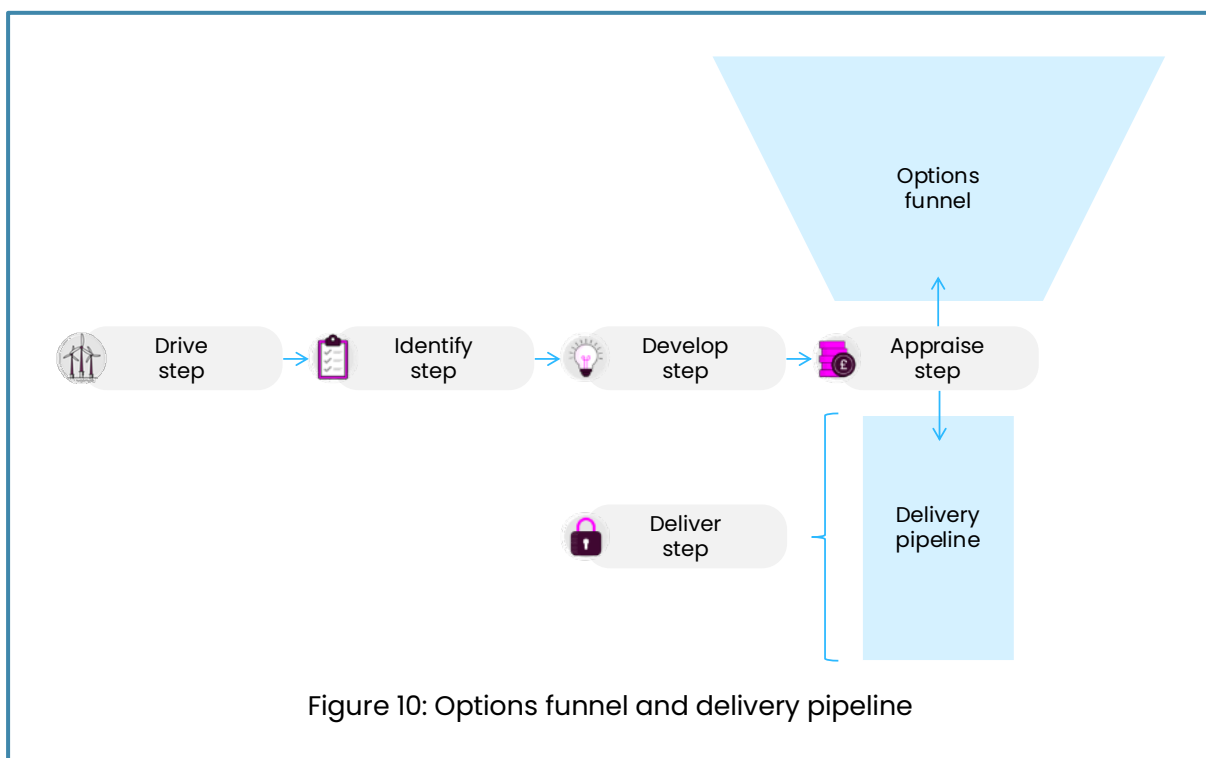
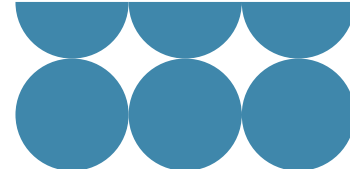


Figure 10: Options funnel and delivery pipeline



Options funnel

The funnel will collate and provide visibility on different reinforcement options and offshore infrastructure that might be needed in the future, in addition to the delivery pipeline. This will allow us to plan and coordinate the development of wider reinforcements and offshore infrastructure over the next 25 years.

The reinforcements and infrastructure in the funnel will be reassessed in future cycles of the plan. As certainty on their needs case increase, they could progress into the delivery pipeline. Some options may also leave the options funnel if they become obsolete or superseded by revised options.

Delivery pipeline

A subset of reinforcement options and offshore infrastructure in the preferred network design will progress into the delivery pipeline. This will depend on their delivery timescale, maturity and needs case. Reinforcements in the delivery pipeline will not be reassessed unless there are substantial changes to the reinforcements or their needs case.

The delivery pipeline will provide confidence to the energy industry and supply chains to help accelerate delivery of these network options. The CSNP will also provide the needs case evidence, linked to Ofgem’s funding decisions. The needs case of reinforcements will be driven by the timing and extent of additional boundary capability provided and any additional drivers such as customer connections, non-load related investments, sunk costs or reuse of assets.

Strategic parameters

Alongside the needs case, the CSNP will determine the strategic parameters as of the reinforcements and infrastructure that progress into the delivery pipeline. The strategic parameters, as listed in Table 5, define the critical considerations and choices when planning significant network infrastructure.

The National Policy Statements (NPS) for energy⁵⁶ acknowledge and recognise the need for and accept the strategic parameters for network infrastructure in the CSNP. The CSNP will also provide the Scottish⁵⁷ and Welsh⁵⁸ governments with a plan they may choose to endorse. This will help accelerate the consenting process and support the upgrade of the network, subject to statutory environmental assessments.

⁵⁶ UK government, [gov.uk/government/collections/national-policy-statements-for-energy-infrastructure](https://www.gov.uk/government/collections/national-policy-statements-for-energy-infrastructure)

⁵⁷ Scottish Government, [gov.scot/publications/national-planning-framework-4/pages/3/](https://www.gov.scot/publications/national-planning-framework-4/pages/3/)

⁵⁸ Welsh Government, [gov.wales/national-planning-policy](https://www.gov.wales/national-planning-policy)

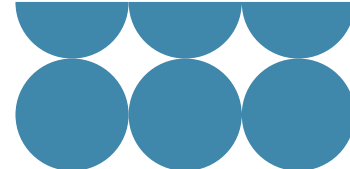
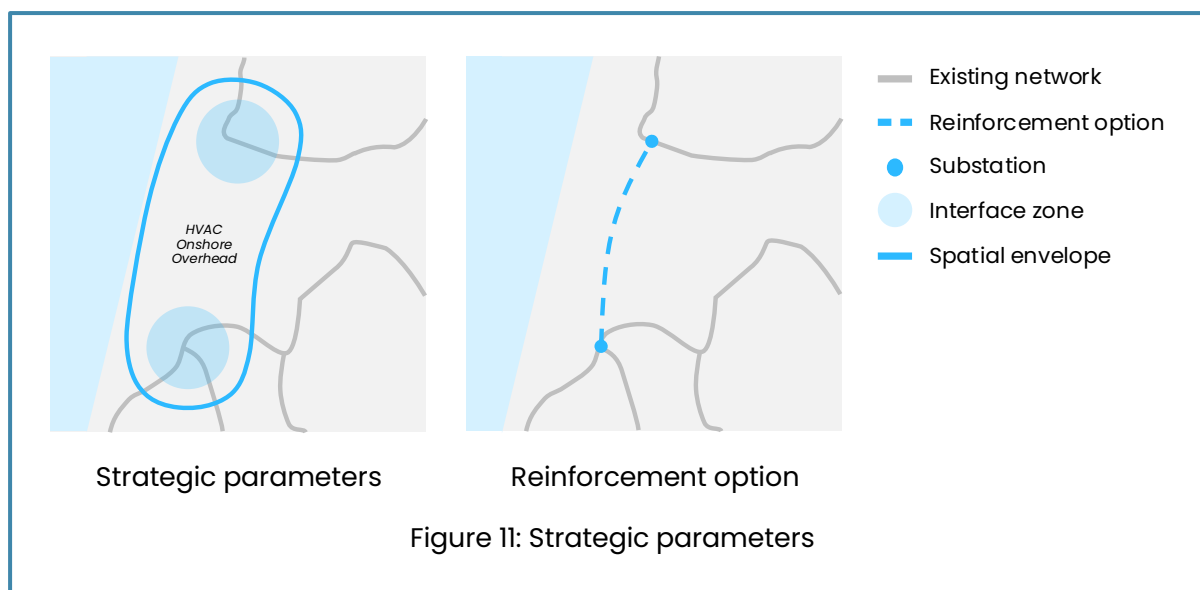
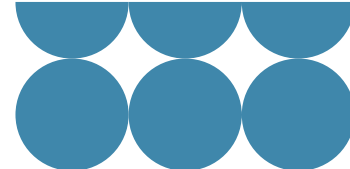


Table 5: Strategic parameters

Parameter	Wider reinforcements	Offshore infrastructure
Spatial envelope	The broad geographical area in which a reinforcement is required.	The broad geographical area in which a connection or reinforcement is required.
Technology type	The type of reinforcement, such as High Voltage Alternating Current (HVAC), High Voltage Direct Current (HVDC) or upgrades to the existing network and its minimum capability, capacity and voltage.	The type of connection or reinforcement, such as High Voltage Alternating Current (HVAC), High Voltage Direct Current (HVDC) and its minimum capacity and voltage.
Strategic design	The high-level design of a reinforcement, including whether it is onshore or offshore, predominantly overhead or underground and any strategic mitigation.	The high-level design of a connection or reinforcement, including whether it is coordinated with offshore assets, generators or infrastructure.
Interface zones	The areas of the transmission system which a reinforcement will connect between.	The areas of the onshore or offshore transmission system where a connection or reinforcement will connect between.

The strategic parameters, including the spatial envelope and interface zones, will provide flexibility to accommodate decision making throughout the delivery pipeline, including opportunities for local engagement. However, the needs case and the strategic parameters will not be reassessed unless significant changes occur.

The extent of this flexibility will be evaluated in the Appraise step to determine where choices may impact the coordinated network design across GB. Figure 11 illustrates the strategic parameters of an example new circuit.



The strategic parameters may include multiple reinforcement options, where they provide consistent benefits across the [assessment criteria](#). These would have the same technology type, strategic design and support the same needs case.

Offshore network specific context

Stages of offshore planning in CSNP

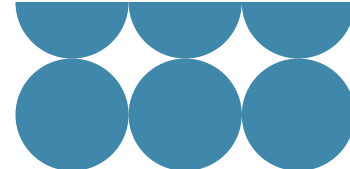
The CSNP plans for the development of both the wider onshore and offshore electricity transmission networks. However, there are elements to the design of the offshore network that are historical and, on an enduring basis, different to the onshore network. In general, this methodology applies to the whole of the electricity transmission network – but there are some elements of offshore network planning that are different and are mentioned in the relevant sections.

Today, the offshore network consists of radially connected offshore wind farms⁵⁹ and interconnectors are point-to-point; there is currently no meshed interconnected network. Whilst further development is planned offshore, some of which will include more coordination, the addition of new significant generation requires new network rather than an extension of the existing network, as can be the case onshore.

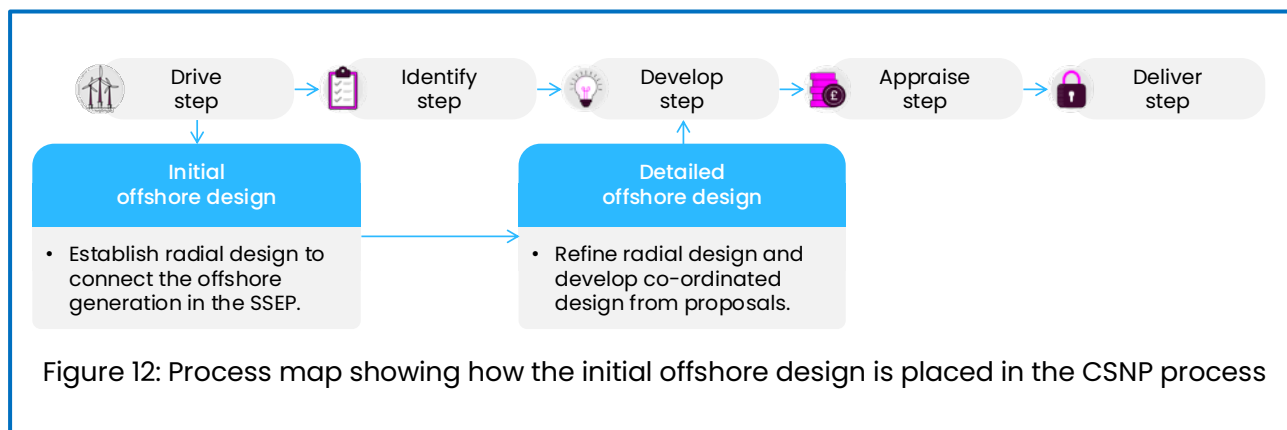
During the Drive step, once the SSEP has developed their shortlisted pathways, the Initial Offshore Design Exercise will create an indicative set of high-level network plans for offshore generation and interconnection. This process will use an initial set of indicative transmission interface points defined in a previous internal process⁶⁰. Interface points are separate to interface zones, as they are a single point on the transmission network where an offshore connection could occur. We will share this initial set of indicative interface points with the transmission owners, along with relevant supporting material to enable

⁵⁹ A radial connection means a single point-to-point link connects an offshore wind farm back to the onshore transmission network.

⁶⁰ This process used the same holistic appraisal as described in the Initial Offshore Design and Detailed Offshore Design sections of the methodology.



any required refinements as designs are produced. Once the SSEP pathway is chosen, this will, by extension, select the initial offshore network design that will be refined and expanded on in the Develop step through the creation of optimised radial and coordinated designs. An indicative design is required due to the lack of existing network offshore to connect new generation to. This will lead to the publication of an initial offshore design for the selected pathway.



During the Develop step, this initial offshore design will be refined by considering different levels of electrical coordination between wind farms, interconnectors and the wider onshore system. External third parties (such as offshore transmission owners (OFTOs) or interconnector developers) will have the opportunity to feedback or submit alternatives at this point. This will be followed by an offshore design freeze to allow for onshore options to be studied using a fixed offshore background. This design freeze will allow time for the offshore options to be assessed as described above and for a preferred radial and coordinated design to be ready for the time when NESO and transmission owners carry out studies on the network at the relevant point in the future.

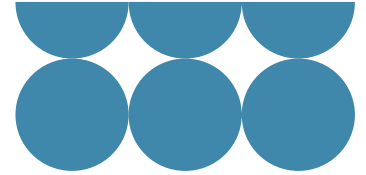
During the Appraise step, the preferred radial and coordinated designs will then be included within the wider appraisal process, resulting in an overall design for the network onshore and offshore.

Defining offshore coordination

Coordination will play a key role in the process to determine the offshore design. This section explains our approach to different forms of coordination and the potential benefits they offer in avoiding network congestion and reducing the need for additional network upgrades.

Our prior planning exercises have highlighted the value of coordinated designs. We've implemented several lessons to enhance these benefits by applying new coordination approaches, including:

- closer collaboration between NESO and leasing authorities developing offshore leasing rounds
- utilising industry standard asset sizes to mitigate supply chain challenges
- considering other ways in which electrical coordination can provide wider transmission system benefits



Role of seabed leasing

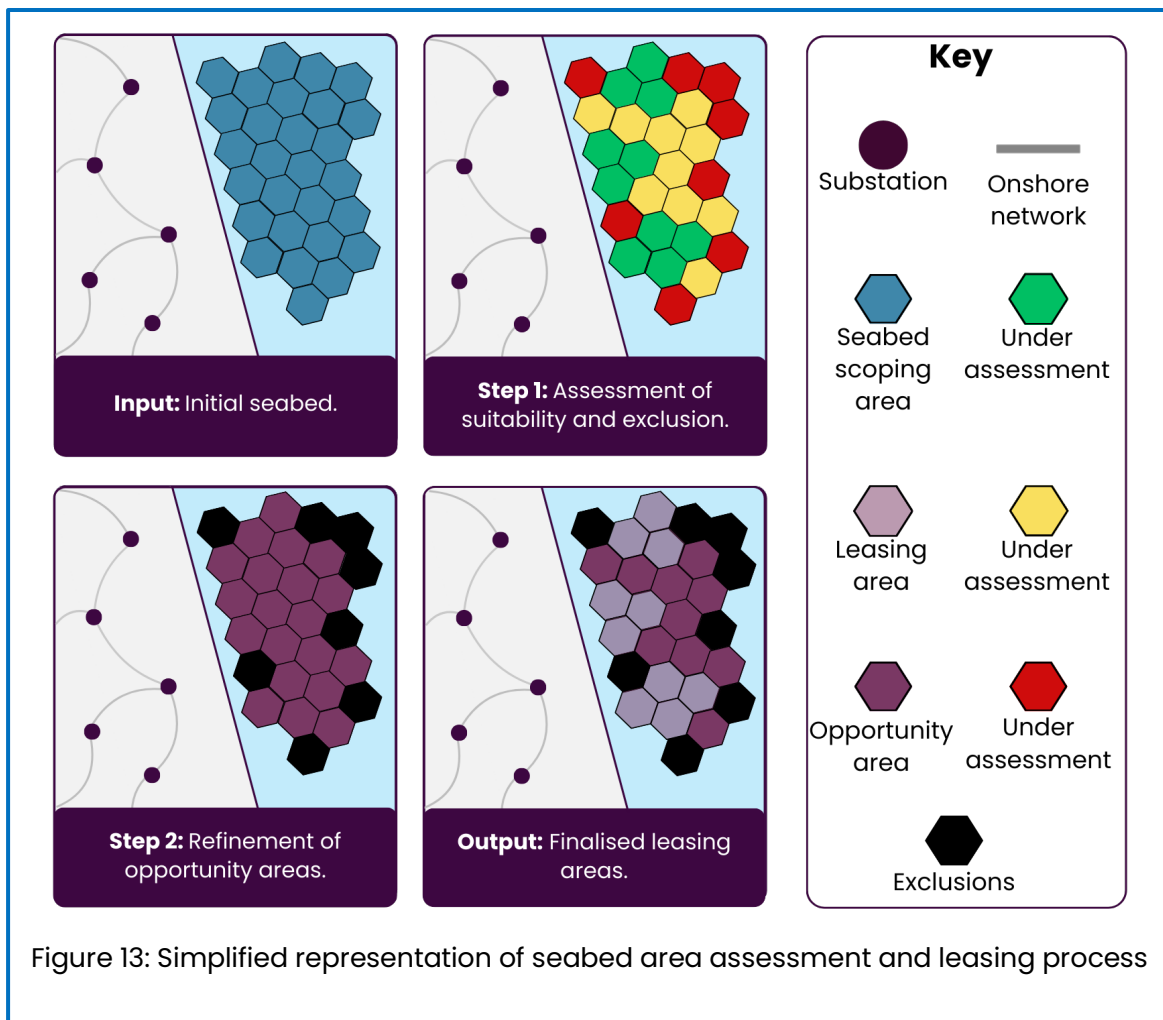
GB has two seabed leasing authorities:

- The Crown Estate (TCE), who are responsible for seabed leasing in England, Wales and Northern Ireland.
- Crown Estate Scotland (CES) who are responsible for seabed leasing in Scotland.

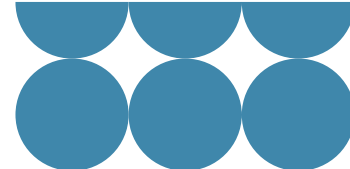
The leasing authorities are responsible for identifying, assessing and subsequently leasing suitable areas for offshore development.

Seabed leasing is a complex process involving extensive analysis that considers a wide range of factors to determine the most suitable areas of seabed for leasing, including wider plans for the use of marine areas. The leasing authorities also engage with a range of stakeholders, including statutory bodies, other utilities, extractive industries and fisheries, to ensure that they balance the needs and priorities of all users of the seabed.

Figure 13 illustrates a simplified representation of a typical seabed leasing design exercise.



There is potential to reduce impacts to the onshore transmission network through early consideration of lease area size and location. Responsibility for selecting and leasing seabed areas sits with the leasing authorities, but through early engagement we can provide network planning input and identify opportunities to minimise the impacts of



offshore assets on the network, the environment and communities. Working closely with leasing authorities can also reduce the risk of misaligned network and offshore leasing planning.

We use the terms ‘strategic’ and ‘spatial’ coordination to broadly describe the processes that can achieve these benefits.

Strategic coordination

Strategic coordination seeks to collaborate between other invested parties in the offshore design. This includes supporting the leasing authority’s determination of capacities and incorporating standardised asset sizes.

Aligning leasing area capacities with standardised cable capacities can reduce the number of cables required for connection and the number of landfalls made. The leasing authorities will need to balance these efficiencies with the complex dynamics involved with siting potential wind farms such as the local geology, wave heights and potential wake effects.

Prioritising consistent offshore asset sizes aims to better support the supply chain by reducing the need for bespoke or novel technologies. The standardised transmission assets would be applicable to export cabling and offshore platforms for both HVAC and HVDC technologies. This seeks to increase industry confidence and the availability of standardised assets and improve the deliverability of our design recommendations. Figure 14 demonstrates how standardising HVDC assets can improve utilisation of cable capacity.

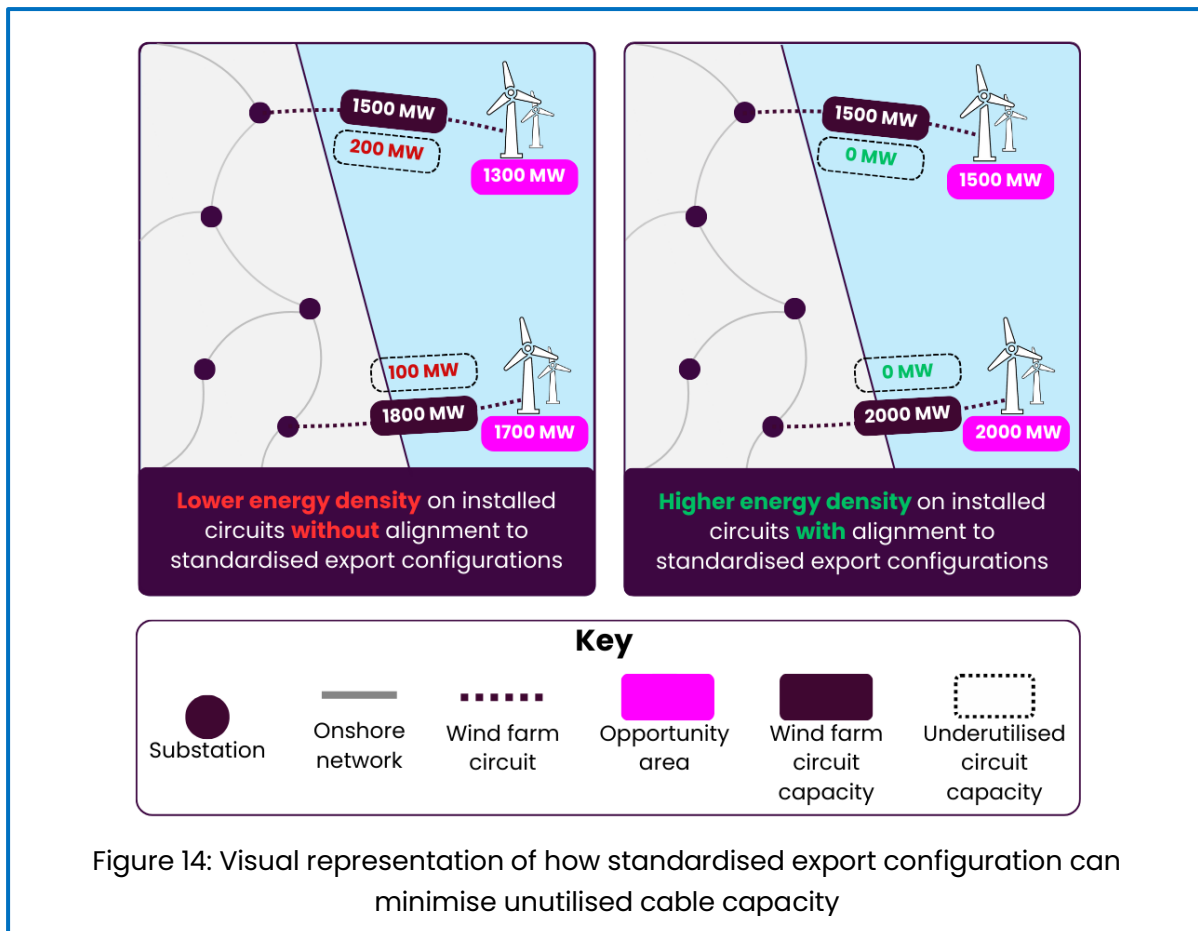
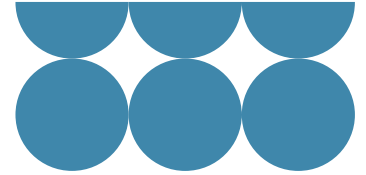


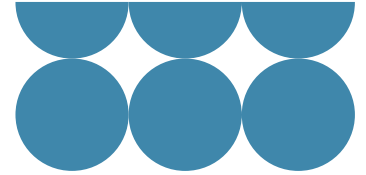
Figure 14: Visual representation of how standardised export configuration can minimise unutilised cable capacity

Engagement with industry has informed our approach for this process and we have subsequently created a set of internal offshore design rules and guidelines incorporating known industry constraints and risks. These will be used to guide our offshore network development process and ensure that we create designs in a consistent and realistic manner. From ongoing discussion, standardisation within the industry has led to four major technology classifications and these are expected to remain standard into the 2040s, as shown in Table 6.

Table 6: Offshore technology classifications

Technology	Capacity limit per circuit	Voltage
HVAC connections ⁶¹	500 MW	132–275 kV
HVDC Symmetric Monopole	1,500 MW	±320 kV
HVDC – Rigid Bipole without dedicated Metallic Return (DMR)	1,800 MW	±525 kV
HVDC – Bipole with DMR	2,000 MW	±525 kV

⁶¹ HVAC circuits should be less than 150 km in total length, with mid-point compensation required for total distances greater than 80 km.

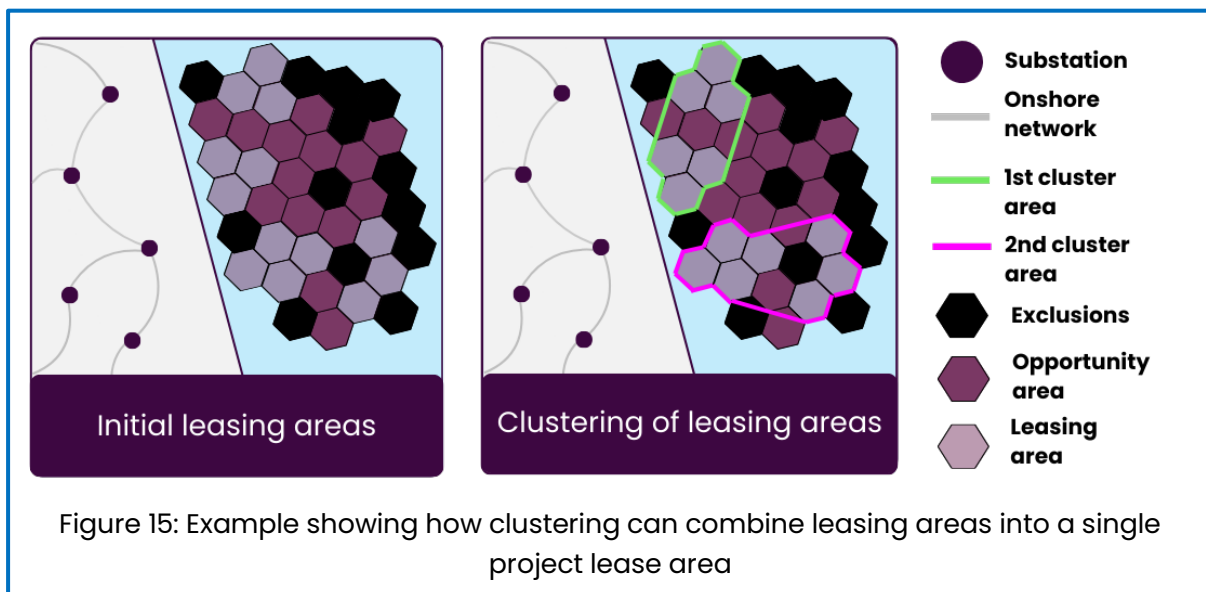


Spatial coordination

Asset standardisation complements spatial coordination. Spatial coordination seeks to align areas of the seabed that may not be able to host a single large wind farm. However, they may be able to host several smaller lease areas that cumulatively total the capacity of a larger wind farm. NESO will investigate whether there is the potential to cluster smaller leasing areas into a single project lease area up to capacities (Figure 14) and the potential to align the size of the lease area with standardised asset sizes.

Benefits of this approach would reduce the number of additional cables to connect smaller offshore wind capacities and hence reduce the environmental and community impact of our designs. Additionally, this would also reduce the complexities of introducing coordination, improve deliverability and lower costs between different projects.

Implementation of these standardisation elements must be done with care and in close collaboration with leasing authorities to ensure that these principles can be incorporated appropriately. Figure 15 shows an example of clustering and how it forms a single project lease area.



Strategic and spatial coordination will be explored and applied during our indicative offshore design process to provide a credible and robust initial design.

4. Section 3: Electricity – Drive

Setting the future energy pathways and foundations

Roles and responsibilities





Setting the future energy pathways and foundations

The purpose of the Drive step is to define the baseline and future state of the energy system, against which requirements are identified, options developed and appraised and the CSNP produced.

There are four key parts of the Drive step are:

- energy pathways
- the design standards and principles
- the initial offshore design exercise
- the baseline electricity transmission network

These activities are primarily undertaken by NESO.

Energy pathways

The route to clean energy requires fundamental changes to the future energy mix. In this context, and to support long-term network planning, it is important to look ahead and align with a vision of the future energy system against which the network can be planned.

We will create a 25-year supply and demand pathway to inform the power system and economic modelling in the CSNP. The plan will use the SSEP pathway, selected by the UK Energy Secretary. Based on the SSEP pathway, the CSNP will plan onshore and offshore transmission networks.

Our 25-year supply and demand pathway will take the output from the selected SSEP pathway and, combined with data from the Connection Queue (for example, the TEC register⁶²), will inform the development of a power system model and an economic dispatch model for use in later steps of the process, starting with Identify.

We will also analyse other energy pathways for further insights in the Appraise step, such as during sensitivity analysis. For example, we may use FES⁶³ to provide a range of different energy scenarios. The insight gained from other scenarios, or variations, may be considered by the CSNP governance and is further discussed in the [sensitivity analysis](#) section.

⁶² NESO, neso.energy/data-portal/transmission-entry-capacity-tec-register/tec_register

⁶³ NESO, neso.energy/publications/future-energy-scenarios-fes



Alignment with the Strategic Spatial Energy Plan (SSEP)

The SSEP methodology⁶⁴ uses zones in its economic modelling to efficiently match the spatial and temporal needs for energy supply with network and demand. The transfer of electricity between these economic zones is limited by a set of boundary capabilities. The economic model might increase boundary capabilities at a cost to improve results, assuming boundary reinforcement.

For bulk electrical power flows, the CSNP will identify network capability and requirements at a greater level of detail following input from the SSEP pathway. We will use additional boundaries developed over many years of operating and planning the transmission system. For each boundary, the Security and Quality of Supply Standard (SQSS)⁶⁵ required transfers and expected annual power flows will be identified to develop the reinforcement options.

This will enable the CSNP to plan the wider network for future customer connections informed by the SSEP.

Design standards and principles

Security and Quality of Supply Standard and resilience

We plan and operate the electricity transmission system to the relevant codes and standards, including the Grid Code and SQSS. The SQSS sets out the criteria and methodology for planning and operating the National Electricity Transmission System (NETS) and includes the definitions of events that the network is secured for, to ensure the system is resilient. In addition, there are other design requirements such, as critical national infrastructure (CNI) considerations, that those submitting options need to consider.

The CSNP helps to strategically plan the wider transmission network, but the CSNP alone does not ensure a compliant system. NESO and regulated entities have a role through licenses in ensuring a safe and secure network, including in connections and compliance and our activities in operability and real-time operation.

The GB electricity transmission system has historically demonstrated high levels of resilience. As the system evolves, climate change intensifies and, given the pivotal role of electricity in society and the economy, it is important that a resilient system is maintained.

⁶⁴ NESO, [neso.energy/what-we-do/strategic-planning/strategic-spatial-energy-planning-ssep](https://www.neso.energy/what-we-do/strategic-planning/strategic-spatial-energy-planning-ssep)

⁶⁵ NESO, [neso.energy/industry-information/codes/security-and-quality-supply-standard-sqss](https://www.neso.energy/industry-information/codes/security-and-quality-supply-standard-sqss)



Electricity resilience is considered in both network planning and wider industry activities. In the CSNP, this will include the application of the SQSS and consideration of potential resilience events.



Security of supply

In this methodology, security of supply means the ability to operate the NETS within acceptable limits, even if an event were to occur that would lead to the loss or compromise of an asset.

The SQSS sets out the criteria and methodology for planning and operating the NETS. This is fundamental to the CSNP. We will study secured events as appropriate in accordance with the SQSS, such as the loss of a single transmission circuit, reactive compensator or section of busbar and the loss of a double circuit overhead line. We will also analyse peak demand conditions to ensure the system is designed to be resilient.



Resilience events

Resilience events in the CSNP, as shown in [Appendix C](#), will consider risks that may have a high impact on bulk power flows across the NETS. Our approach to considering resilience events is explained in the [Appraise step](#).



Industry activities

Beyond the CSNP, our resilience and emergency management⁶⁶ role considers system resilience and preparation for emergencies. We continuously assess various risks to the energy system so that we can reduce vulnerabilities and coordinate the preparation for emergency response across the energy sector. These risks include potential malicious attacks on infrastructure.

Resilience will also be integrated into the CSNP by using energy pathways with embedded resilience. The SSEP methodology sets out its approach to weather and security of supply. We will also account for resilience in our economic modelling by:

- utilising weather assumptions
- allowing no unserved electricity following redispatch

⁶⁶ NESO, [neso.energy/what-we-do/resilience-emergency-management](https://www.neso.energy/what-we-do/resilience-emergency-management)



- factoring plant availabilities into our modelling

Many aspects of resilience will also be indirectly considered in the CSNP and managed by the transmission owners or addressed through relevant standards. For example, the SQSS requires limits to the loss of power following secured events.

Electricity Transmission Design Principles

In 2023, the Electricity Networks Commissioner proposed recommendations on how to accelerate the deployment of strategic electricity transmission infrastructure in GB. The UK Government adopted these recommendations, which now form the basis of the Transmission Acceleration Action Plan (TAAP)⁶⁷. The TAAP sets out 43 recommendations, which collectively seek to reduce build time of electricity transmission network infrastructure from 14 to seven years.

Recommendation “RD1” of the TAAP sets out that Electricity Transmission Design Principles (“the Principles”) be created to provide greater clarity on the type of asset to be used in different environments.

The Principles sit in the context of other planning reforms by the UK Government to speed up and streamline the delivery of new critical infrastructure. This includes updating the National Policy Statements for energy infrastructure⁶⁸, which set out that developers of electricity transmission infrastructure should have regard to the Principles.

The Principles consider strategic, network planning and project development needs. They have been developed by the NESO and other industry stakeholders through a working group, and the draft Principles were also consulted on⁶⁹.

The Principles provide greater clarity on:

- the type of asset to be used in different environments
- how to consider the mitigation of the impact of transmission infrastructure on the environment and communities
- flexibilities available for route and technology design

Projects considered within the CSNP will be expected to have regard to the relevant Electricity Transmission Design Principles. However, we do not specify how this will be represented or monitored in this methodology. This will instead be captured through the working and governance processes as the CSNP and options develop.

⁶⁷ UK government, [gov.uk/government/publications/electricity-networks-transmission-acceleration-action-plan](https://www.gov.uk/government/publications/electricity-networks-transmission-acceleration-action-plan)

⁶⁸ UK government, [gov.uk/government/collections/national-policy-statements-for-energy-infrastructure](https://www.gov.uk/government/collections/national-policy-statements-for-energy-infrastructure)

⁶⁹ NESO, [neso.energy/document/368061/download](https://www.neso.energy/document/368061/download)

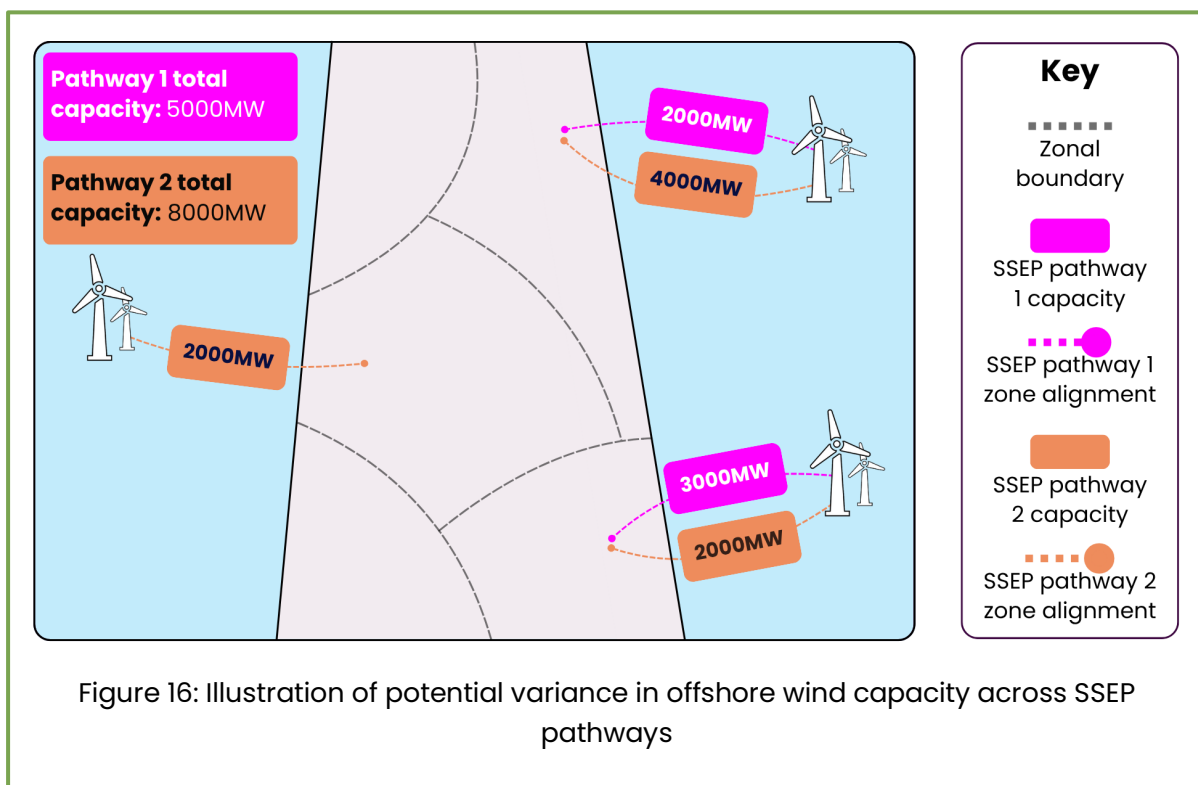


Initial offshore design

The SSEP will create multiple pathways, demonstrating different ways in which GB's energy system could be developed in the future, including a range of offshore requirements. These pathways will be presented to the UK Energy Secretary for consideration prior to the CSNP. As shown in Figure 12 (under "[Stages of offshore planning in CSNP](#)" above) indicative offshore designs will be created for each of these pathways.

An initial offshore design therefore needs to be created for each SSEP pathway to ensure that analysis to identify system requirements for the CSNP can begin at pace once a preferred pathway has been selected. This will provide an indication for future onshore requirements and act as a foundation for further refinement.

There are a range of different opportunities for developing new offshore wind and interconnection to neighbouring countries. As such, potential offshore designs could look very different between pathways. Figure 16 illustrates how two pathways can differ in offshore wind levels between zones, changing network requirements and flows and therefore the overall designs. Note that the capacity figures and regions are for illustrative purposes only.



As the SSEP makes capacity recommendations on a zonal basis, it is necessary to attribute the capacity from each SSEP pathway back to specific points on the network. These connections will align with the SSEP recommendations through only considering interface points within the relevant onshore SSEP zone.

Each assumed wind farm location (the final locations used for any future leasing process are the responsibility of the leasing authorities) or interconnector will need to be attributed to a specific interface point on the onshore transmission system. The indicative



offshore design will do this based on the rankings established for interface points in the prior strategic analysis. The order of these connections will be based on the date of connection as modelled in each SSEP pathway.

Each design will account for the variation in location, volume and different types of generation technology (for example, fixed or floating offshore wind) recommended by the respective SSEP pathways. Each design will also be assessed to understand the level of onshore works required for each design, but this is not detailed enough to identify individual works at this stage.

To ensure that a robust set of designs can be established within the short time between the SSEP pathways being finalised and the UK Energy Secretary’s decision on a final pathway, several different approaches and assumptions will be taken to streamline the assessment and establish a baseline for each pathway:

- The initial designs will first investigate point-to-point interconnectors and radial offshore wind farm connections to meet the requirements of the shortlisted SSEP pathways.
- Standardised asset sizes will be used to meet the regional capacity requirements identified by the SSEP, allowing us to quickly establish a robust and deliverable generation background. Using a range of standardised asset sizes will allow us to optimise specific elements of the network design.
- It will be assumed that interconnectors have the same landfall and onshore spatial requirements as offshore wind farms with HVDC connections. At this stage, we will also assume that the electrical requirements (such as capacity on the local network) for interconnectors and offshore wind are similar to simplify the design process. However, this will be expanded to fully model electrical flow in both directions once a design is taken forward for further refinement. This does not mean that offshore wind farm and interconnector connections can be interchangeable.

Additionally, prospective interconnector options will be considered against:

- the high-level electrical limitations of each connecting market, such as the distinct infrequent loss of infeed limits of the Nordics, as identified through the prior strategic analysis
- a spatial map which ensures that interconnection options between each SSEP region and the proposed foreign market is viable, ensuring that any combinations that are clearly not viable (such as connections between North Wales and Denmark) are not considered

We are also engaging multilaterally with European TSOs throughout the design process as part of our contribution to the Offshore Transmission System Operator Collaboration (OTC) working group. The group’s third expert paper “Joint Planning in Europe’s Northern Seas⁷⁰” has helped inform our view of future cross-border opportunities. We will also

⁷⁰ OTC, offshore.amprion.net/Mediathek/Expert-Paper-III-TSO-Collaboration-040425.pdf



engage bilaterally with individual European TSOs to refine our planning assumptions at this stage.

The initial offshore design developed for each SSEP pathway will then be assessed against the CSNP's assessment criteria, at a high-level. To achieve this, the SSEP's zonal capacity values will be allocated to individual interface points to guide the design process.

As illustrated in Figure 17, some SSEP zones may have more than one potential interface point (or no viable interface points). Alternative designs within each pathway will be appraised to determine the most optimal interface points in each SSEP zone at this stage in the process, which may be one or more of the available interface points.

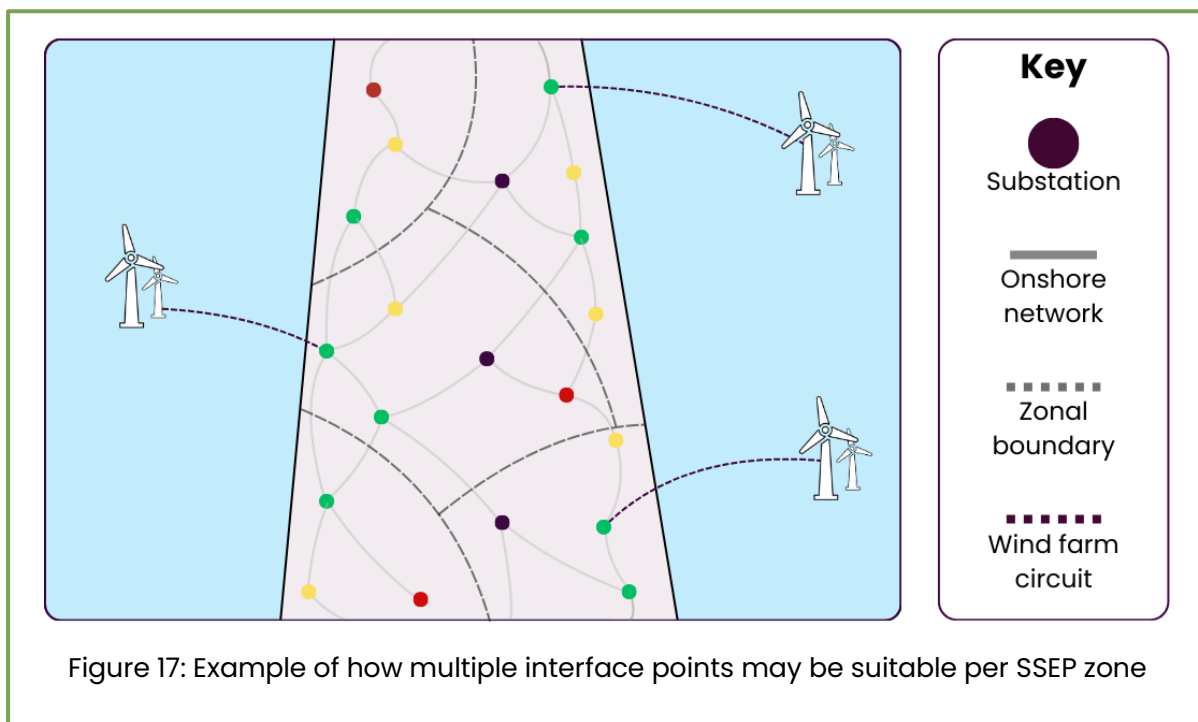


Figure 17: Example of how multiple interface points may be suitable per SSEP zone

Our design process aims to avoid known marine and other constraints (the types of constraints considered are explained in the Appraise section) at an early stage of the IODE where possible, and will use broad, indicative routing to achieve this.

The designs will also consider the potential network impact of connections at the individual interface point and surrounding transmission network. This will provide a starting point for the system's requirements analysis to understand the impact of the connection on local and wider power flows.

Publication

Following the selection of an SSEP pathway, the corresponding indicative offshore design will be developed and shared alongside system requirements and will give stakeholders an opportunity to review, provide feedback and propose alternative solutions. Following its publication, further opportunities for electrical coordination will be considered as the design is refined. This process is covered in more detail in the [Develop chapter](#).



Baseline transmission network

It is necessary to define which network sits in the background of the analysis that is undertaken in the CSNP and, therefore, which network needs to be reassessed. Importantly, the network which is in the baseline is not subject to reassessment and its impact on all factors (cost, electrical, environmental and so on) will be assumed in the baseline of all analysis.

The baseline transmission network will be determined during the Identify step, in partnership with the existing TOs and Ofgem. The baseline network is expected to include two key elements, consisting of:

- the existing onshore and offshore GB transmission network, removing any elements that are expected to be decommissioned
- the planned onshore and offshore GB transmission network, where there is certainty through regulatory funding (such as the projects funded under the delivery track framework in Ofgem's tCSNP2 funding decision⁷¹)

During the Deliver step, the change control process can highlight options that need to be re-evaluated in the subsequent CSNP. Such options, identified for reassessment after change control, are not included in the baseline. For the first CSNP, the baseline is expected to include all the reinforcement options which form the baseline of the tCSNP2 Refresh. It is also expected to include any projects from the tCSNP2 Refresh that Ofgem decides to fund for delivery (i.e. for preconstruction work as per its RIIO 3 framework), as adjusted by any subsequent checks such as validating against the chosen SSEP pathway.

The baseline will be agreed through the CSNP governance, and details will be published alongside the system requirements in the [Identify step](#).

⁷¹ Ofgem, [ofgem.gov.uk/decision/funding-and-approval-framework-onshore-transitional-centralised-strategic-network-plan-2-projects-decision](https://www.ofgem.gov.uk/decision/funding-and-approval-framework-onshore-transitional-centralised-strategic-network-plan-2-projects-decision)



Roles and responsibilities

Initial offshore design

In the initial offshore design stage, NESO will be responsible for producing and appraising the draft initial offshore designs, along with the other relevant work at this stage. Following the selection of an SSEP pathway, the corresponding indicative offshore design will be published by NESO.

Baseline transmission network

NESO will work with transmission owners and Ofgem to create a list of reinforcement options to form the baseline for the CSNP. The baseline will be agreed through the CSNP governance and details will be published alongside the system requirements in the Identify step.

5. Section 3: Electricity – Identify

System requirements

Bulk power flow analysis

Residual operability analysis

Analysis framework





System requirements

We expect that the electricity transmission network will require significant investment to enable power to get to where it is needed, when it is needed and ensure continued access to reliable, clean and affordable electricity.

In the Identify step, we will consider power-system requirements arising from both bulk power flows and residual operability, based on the energy pathways developed in the Drive step. All requirements will be published.

This section of the methodology has three sections, consisting of:

- identification of bulk power flow requirements
- identification of residual operability requirements
- a discussion of the analytical framework for reinforcement options for bulk power flow and residual operability requirements

In the case of bulk power flow requirements, the three-yearly cycle will identify where future bottlenecks might occur. The publication will allow transmission owners, NESO and third parties to prepare options in the Develop step. These options should cover both thermal and other operability challenges.

For residual operability challenges, the annual cycle will identify where there are residual operability requirements remaining following the assessment of bulk power flows and are important to identify on an annual basis due to their dependence on changing system conditions. Following the Identify step, and as part of the procurements of Network Services⁷², the requirements will be published. Network Services' procurements are outside of the CSNP methodology and are run separately by NESO.

The majority of the analysis in this section is undertaken by NESO, in partnership with the asset owners of the current network – the transmission owners. As such, some of the further details regarding data exchange and model creation form part of the updated System Operator and Transmission Owner Code (STC) and associated procedures (STC-P). The STC and STC-Ps will be updated, in accordance with the principles set out in this methodology and following the code change process for the STC.



Bulk power flows

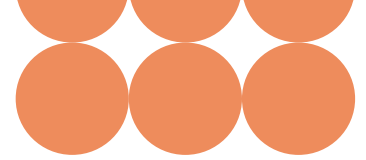
We will use the concept of boundaries, which can be limited by thermal circuit ratings, voltage constraints and system stability, alongside additional insight from



Residual operability

On an annual basis, we will also identify residual requirements, including high and low voltage needs as well as inertia and system strength requirements. Following

⁷² NESO, [neso.energy/industry-information/balancing-services/network-services](https://www.neso.energy/industry-information/balancing-services/network-services)



thermal loading analysis, to inform when and where additional capability may be needed and the development of reinforcement options every three years.

our analysis, we will signal opportunities for transmission owners and industry to meet needs through Network Services.

As the CSNP covers long-term investment planning time horizons, system requirements analysis relies on assumptions about future network conditions and scenarios. At these early stages, detailed technical parameters (such as specific network designs or vendor-level information) are not yet available. As more granular data becomes available through the delivery pipeline, subsequent CSNP cycles will incorporate the revised and refined data.

Given the inherent uncertainty in long-term forecasting, the CSNP analysis cannot capture every future operational or network condition. Instead, it aims to provide a robust view aligned with the best information available at each cycle.



Bulk power flow analysis

Boundaries

Overview

The transmission network allows electricity to get from areas where it is generated to where it is used. Boundaries split the transmission system into multiple parts, crossing critical circuits that carry power between areas where power flow limitations may occur. NESO will use the concept of boundaries to publish future network requirements for the SSEP pathway and other energy pathways, as necessary.

These requirements, comprising an indication of expected power flows throughout the years, will help inform the development of reinforcement options for the next 25-years. NESO and transmission owners will then undertake power system analysis to determine future boundary capabilities.

The boundary capability is the maximum power flow that can be securely transferred across the boundary, while maintaining compliance with the SQSS. Limiting factors on capability can include:

- thermal circuit rating
- voltage constraints
- system stability

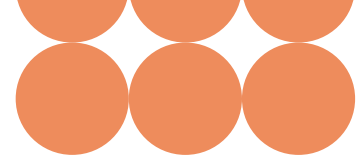
Boundaries are useful for showing network capability and long-term power flow requirements. They have developed over many years of operating and planning the transmission system and enable requirements between different energy pathways to be compared to previous publications, such as the Electricity Ten Year Statement (ETYS)⁷³.

Two types of boundaries will be used in the CSNP:

- **Local boundaries** – encompass small areas of the network containing a high concentration of generation. These power export areas can present a high probability of overloading the local transmission network.
- **Wider boundaries** – split the network into large areas containing significant amounts of generation and demand. The SQSS required transfers for these boundaries will be determined by the economy criteria and security criteria set out in the SQSS.

When major changes occur, boundaries may be updated or removed after relevant consultation and following the relevant STC Procedure. Most boundaries will remain unchanged, as they remain valid for assessing electricity transmission constraints and comparing previous network capability.

⁷³ NESO, neso.energy/publications/electricity-ten-year-statement-etys



Analysis

Network requirements will be determined from a regional allocation of generation and demand according to the SQSS planning criteria and our economic modelling tool. The economic modelling tool will prioritise the cheapest available generation to minimise operating costs. It will utilise demand data, weather assumptions and representation of the European markets to determine interconnector flows.

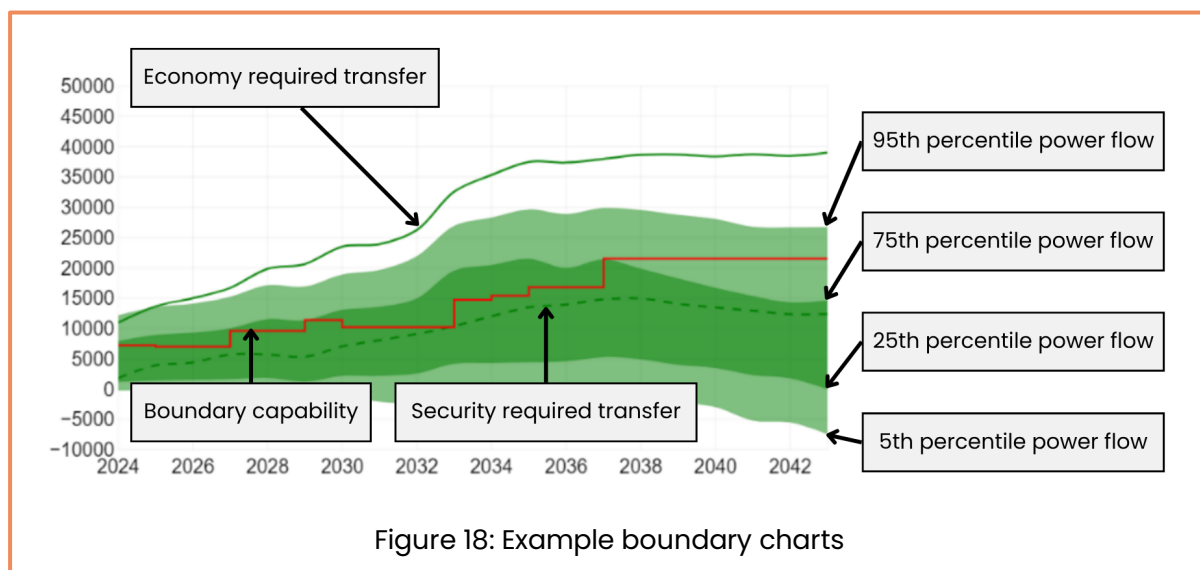
Publication

For each boundary and different energy pathways, a chart and accompanying data will be published, showing:

- SQSS required transfers
- annual unconstrained power flows
- future boundary capabilities

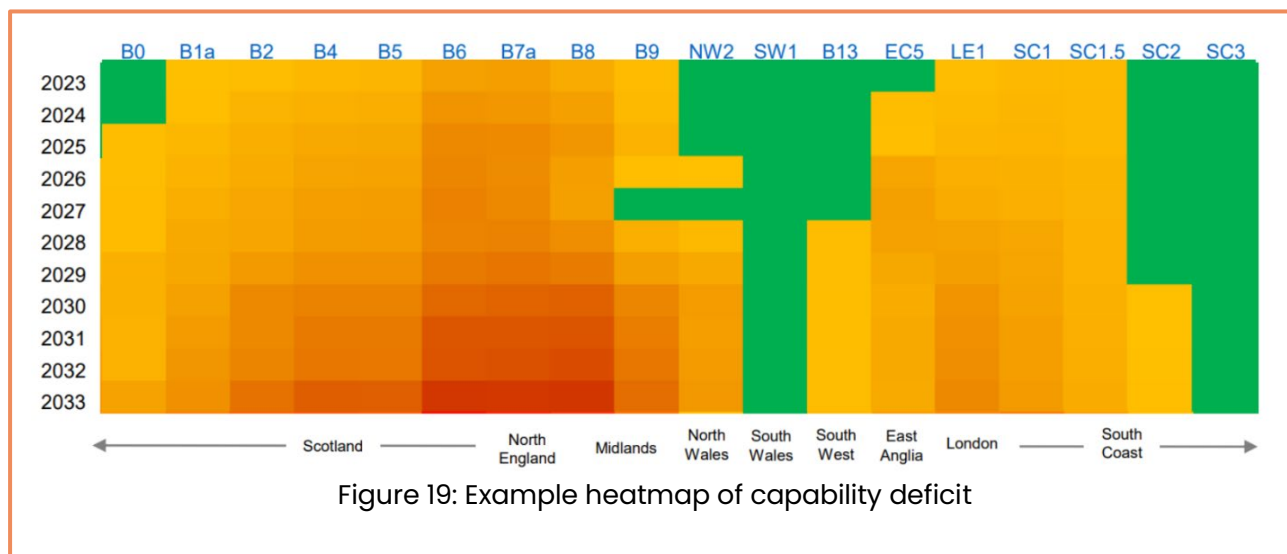
The charts, as illustrated in Figure 18, will indicate where the expected future needs could be in comparison with expected power flows and future boundary capabilities. Each chart will indicate the confidence of power flows across each boundary by showing areas reflecting 50%, between the 25th and 75th percentile and 90%, bound by the 5th and 95th percentile, of the expected annual power flows. For example, the 95th percentile reflects that 95% of annual power flows across the boundary are lower than this level. The horizon covered by the charts will extend out to 25 years.

To enable the timely development of reinforcement options, the published charts will initially use boundary capabilities from NESO's latest network plan to reflect where additional reinforcement may be required. These will be updated after the boundary analysis to reflect the new reinforcements following the [Appraise step](#). At this point, the charts could be used to evaluate deviations from the SQSS required transfers and any need for derogations.





A summary heatmap, as shown in Figure 19, will also be provided. This will indicate which boundaries require additional capability.



Thermal loading

Overview

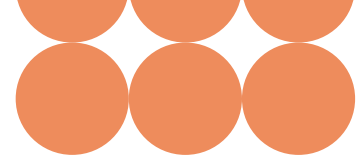
Alongside boundary analysis, NESO will also conduct year-round thermal loading analysis using the SSEP pathway. This will provide insight on thermal overloads at a circuit-level and consider a wide range of system conditions. This innovative analysis will provide additional insight within a 15-year horizon ahead of the Develop step to support more targeted reinforcement options and opportunities for commercial solutions.

While the boundary concept is a useful representation of network requirements and capability, it cannot fully reflect the variation in capability that might arise under different system conditions across the year. Additional thermal analysis at a circuit level, rather than at boundaries, and across the year, will provide insight on which individual circuits and assets experience thermal overloads, driven by credible conditions that may not be considered through the boundary analysis.

Analysis

The thermal analysis will be conducted on network planning models with year-round dispatch of generation and demand applied from the same pan-European economic modelling tool and approach as outlined in the [Appraise step](#). Unlike the winter peak boundary analysis, which does not consider planned network outages, the year-round analysis can include these outages to understand potential impacts on the transmission network.

To capture the variations in system conditions throughout the year, each year will be divided into time blocks of a minimum of three-hours. The network conditions for each time block will be analysed considering varying demand, generation, secured faults and anticipated outages. At a three-hour time block duration, each year would be split into, and analysed across, 2,920 individual blocks. From analysing the data from all the time



blocks, the magnitude and frequency of individual circuit and asset overloads will be identified to inform an overload severity index for each year studied.

As well as providing insight on individual circuits and assets, the analysis will provide more understanding of boundary capabilities. By studying a wide range of network conditions, the analysis will indicate a credible range of boundary capabilities across the year. For each time block analysed, and by considering whether individual circuits and assets are overloaded, the study can define the boundary transfer state as either overloaded or not overloaded. This may be used to inform additional sensitivity analysis for boundary capabilities.

Publication

For each boundary, charts such as Figure 20 will be published, showing transfers as either overloaded or not overloaded. This is an example of summarised data produced from modelling a full year's unconstrained network operation and evaluating the network loading and boundary transfers.

Large periods of overloading indicate possible high constraints and the need for network reinforcement options. No overloading indicates where less reinforcement is needed. The vertical line between the overloaded and not overloaded areas is the boundary capability. There may be an overlap between the overloaded and not overloaded states, which indicates that the boundary capability is variable over this range. In the example shown, the boundary capability could range between the start of the overloaded area (near 5 GW) and the end of the not overloaded area (near 7 GW).

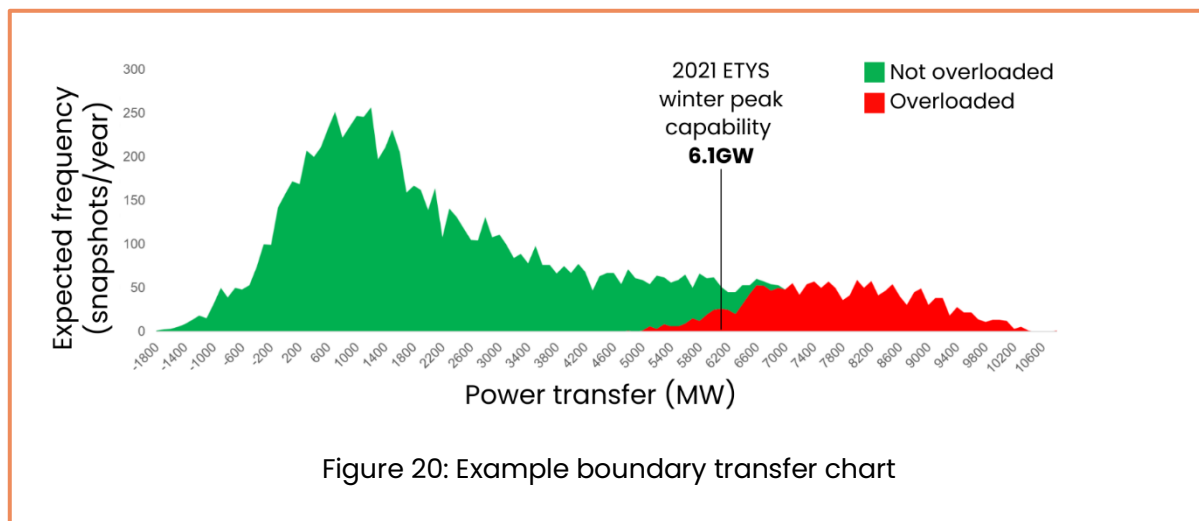
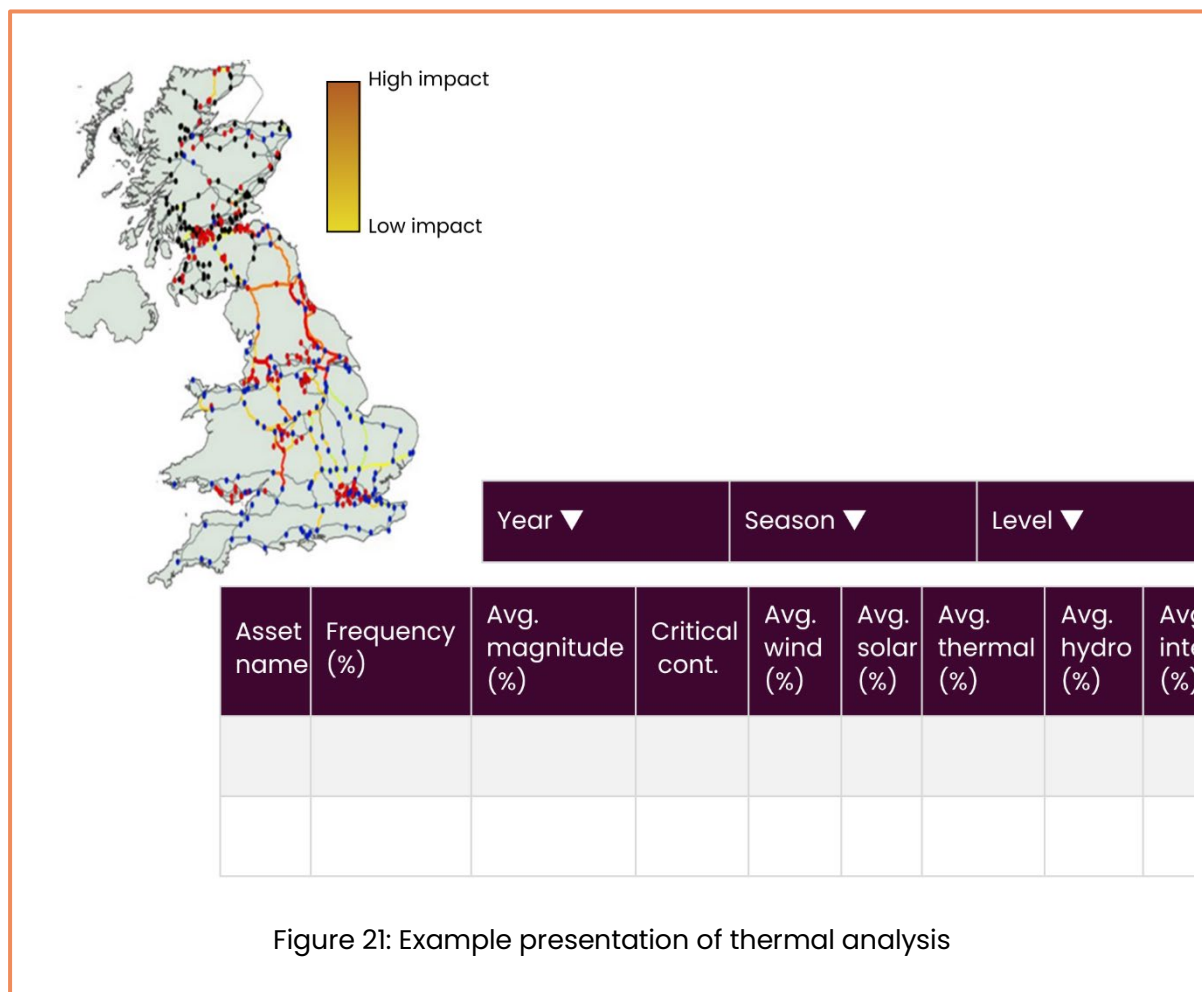


Figure 21 is an example of how network modelling at an individual circuit and asset level may be presented. Alongside a geographical representation of the network, data will be provided on:

- overload frequency
- overload magnitude
- corresponding network conditions



This will highlight the circuits and assets that may have the highest impact on future network operation across the year. Data sorting and filtering will be provided to allow selection of specific parameters such as year, season and background conditions.



Roles and responsibilities

NESO shall produce the pathways and use them to produce the boundary requirements, which we will publish for all option developers to use.

The system requirements thermal loading analysis shall be conducted by NESO, using the latest available network planning models produced in collaboration with the TOs and under the STC modelling procedure. The results of the analysis shall be published by NESO, following the boundary requirements.



Residual operability analysis

Residual stability

Overview

NESO will conduct residual stability analysis on an annual basis to ensure the safe and reliable operation of the electricity network. The analysis will use the latest annual FES pathway update, if available. The study will include a year-round assessment of the system inertia and system strength (further categorised as phase locked loop stability and transient voltage stability) at credible worst-case conditions. This analysis will be conducted within a ten-year horizon.

NESO's residual stability analysis will consider as baseline network conditions the following data, if available: the latest TO investment plans (including the ones triggered by the CSNP boundary analysis), TO approved regulatory plans, connections enabling works and asset replacement plans. Therefore, the residual studies will account for requirements arising beyond other investment processes, considering requirements driven by wider system changes such as in generation, demand and network configurations.

NESO will collaborate with TOs ahead of analysis to establish guidelines and required inputs on network models. We will welcome any independent analysis conducted by TOs. Where we choose to meet any residual requirements through a Network Services' tender, requirements will be shared with TOs and third parties concurrently to allow all interested parties to develop and propose solutions.

Inertia

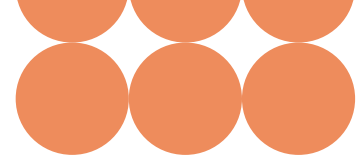
Inertia is the sum of the kinetic energy stored in the rotating parts of synchronous machines, and some industrial motors, connected to the system as well as similar energy provided by grid-forming (GFM) inverter-based resources (IBR). In the case of system frequency changes, like a disturbance caused by a generator or demand tripping, this stored energy can temporarily reduce the rate of change of frequency (RoCoF) helping to maintain frequency stability.

With the increasing displacement of synchronous generators with IBRs, traditional sources of inertia are reducing. Alternative sources must be found to ensure the safe and secure operation of a clean power system.

The purpose of the inertia study is to assess available inertia in the future and to identify potential deficits in meeting minimum system inertia requirements.

System strength

System strength is the power system's ability to maintain stable voltage in response to system disturbances. At NESO, system strength needs are categorised in the context of minimum short circuit level (SCL). SCL is the amount of current that flows on the system during a fault. The faults can be caused by events such as a lightning strike, adverse weather conditions or equipment failure. High levels of SCL help maintain system voltage



stability and enable quicker recovery from disturbances. In a weak system, characterised by low system strength, a small injection of current typically brings about a large change in voltage. In a strong system, characterised by high system strength, a small injection of current typically causes a small change in voltage.

SCL in the network varies throughout the year depending on generation and demand. In winter, more generators and synchronous plants run to meet the high levels of demand. In summer, less generators and synchronous plants run due to the low levels of demand. SCL in the network typically reaches a peak value during winter and a minimum value during summer.

Peak and minimum SCLs have different implications for power system operation. Upper thresholds for peak SCL values are subject to the ratings of power system protection equipment and the maximum fault current they can withstand. Other power system parameters, such as ratings for mechanical loading of busbar systems, also depend on upper thresholds for peak SCL values. Lower thresholds for minimum SCL are important for transient voltage stability in the power system.

In general, SCL in the network has been decreasing due to the shift from synchronous plants to inverter-based renewable sources, like wind and solar, which produce lower fault currents compared to synchronous machines. This decrease is more prominent during system minimum conditions, when low levels of synchronous plants are running. Synchronous machines are generally more expensive to run, so they are used only when demand is high or they need to run to satisfy operational constraints in the system.

The focus of the system strength study as part of the stability analysis is on a system minimum SCL condition only, usually seen during the summer.

Phased locked loop stability

Most IBRs connected to the system today were designed using grid following (GFL) technology, meaning that they need a strong system for stable operation. GFL plants rely on phase locked loop (PLL) controllers to track system voltage to remain synchronised to the system and maintain stable operation.

With low levels of system strength, network voltage waveforms are more volatile during a network disturbance which increases the risk for PLL to lose track of system voltage waveform and phase, leading to desynchronisation or instability. Newer IBR converter designs with grid-forming (GFM) technology behave similarly to a synchronous machine and do not rely on PLL to remain synchronised to the system. As a result, GFM plants can work in a weaker system without PLL restrictions. This can provide SCL and inertia support to the system during times of need with suitable design and control strategy.

The purpose of the system strength study under PLL stability is to identify potential deficits in meeting future minimum SCL needs in different regions of the network. In doing so, consideration is given to potential support available from new IBR connections that conform with the more recent GFM technology.



Transient voltage stability

Another important measure of system strength is based on the transient voltage performance of the system during and immediately after a fault or a disturbance. The fault ride through (FRT) capability of equipment, such as a generator, is the ability of the plant to stay connected to the power system during and immediately after a power system disturbance, such as after a transmission circuit fault. For a weak network, there are more risks that power system parameters might fall outside the minimum standards set out in the SQSS and the Grid Code during faults and/or after fault clearance. This in turn might cause the connected generators, such as IBRs, to either disconnect from the system or experience oscillations in their outputs.

The purpose of the system strength study for transient voltage stability is to identify potential risks associated with disconnection of generators from the network during faults and/or after fault clearance. This may occur due to non-compliance of busbar transient voltage profiles, as specified in SQSS and Grid Code.

Analysis

The annual stability analysis will use the latest annual FES pathway update, if available, and redispatch of generation and demand, considering network constraints, from our economic modelling tool. The phased locked loop and transient voltage stability analysis will be conducted using the latest network model.

Inertia

The inertia analysis will identify the total available system inertia in the future, including contributions from:

- synchronous generators
- grid-forming plants
- procured stability services
- approximations from demand

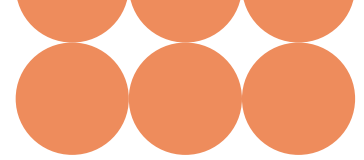
The available system inertia will then be compared against system inertia thresholds to compute the deficit on an hourly basis across the year, using the following equation:

$$\text{Inertia requirement} = \text{system inertia threshold} - \text{total available inertia}$$

In the equation, the system inertia threshold is the minimum inertia the system needs to hold to cover the largest loss of generation or demand and maintain the RoCoF within operational limits. The threshold used in assessments for future years will be in accordance with the Frequency Risk and Control Report⁷⁴ and Operability Strategy Report⁷⁵.

⁷⁴ NESO, [neso.energy/industry-information/codes/security-and-quality-supply-standard-sqss/frequency-risk-and-control-report-frcr](https://www.neso.energy/industry-information/codes/security-and-quality-supply-standard-sqss/frequency-risk-and-control-report-frcr)

⁷⁵ NESO, [neso.energy/publications/system-operability-framework-sof](https://www.neso.energy/publications/system-operability-framework-sof)



System strength

Phased locked loop stability

At NESO, PLL stability is currently investigated using the short-circuit ratio (SCR) index. The aim is to maintain a minimum SCR in different regions of the network to ensure acceptable system strength levels during minimum SCL conditions.

The SCR is the ratio of the SCL, or system strength, at a transmission substation to the rated capacities of the grid-following IBRs connected to that substation. SCR values will be calculated at a nodal level and assuming intact network conditions. The resultant values will be compared against pre-set thresholds to identify worst-case minimum SCL needs in the future.

Minimum SCL requirements will be derived by checking the gap between the calculated SCR values against pre-set minimum SCR thresholds required for maintaining minimum system strength. SCL requirements are locational, hence additional SCL sources will be incrementally inserted into the affected parts of the network to work out the least SCL requirement needed to cover the SCR gap.

We will continue to review our approach to system strength based on the outcomes of ongoing innovation in this area and learnings from the industry and other system operators across the world. In future years, we expect to incorporate further learnings into this methodology based on the outcome from these activities.

Transient voltage stability

Transient voltage stability studies will be carried out for a summer minimum scenario to test a credible worst-case system condition and identify potential transient voltage stability support requirements in the future network. A contingency analysis will be conducted to study several critical circuit faults, with simulations performed in the root mean square (RMS) domain. The results will be recorded and compared against the GB Grid Code⁷⁶ Fault Ride Through obligations for voltage depressions lasting up to 2.2 seconds.

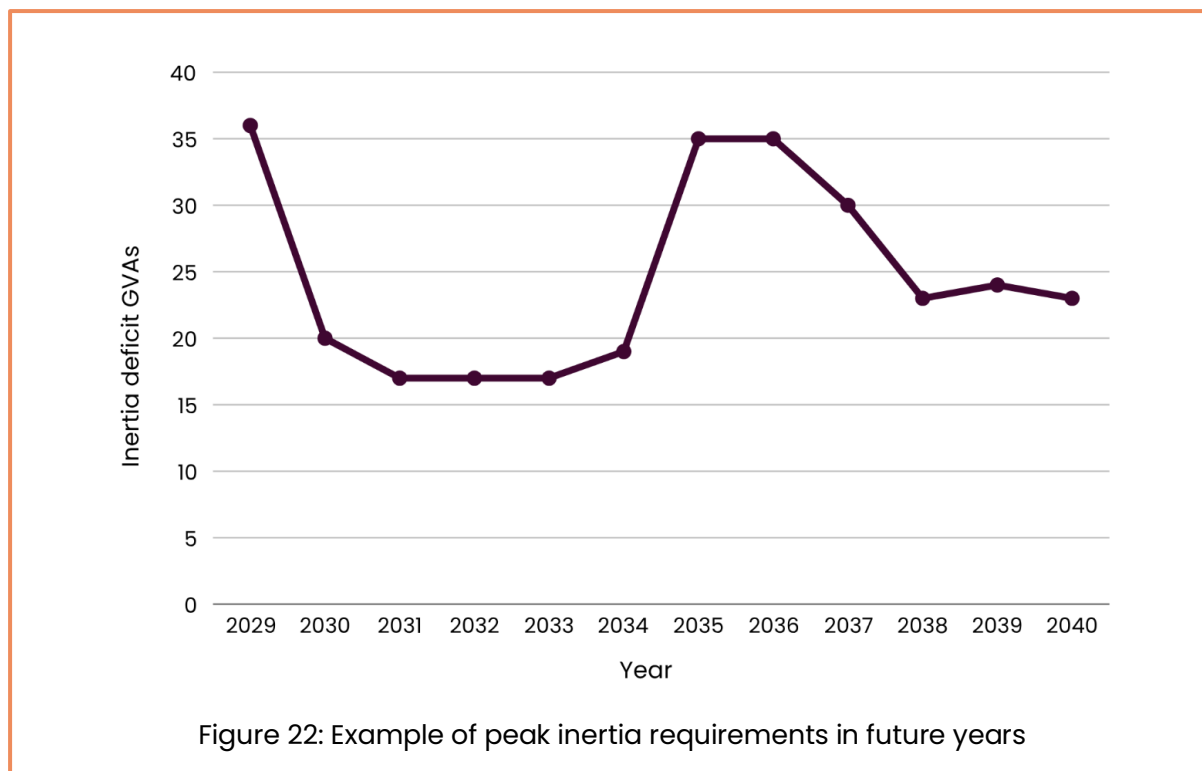
To identify requirements for transient voltage stability, we will monitor and review voltage profiles at relevant transmission busbars against FRT obligations. These profiles will come from RMS simulations with critical contingencies considered. Identified issues are locational and we will propose and test regional solutions in the RMS simulation accordingly to ensure compliant FRT performance.

It should be noted that EMT modelling and analysis is not in scope.

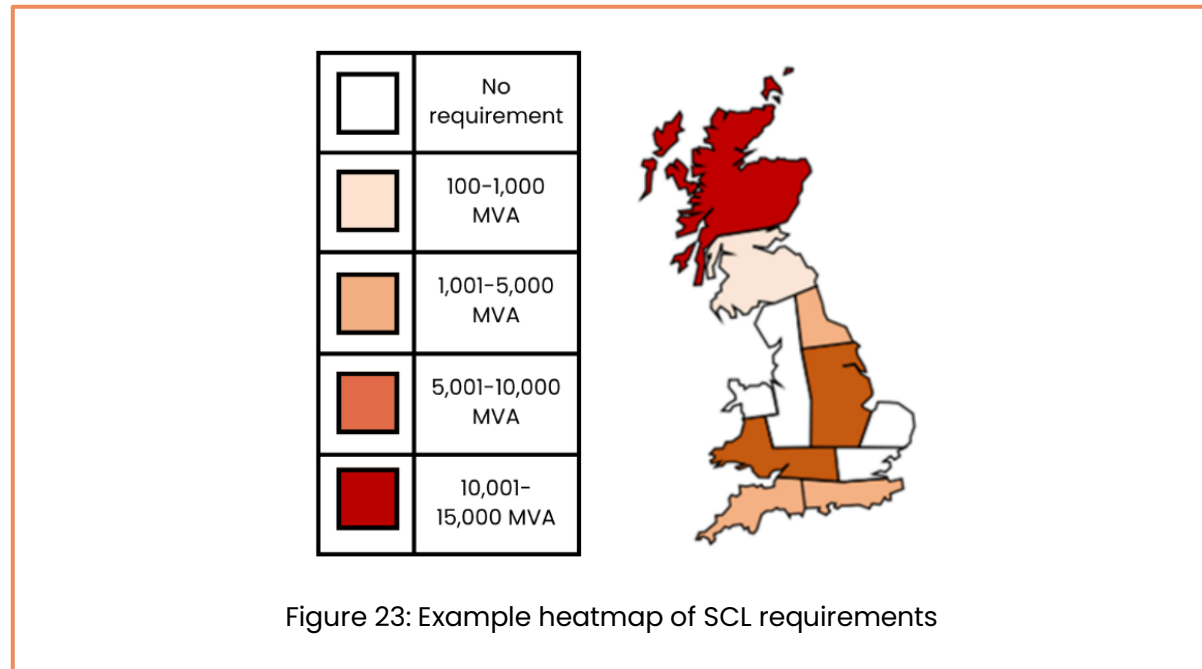
Publication

The inertia and system strength needs identified through the stability analysis will be published. Peak inertia requirements in the future will be graphically presented as seen in Figure 22.

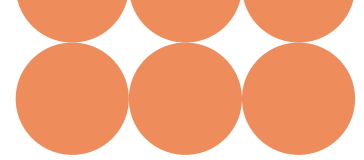
⁷⁶ NESO, [neso.energy/industry-information/codes/grid-code-gc/grid-code-documents](https://www.neso.energy/industry-information/codes/grid-code-gc/grid-code-documents)



Future system strength needs will be graphically presented using regional heatmaps, as shown in Figure 23, ahead of any Network Services tenders. These regions have been formed by existing system boundaries and system operability issues.



It should be noted that phenomena such as sub-synchronous oscillations are out of scope of the residual stability analysis. Assessment of such phenomena is highly dependent on detailed and accurate models of users (which will not be available at the network development stage), the network and expected scenarios in frequency domain



and EMT environment. This necessary data is not available for long-term planning timescales.

It should also be noted that harmonic assessment is out of scope of the CSNP as this is a local planning activity undertaken by TOs as part of the local network design and connections analysis.

Residual voltage

Overview

Using the latest annual FES pathway update (if available), NESO will conduct annual residual voltage analysis to identify reactive power requirements. The analysis will be conducted across a ten-year horizon to manage identified high and low voltage issues at credible worst-case conditions across the year. NESO and transmission owners are responsible for managing voltage levels across the transmission system. To comply with the SQSS, voltage must be kept within set limits across the transmission system to ensure safe and efficient operation.

NESO's residual voltage analysis will consider as baseline network conditions the following data, if available: the latest TO investment plans (including the ones triggered by the CSNP boundary analysis), TO approved regulatory plans, connections enabling works and asset replacement plans. Therefore, the residual studies will account for requirements arising beyond other investment processes, considering requirements driven by wider system changes such as in generation, demand and network configurations.

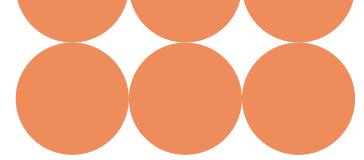
NESO will collaborate with TOs to establish study guidelines and required inputs to network models. We will welcome any insights from independent analysis conducted by TOs. Any residual requirements that NESO chooses to meet through a Network Services' tender will be shared concurrently with TOs and third parties.

Generally, voltage levels are related to reactive power injecting to and absorbing from the system. Absorbing (consuming) reactive power helps lower the voltage, while injecting (providing) reactive power helps raise the voltage. Voltage management can be broadly categorised into low voltage and high voltage control under various system conditions.

During summer minimum conditions, voltages are raised due to less reactive power consumption and reduced power flows across the network due to low demand. During winter peak conditions, voltages are usually lower due to higher reactive power consumption and increased power flows across the network for high demand.

Analysis

The voltage analysis will be conducted using the latest network model, following option selection, under various system conditions to assess power flows and voltage levels. An intact network will be used, except for equipment agreed to be in long-term outages. All reactive providers will have their reactive range scaled down based on an agreed factor from their original capacity to account for any planned short-term outages. The reactive capabilities from HVDC converter stations, as provided by technology and grid code



obligations, are considered in the background to support voltage control based on asset availabilities and system conditions.

High voltage

High voltage analysis focuses on studying the requirements for reactive power absorption. This analysis will identify potential high voltage issues in the system and determine the necessary reactive power absorption compensations for the identified issues.

Different system conditions will be set up for high voltage analysis based on generation and demand during summer minimum conditions. This includes sensitivities reflecting different generation mixes, running patterns, interconnector flows and network power flows in the system.

The high voltage analysis will include both pre-fault and post-fault (contingency) assessments. The contingency analysis will evaluate system voltages under credible fault conditions, with contingency faults defined in SQSS. The total reactive power needed to address high voltage excursions will include both pre-fault and post-fault requirements.

The pre-fault requirement refers to the reactive power absorption compensation needed to reduce voltage to the pre-fault voltage limit set by SQSS before any secured fault event occurs. This is achieved by connecting additional reactive power absorption compensation at transmission substations to bring voltage excursions back within SQSS limits. The total pre-fault requirements are determined by combining these additional compensations through an iterative process to resolve all voltage issues in the network.

The post-fault requirement refers to the reactive power compensation needed to bring voltage down to the post-fault voltage limit set by SQSS following a secured fault. With pre-fault compensation already in place, the post-fault requirements are derived by connecting extra reactive compensation to the network to bring voltages back within SQSS limits. This process is applied to each contingency to calculate the minimum total reactive power absorption volumes (in MVAR) necessary to ensure network compliance for all secured events.

Voltage step change analysis will be conducted to determine if the newly added compensation can exacerbate any existing voltage step issues or create new excursions.

When the pre-fault and post-fault requirements are derived, the corresponding reactive power compensation for each area of network will be added into the model. Voltage step change limits will also be assessed in line with SQSS guidance.

Low voltage

Low voltage analysis focuses on requirements for reactive power injection. In GB, typically winter peak demand combined with a windy condition (where flows from North to South are typically high) is a suitable system condition to test for low voltage issues. These conditions are challenging but credible. This is a similar set of conditions as defined for network planning in the SQSS and used for boundary analysis.

The power flow conditions used for the analysis will be set to levels that are close to their known capability limits across the network. Boundary power flows will not exceed their capability limits as this would not represent a credible state. Additional sensitivity studies

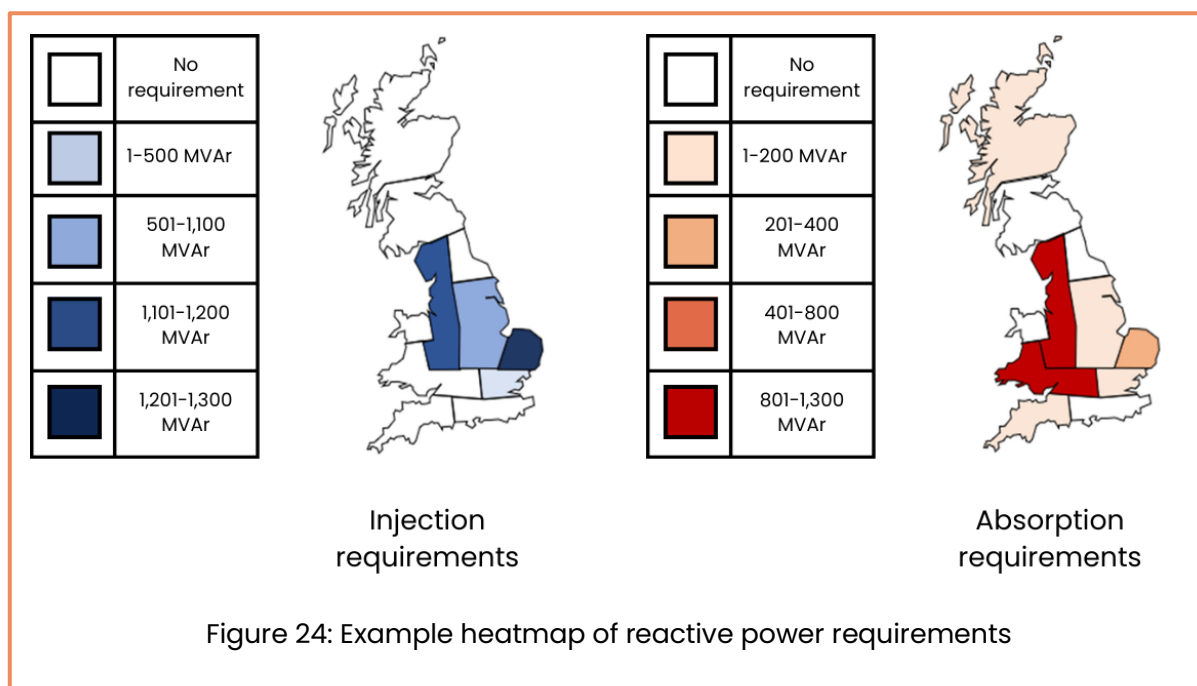


may be conducted to ensure all areas of the transmission network are studied at their local capability limits. This process will utilise a similar approach to the scaling of generation and demand used to determine boundary capabilities.

The low voltage studies will be conducted in a similar manner to the high voltage studies. The analysis will identify pre-fault and post-fault requirements in line with the SQSS limits and securable fault events. Voltage step limits will also be assessed in line with SQSS guidance.

Publication

The regional reactive power requirements will be presented on a geographic heatmap, as shown in Figure 24, ahead of any Network Services’ tenders.





Analysis framework

Interactions

Reinforcement options will be identified to satisfy boundary requirements. It is important that operability considerations, such as reactive power compensation, are factored into reinforcement options and that these consider the impact on future operations as well as relevant standards, such as the SQSS. This will ensure safe and efficient operation of the transmission system and that associated costs can be considered in the Appraise step. If additional operability requirements are identified through the delivery pipeline, driven by interacting reinforcement options, changing system conditions or further design development, the delivery body should engage with NESO ahead of residual analysis to ensure these are considered.

The annual residual stability and voltage analysis will then identify any remaining requirements, or those driven by changing system conditions, as well as needs that do not interact with bulk power flows. Identified needs may be resolved through Network Services tenders. This is subject to the context of the requirements and Network Services being the most appropriate route to resolving the need. In some circumstances, solutions to residual needs, particularly for low voltage, may overlap with boundaries. Amongst other factors and ahead of resolving requirements through Network Services, NESO will:

- seek to progress low voltage needs through the Develop step of the CSNP, where appropriate
- prioritise potential opportunities to resolve multiple needs concurrently through Network Services
- evaluate the longevity and timing of any need as well as engagement with transmission owners regarding the local planning of their networks
- identify potentially interacting reinforcement options that are part of the Develop step
- consider counterfactual solutions from transmission owners within Network Services
- consider options proposed within the CSNP design which contribute to residual operability needs

Network Services

The Network Services programme provides opportunities for industry to offer solutions to meet system requirements, including for thermal, stability and voltage needs. More information on the stability and voltage markets outlined in Table 7 is available in the Markets Roadmap⁷⁷. Through these markets, NESO will seek to widen market access,

⁷⁷ NESO, [neso.energy/publications/markets-roadmap](https://www.neso.energy/publications/markets-roadmap)



enhance competition, bring costs down and, where possible, facilitate the stacking of services to resolve concurrent issues.

Table 7: Stability and voltage markets

Network Services	Description
Long-term (Y-4) stability and voltage markets	The long-term stability and voltage markets will procure services with a lead time of up to four years from contract award and offer contract lengths in the region of ten years.
Mid-term (Y-1) voltage and stability markets	The mid-term markets will procure services with a lead time of up to one year from contract award, with contract lengths of up to one year.

Roles and responsibilities

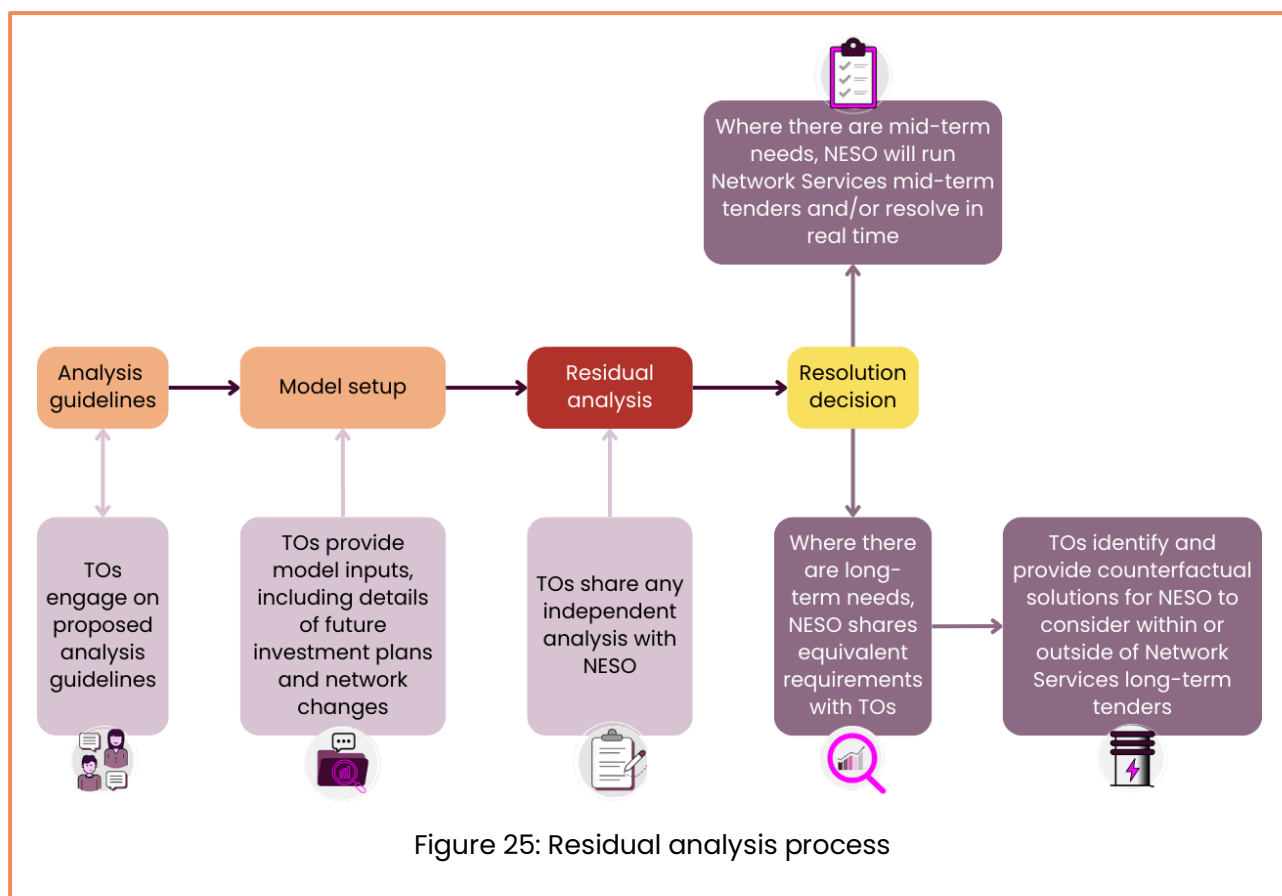
When conducting residual stability and voltage analysis, NESO will carry out the analysis and collaborate with TOs, as illustrated in Figure 25.

As described in Figure 25, NESO will collaborate with TOs on the study guidelines and the network modelling process. We will decide how the identified residual requirements are met after taking into account independent TO analysis and feedback if available, as well as the latest insights from the boundary assessment process.

NESO will consider various aspects before deciding whether Network Services (such as Long-Term or Mid-Term markets) and/or other mechanisms available to NESO (such as the Balancing Mechanism (BM) or TO investments outside of Network Services) are required to meet the identified system needs. These aspects would include (but not limited to) the timings of the identified needs, delivery of other interactive investments and potential delivery timeframes for market participants and TOs.

Where NESO decides to run a Long-Term Network Services tender, to provide a level playing field for all potential participants, we will share the requirements to be met under Network Services concurrently with TOs (via STC processes) and with market participants via Network Services tenders. The treatment of all participants to Network Services will be considered in line with Network Services' processes. As part of the Network Services process, NESO reserves the right to review and amend requirements and procured volumes to reflect any feedback from TOs and market participants.

NESO will include details of the technical model exchange process within the updated STC-procedures.



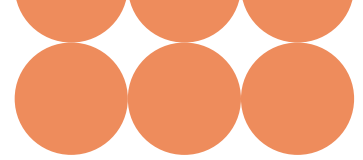
Model exchange

NESO and TOs will exchange network models and data annually to enable detailed power systems analysis. We will work with TOs under the Common Modelling work group of the Joint Planning Committee – Modelling Group, to establish a new model exchange process. This will build on the existing industry practice defined by the SO-TO Code Procedure (STCP) 22-1, while ensuring the needs of wider model dependencies are met. We expect to informally consult with Ofgem on the development of the study guidelines.

The Identify step will use the latest network models available, considering the latest TO investment plans (such as TOs approved regulatory plans, connection enabling works, planned asset replacements and updated progressed reinforcement options), to undertake the defined power systems analysis in this step. The model exchange will then facilitate the Develop step and the undertaking of power system analysis to determine future boundary capabilities.

Alongside system needs, we will publish information for select years within a 15-year horizon to enable relevant stakeholders to understand developments to the NETS. This will include the following information and will be published every three years:

- Schematic and geographical representations of the transmission system.
- High-level specification of the asset ratings to support network modelling.



- Fault levels at minimum and peak demand provided by transmission owners.

Future trends

Beyond the horizon of detailed power system analysis, the CSNP will also indicate long-term system insights and future trends to suggest how the anticipated energy mix may influence the future system. This will support the earlier indication of any needs and potential future challenges. Trends will be established from analysis and engineering insight applied across different energy pathways to evaluate potential impacts on network flows, stability and voltage.

For network flows, boundary charts will be published out to 25 years to indicate needs in comparison with future boundary capabilities. For system inertia, long-term redispatch of generation and demand will be assessed to determine the anticipated availability of future system inertia. Broader factors influencing stability and voltage will also be evaluated across different energy pathways to consider the potential impacts of generation and demand.

6. Section 3: Electricity – Develop

Creating options to address identified needs

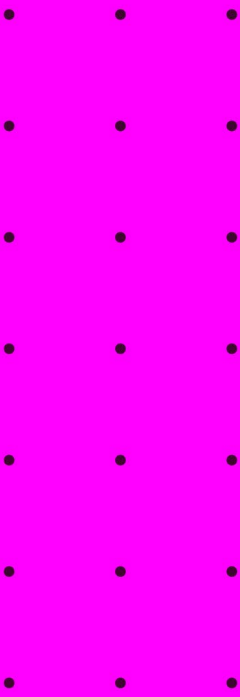
Process for licensed parties

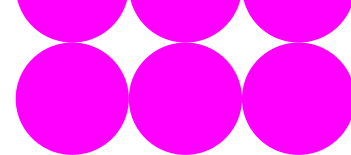
Third-party options

Offshore proposals

Required information

Roles and responsibilities





Creating options to address identified needs

The Develop step outlines how reinforcement options should be created to meet the system requirements created in the Identify step. It also explains the data and information that is required to allow the assessment in the subsequent Appraise step.

Reinforcement options are expected to be proposed to satisfy boundary requirements. It is important that operability considerations, such as reactive power compensation, are factored into the analysis of reinforcement options and that these consider the impact on future operations as well as relevant standards, such as the SQSS. This will ensure safe and efficient operation of the transmission system and that associated costs can be considered in the Appraise step.

Reinforcement options will be proposed by two groups: licensed parties and third parties. Licensed parties include the incumbent onshore TOs and NESO, and third parties are groups, communities, or organisations that do not have a GB transmission licence but have an interest in developing the transmission network. Third parties are provided with additional support, given they do not have intrinsic and detailed knowledge of the system or access to the modelling.

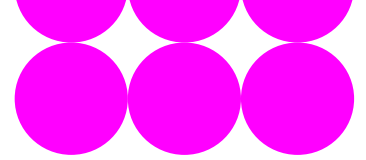
This section is structured as follows:

- the process for licensed parties to develop and submit options
- the process for third parties to develop and submit options
- specific considerations for the development of offshore proposals
- summary of the required information that must be prepared and supplied for each option submitted

The analysis in this section will be undertaken by the transmission owners, NESO and third parties in developing their options, culminating in submission of these to NESO by a specified date. In addition, there is a role for licensed parties in the initial filtering of their options and a role for NESO and the TOs in supporting the development of third-party options.

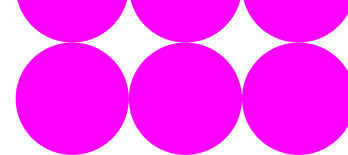
The precise mechanism and form of data submission to NESO of options will be defined, along with the timetable for the submission of draft and final options to be considered through the CSNP governance, based on the information in this methodology.

For the TOs, their role in initial filtering and supporting third parties, as well as the data submission information, is also expected to be specified in the Study Guidelines, which will be under the updated System Operator and Transmission Owner Code (STC) and associated procedures (STC-P). The STC and STC-Ps will be updated following the



agreement of the submission mechanisms, in accordance with the principles in the methodology and following the code change process for the STC.

As a reminder, residual operability requirements identified through the annual assessment, as considered by the procurement of Network Services, sits outside of this methodology.



Process for licensed parties

Identifying options

The Develop step will ensure a consistent, robust and transparent approach to developing reinforcement options, considering different strategic parameters across transmission owners and NESO.

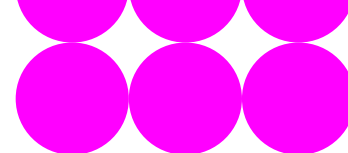
Following system needs, TOs and NESO will develop a range of reinforcement options that provide additional capability. TOs must develop reinforcement options that when combined, at a minimum, satisfy the greater of either the SQSS required transfer levels or the 95th percentile of annual power flows. Unless otherwise agreed, this will ensure a breadth of reinforcement options are identified. The SQSS requirements supplied will be based on the current SQSS version.

A range of reinforcement options must be developed for each boundary, including those with different capabilities, delivery timescales and investment costs. Upgrades to the existing network should be considered ahead of identifying more significant reinforcement options. This will allow the Appraise step to consider diverse reinforcement options that, individually, may only partially meet needs. Reinforcement options from previous strategic planning processes, but not progressed into the delivery pipeline, should also be re-considered, where appropriate.

Ahead of the Appraise step, licensed parties must consider relevant strategic parameters for each need, as listed in Table 8. Prior to the reinforcement option submission, some parameters may not be fully defined, such as the spatial envelope and strategic design. Equally, for network management options or upgrades to the existing network, some parameters may be less relevant.

Table 8: Strategic parameters

Parameter	Description
Spatial envelope	The broad geographical area in which a reinforcement could be required. At this early stage, we recommend that the width of the spatial envelope is limited to 25 km where possible.
Technology type	The potential type of reinforcement, such as High Voltage Alternating Current (HVAC), High Voltage Direct Current (HVDC) or upgrades to the existing network and its minimum capability, capacity and voltage.
Strategic design	The high-level design of a reinforcement, including whether it could be onshore or offshore (and any coordination with offshore attestations), predominantly overhead or underground and any strategic mitigation.
Interface zones	The areas of the onshore or offshore transmission system where a connection or reinforcement will connect between.



When considering these parameters, parties should have regard to the Electricity Transmission Design Principles (“the Principles”)⁷⁸. The Principles provide clarity on the type of asset to be used in different environments. If it is credible to consider an offshore circuit, for example, where significant reinforcement is required across multiple boundaries or as guided by the Principles, this should be developed separately, and a counterfactual onshore circuit should be developed for comparison.

The range of reinforcement options and the extent of strategic parameters identified will depend on the boundary, system needs and potential additional drivers, such as compliance, customer connections, significant non-load related investments, sunk costs or reuse of assets. When developing long-term reinforcements, the full extent of strategic parameters may still need to be considered. NESO will ensure that the minimum level of design for options is reviewed periodically via engagement with key stakeholders.

As part of Connections Reform, new connection applications will be assessed through regular gated application windows⁷⁹. Through these, the relevant TO will identify reinforcements required to facilitate new connections. These reinforcements may also provide additional boundary capability and therefore be considered in the CSNP. To ensure an efficient, coordinated and economical system, TOs should consider customer connections when developing wider reinforcement options. A range of reinforcement options and different strategic parameters should still be identified, while meeting additional drivers and contracted connection dates. Where optionality is limited, context and justification should be provided to NESO. In advance of the first CSNP, most customer connections in the reformed queue will be connecting prior to 2035. Therefore, beyond this horizon, an extensive range of reinforcement options and strategic parameters are expected to be developed. The CSNP, driven by the SSEP, will then plan the wider network in anticipation of future customer connections.

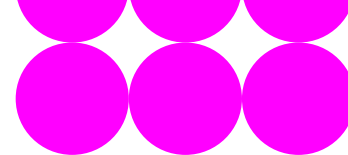
NESO and TOs will consistently document the range of reinforcement options identified and the extent of strategic parameters identified for each need. Through CSNP governance, we will ensure regard has been given to the Principles and review where optionality is limited. We will examine the details submitted for each option and may request additional detail or explanation where options do not appear to have shown regard to the Principles in their development.

To support the development of diverse reinforcement options, NESO will collaborate with TOs and may suggest reinforcement options. This will utilise insights from our power system and economic modelling capabilities and our view across the assessment criteria. We may also develop reinforcement options on behalf of third parties. The framework for facilitating third parties is detailed later in this chapter.

To ensure coordination between TOs and NESO, a technical description of reinforcement options that are under development are to be shared through CSNP governance. This will allow NESO and TOs to:

⁷⁸ NESO, [neso.energy/document/368061/download](https://www.neso.energy/document/368061/download)

⁷⁹ NESO, [neso.energy/industry-information/connections-reform](https://www.neso.energy/industry-information/connections-reform)



- review reinforcement options under development
- ensure sufficient reinforcement options to satisfy boundary requirements
- understand interactions between reinforcement options

Similarly, we will work with TOs to explore the potential for commercial solutions.

Boundary analysis

Through the Develop step, NESO and TOs will undertake power system analysis on network models to determine future boundary capabilities. The network models will integrate the initial offshore designs. The analysis will be carried out on the SSEP pathway at winter peak demand to stress the transmission system to its capacity. The analysis will align with the demand and generation pathways and consider reinforcements already in the delivery pipeline in the background.

To represent variation in boundary capability through annual operation, the winter peak intact boundary capability will be scaled. NESO and TOs will review the scaling representation of boundary capabilities across the year.

Additional sensitivities representing wider system conditions, such as interconnector flows, generation patterns or time of the year that may cause critical changes in boundary capability, may be assessed separately. Where there are no significant changes in generation and demand, some boundaries may not be studied and the same capability as previous analysis will be assumed.

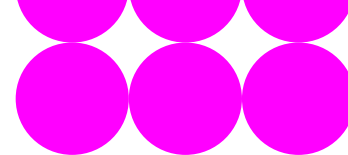
Initial filtering

The different strategic parameters identified may generate multiple reinforcement options for each identified need. Where this is the case, and to enable focus on the most viable options, NESO and the relevant licensed party developing the option should apply an initial filter. This will ensure only feasible options and those that benefit the system requirements progress to the Appraise step. Options that were filtered out should be summarised and submitted to NESO with brief justifications based on the relevant assessment criteria as applicable. We will provide a submission template for the licensed parties and document its own filtering in a consistent manner with other parties.

High-level appraisal

The initial filter will be applied to discount any reinforcement options that do not contribute a benefit to the identified system need. It may also be used where there remain multiple similar options to progress those that provide relative benefits over others in consideration of the assessment criteria. Reinforcement options are considered comparable and may be progressed over others where they:

- impact the same boundary or boundaries and reinforce a similar part of the transmission network



- have the same strategic design and technology type
- are clearly distinguishable at this early stage and dominate across the multiple assessment criteria
- provide relative benefits in terms of their needs case and have greater capability, lower costs or earlier delivery

The application of the initial filter is not intended to be an onerous process. If reinforcement options are not clearly distinguishable or not considered comparable, they should progress to the Appraise step for further assessment.

Filtering criteria

At this early stage and alongside economic efficiency, the specific sub-criteria considered are summarised below. The appraisal of progressed options is detailed in the Appraise step.

Economic efficiency

Given the need to develop and maintain an efficient, coordinated and economical electricity transmission system, the initial filter will identify reinforcement options that provide relative economic benefits. Reinforcement options may be preferred if they:

- have lower costs
- provide greater capability
- enable earlier delivery

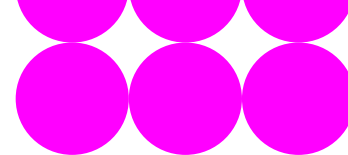
For example, a lower-cost reinforcement option that is otherwise comparable may be progressed over others.

Environment and community

We will establish a list of constraints for each of the environment and community sub-criteria that will be used by NESO and reinforcement option developers to undertake high-level geospatial mapping and inform the initial filter. This will also include screening areas where the siting of infrastructure may not be feasible due to physical, legal or land and sea use restrictions. At this early stage, reinforcement options may be preferred if:

- they avoid internationally and nationally designated landscapes, including national parks and National Scenic Areas
- risks to the environment or communities can be mitigated

The geospatial mapping will inform the high-level appraisal and summarise significant potential effects. The presence of constraints may not necessarily discount a reinforcement option if it provides other relative benefits over other options.



Deliverability and operability

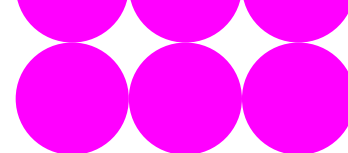
Licensed parties are to provide a brief justification for the filtered-out options based on the deliverability and operability sub-criteria points below. This could include reference to outages and sequencing, substation feasibility and the identified need or any additional drivers. Generally, options would be preferred if they:

- meet additional drivers, alleviating other constraints
- are considered less complex to build or operate

Documentation and transparency

After consideration against filtering criteria, NESO will document evidence of any discounted reinforcement options or those progressed over others. We will establish standardised documentation and templates to ensure the filter is applied consistently.

The initial filtering will also provide additional context on progressed options in the Appraise step and may further inform the strategic parameters, such as the spatial envelope and any strategic mitigation. We may decide to progress options discounted through the filtering where we see benefit and with sufficient time for them to be developed in line with the required information outlined later in this chapter.



Third-party options

Scope of third parties

We welcome participation from third parties that are interested in developing the transmission network in addition to licensed parties. In the five stages outlined below, we will support third parties whether proposing alternatives to the initial offshore design or developing new reinforcement options. This will facilitate innovation and early engagement in network planning.



1. Engage on system needs

Alongside publishing the initial offshore design and system needs, we will engage with third parties to support their readiness to develop offshore proposals or reinforcement options. Engagement mechanisms will be shared outside of this methodology.



2. Submit proposals and options

Third parties will be able to submit offshore proposals or onshore reinforcement options ahead of a defined submission deadline. These must be provided with the required information.



3. Apply initial filter

NESO will apply an initial filter to progress those that are feasible and provide relative benefits over others in consideration of the multiple assessment criteria.



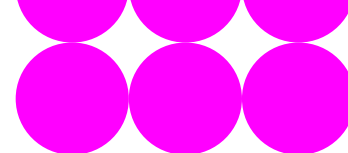
4. Collaborate on development

Proposals and options that pass this filter will be taken forward. NESO will conduct power system modelling and collaborate with third parties to ensure proposals and options are suitably developed.



5. Progress to Appraise step

Those that are sufficiently developed will be considered as part of the network design appraisal. If proposals or options are at an early stage of development, these may be considered in a future cycle.



Whilst NESO will help and facilitate the development of other options proposed by third parties, we are unable to provide funding or consultancy services to the third party. Additionally, we are only able to consider proposals for options at transmission voltages which are 275 kV or more in England and Wales and 132 kV or more in Scotland.

TOs and industry may also have the opportunity to compete for the later design, build and ownership of onshore transmission solutions through early competition⁸⁰.

Engage on system needs

In parallel to publishing the initial offshore design and system needs, we will engage with organisations which have expressed an interest in developing the transmission network.

As described in the Identify step, we will publish system needs charts showing boundary capabilities and where additional reinforcement may be required. Through our engagement, we will set out how industry can respond to the initial offshore design and system needs and provide more guidance on the scope of offshore proposals, reinforcement options and market opportunities. Third parties will be able to submit more than one proposal into the process. We will also explain the required information and define the relevant submission deadlines for third parties. We will engage with stakeholders to support option development in a timely manner outside of this methodology.

Submitting proposals (options)

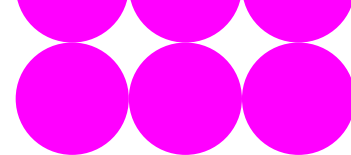
Following the publication of the initial offshore design and system requirements, third parties will be able to submit offshore design proposals and onshore reinforcement options into the CSNP process. Submissions must include relevant information that will allow us to evaluate and appraise them in line with options from licensed parties. The full requirements will be set out in detailed submission guidance, but should include context on the option and a description of its strategic parameters and needs case, alongside more detailed information such as:

- cost and programme breakdown of constructing and operating the proposal or option
- spatial information on the expected area the option would be developed in
- technical information on how the proposal or option would provide benefit to the network

For offshore proposals, the submission could comprise a standalone offshore proposal separate to the initial offshore design or it could be a refinement or alternative to elements of the initial offshore design.

Third parties must submit their offshore proposals and reinforcement options ahead of the relevant submission deadlines. This will ensure sufficient time for NESO or TOs, to develop them further.

⁸⁰ NESO, [neso.energy/about/our-projects/early-competition](https://www.neso.energy/about/our-projects/early-competition)



Apply initial filter

On submission, we will scrutinise the provided information to ensure it is valid and a credible option is proposed. For offshore proposals and reinforcement options provided with credible information, we will apply an initial filter after the submission deadline to progress those that are feasible and provide relative benefits over others. This will be equivalent to the initial filter set out for the transmission licensed parties and involve a high-level appraisal. We will use the information provided to inform this.

If we conclude that any offshore proposal or reinforcement option is not feasible to deliver or operate, we will inform the third party. Where there remain multiple comparable offshore proposals or onshore options, we may decide to progress those that perform better than others when considered against the assessment criteria.

Collaborate on development

Offshore proposals and reinforcement options that progress may require further development ahead of the Appraise step to ensure we have all the required information for appraisal. This includes the more technical information required for a full appraisal, on top of the initial information provided for filtering, such as:

- additional drivers
- boundary capability
- substation feasibility
- criteria scoring
- outages and sequencing

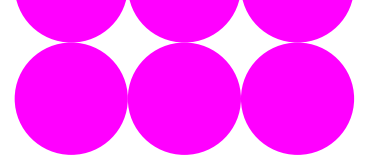
Where able to, third parties should provide this information. Otherwise, NESO will collaborate with third parties to further develop proposals and options. We will conduct the required power system studies. Specific data will only be shared with parties subject to the System Operator Transmission Owner Code (STC) in line with submission guidance. A third party and transmission owner may also choose to partner to develop a reinforcement option, and we will help facilitate such opportunities.

If proposals or options provide benefits but use emerging technology or innovative solutions that require significant further development, they may need to be considered in a future cycle of the plan. In such a case, NESO or a TO may support the third parties to develop proposals and options after the current cycle. We may also direct third parties towards the Strategic Innovation Fund⁸¹ to receive support and funding. The Strategic Innovation Fund supports network innovation that contributes to the achievement of net zero, while delivering real net benefits to network companies and consumers.

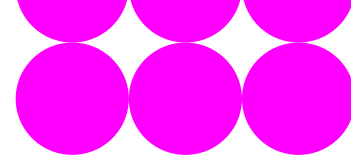
Progress to Appraise step

Following any required further development, offshore proposals and reinforcement options will progress to the Appraise step and be evaluated as part of a network design. If reinforcement options are selected within the preferred network design and progress into

⁸¹ Ofgem, uk-business-connect.org.uk/programme/ofgem-strategic-innovation-fund/



the delivery pipeline, these may be eligible for network competition. Otherwise, they could be delivered by, or alongside, an incumbent transmission owner. Offshore proposals will be subject to a separate delivery mechanism.



Offshore proposals

Developing from the initial offshore design

Using the initial offshore design as a starting design, NESO will consider ways to both refine the design and introduce coordination to the process. In this manner, we will explore how different offshore topologies could provide benefits to the transmission system. At this point in the process, there is an opportunity for interested parties (such as licensed transmission owners, wind farm developers and other third parties) to also submit offshore options. When considering additional offshore design options, we will apply an initial filter to progress offshore proposals that are feasible and provide relative benefits over others in the same manner as described previously. Within this process, we will also engage with TOs to further refine the transmission interface points available for connection within offshore designs.

All potential refinements and options will be used to form a shortlist of alternative designs to the initial offshore design. These alternative designs will seek to either improve upon the initial radial design or explore options for coordination. The number and distinction of the preferred offshore designs will be subject to CSNP governance. Once a shortlist is formed, designs will undergo an offshore appraisal against the five CSNP assessment criteria and the best performing radial and coordinated designs will be selected. In the Appraise step, onshore options will be assessed against each offshore design.

As any changes or alternatives to the initial offshore design may have significant impacts on the transmission system, submission of offshore options will close earlier than the submission of onshore options, marking an offshore design freeze. This will allow time for the offshore options to be assessed as described above and a preferred radial and coordinated design to be ready for the time when NESO and TOs exchange network models for studying the network at the relevant point in the future. This means that a fixed set of offshore designs and interface points can be provided as inputs into the model exchange to support the development of associated reinforcement options ahead of the Appraise step. At this stage, the onshore enabling works that would be required to enable offshore-to-onshore connections within each offshore design would be identified by the relevant TO.

Types of offshore coordination

In addition to spatial and strategic coordination, some offshore proposals considered will explore electrical coordination and shared infrastructure to link projects to form an integrated offshore network. This could involve connecting two assets or developing a complex mesh network that connects multiple assets and infrastructure with neighbouring countries. To ensure alignment with the SSEP pathway, the location and capacity of offshore generation will not be changed.

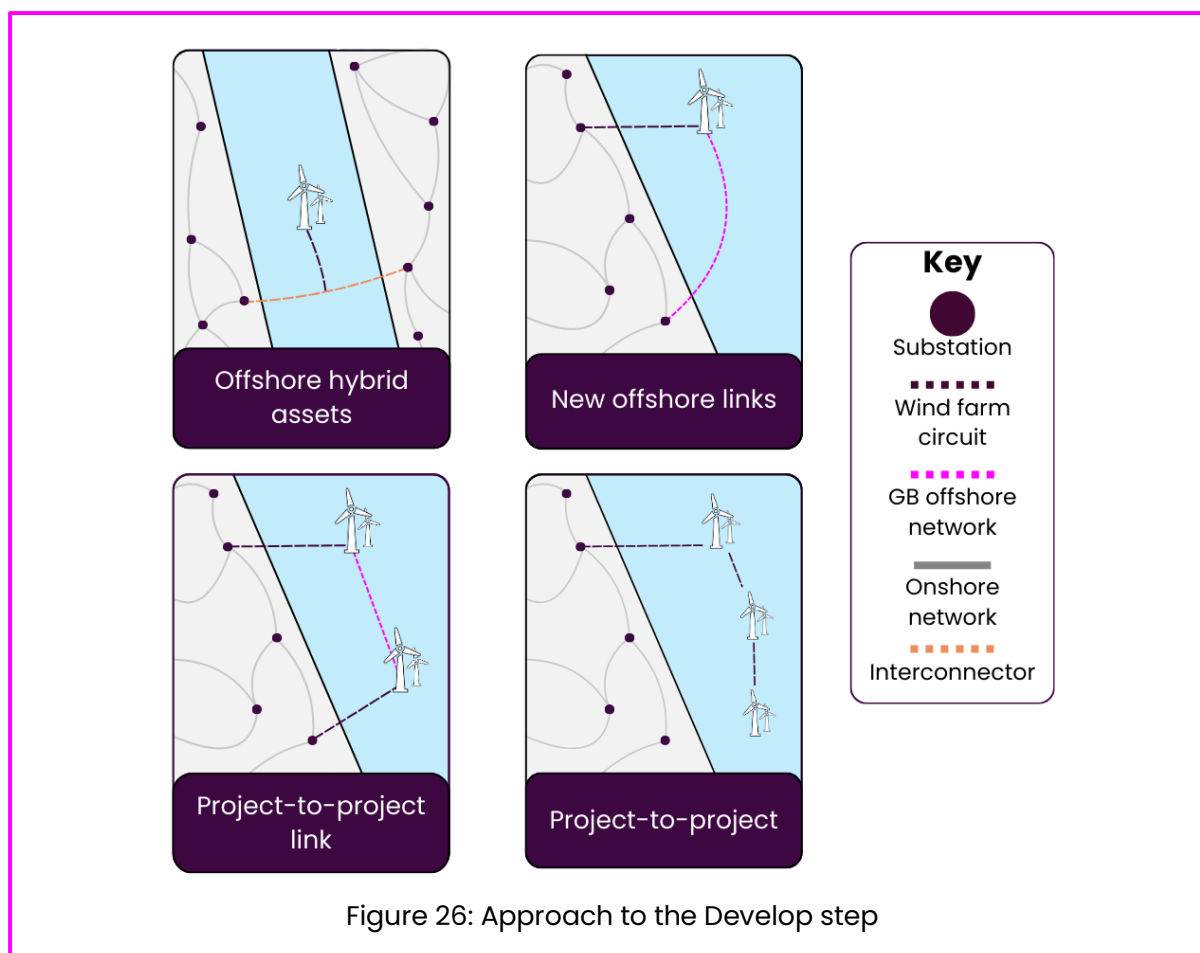
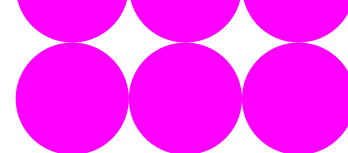


Figure 26: Approach to the Develop step

As shown in Figure 26, there are many potential benefits to electrical coordination, such as supporting additional redundancy, increased asset utilisation and efficient trade between neighbouring electricity markets. These benefits also include reducing the need for reinforcement options and risks to the environment and communities. Detail on the types of coordination that will be considered are shown below.

Offshore hybrid assets

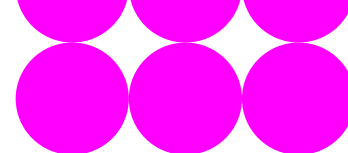
Offshore hybrid assets (OHA) combine an offshore wind farm with an interconnector that links together two distinct electricity markets. These can be further categorised into multi-purpose and non-standard interconnectors, where the offshore wind farm is located within GB waters in the former and out with GB waters in the latter.

New offshore links

Offshore transmission links provide offshore wind farms with two electrical routes to the onshore transmission system. This allows for the offshore link to be used to both transport generation from the wind farm and reroute power around congested areas of the onshore network. This can reduce the number of new onshore transmission assets that are required to manage congestion on the network.

Project-to-project (shared cable)

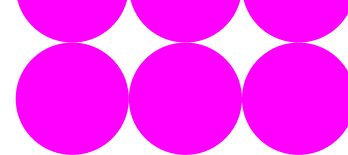
Project-to-project links connect multiple offshore wind farms to shore through a shared cable, often reducing the total environmental and community impact when compared to



a radial solution. However, with shared cables, this reliance on other projects can create investment uncertainty and risk, making the deliverability of such projects more challenging.

Project-to-project links

Project-to-project links are a combination of the new offshore links and project-to-project connections, creating a link that connects more than one offshore wind farm to shore at multiple points on the transmission network. This can increase the utilisation of installed cabling, potentially reducing the total volume of cabling required. It can also reduce the environmental and community impact as well as total cost. However, the sharing of network assets may increase the deliverability risk to the project.



Required information

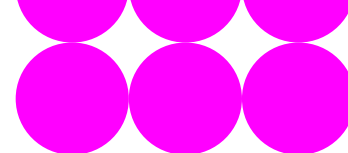
Progressed options

Reinforcement options must be developed in line with the requirement information set out in Table 9 to progress to the Appraise step. We will establish standardised documentation and submission forms to ensure consistency and may request specific additional information if required. Any commercially sensitive information will be treated accordingly.

Similar information is needed for long-term reinforcement options to enable equivalent consideration. We note that this information will be more uncertain. To satisfy the minimum design requirements for inclusion in the delivery pipeline, a reinforcement option must supply all the data outlined in Table 9, along with the strategic parameters specified in Table 8. However, information marked with an asterisk is optional for reinforcement options that are still within the options funnel.

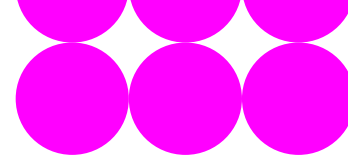
Table 9: Required information

Information	Description
Delivery dates	A deterministic earliest delivery date and a probability distribution, including P50 and P80 delivery dates.
Boundary capability	The additional boundary capability provided by reinforcement option should be specified, including in combination with other relevant reinforcement options. We will check capability results, ahead of using these in our cost benefit analysis in the Appraise step.
Costs and programmes	Annual expenditure profiles for the deterministic earliest delivery date and a probability distribution, including P50 and P80 delivery dates, should be provided for each reinforcement option. These must specify the Weighted Average Cost of Capital and include a breakdown of component assets, cost types and key milestones. Cancellation and delay costs should also be provided, where relevant, for reinforcement options in a later stage of development. This information will inform our cost-benefit analysis in the Appraise step.
Deliverability and operability	Reinforcement options must be provided with a narrative appraisal and scoring of the deliverability and operability sub-criterion, as outlined in the Appraise step. This will inform the determination of a network design that is deliverable and operable.



Environment and community	A narrative appraisal of the environment and community sub-criterion, as set out in the Appraise step, must be provided for each reinforcement option. This should reflect the spatial envelope, for which a shapefile should be provided alongside an estimated circuit length. The narrative should detail any strategic avoidance or mitigation. This information is required for scoring and considering risks to the environment and communities in the Appraise step.
Power system modelling	Reinforcement options must be provided with sufficient information to enable power system analysis. This should be submitted through the annual model exchange with specification of asset ratings and electrical parameters per the GB Planning Model Guidelines ⁸² . A single line electrical schematic should be provided depicting the reinforcement option and connectivity with new and existing infrastructure, including any reactive power compensation.
Outages and sequencing*	Where available, indicative outage requirements should be provided for reinforcement options. These should specify any impacted assets and their outage duration in weeks, or other duration as appropriate, for each year if delivered on its P50 delivery date. Any sequencing restrictions with other reinforcements must also be detailed. This information will inform our analysis of optimal delivery in the Appraise step. If appropriate, alternative outage requirements for a project should be provided for analysis. For example, a reinforcement option which could change its construction and delivery programme to change its outage requirements could have multiple outage requirements assessed.
Substation feasibility*	Reinforcement options should be provided with a description of any involved substations. This should include evidence of available bays suitable for connection or the works required to extend the substation, as relevant, to demonstrate feasibility ahead of the delivery pipeline.
Technical solution	A description of the technical solution must be provided. This should include context on the reinforcement option and a description of its strategic parameters and needs case. The needs case should detail its relevance to system needs and any additional drivers, including compliance, customer connections or significant non-load related investments.

⁸² UK government, [gov.uk/government/publications/national-planning-policy-framework--2](https://www.gov.uk/government/publications/national-planning-policy-framework--2)



Costs and programmes

To determine whether a network design is efficient, coordinated and economical, reinforcement options must be provided with distinct cost and programme information.



Additional drivers

Reinforcement options should be provided with costs attributed to any distinct drivers, such as committed non-load, connection related investments, sunk costs or reuse of assets. This will provide visibility of costs required regardless of the reinforcement option to support understanding of whether it is efficient to plan more substantial works and provide additional capability.



Staged delivery

To allow consideration of staged network expansion, reinforcement options should define the additional boundary capability they provide. We will then be able to determine which set of reinforcement options is most efficient, accounting for any interactions between reinforcement options.



Optimal delivery

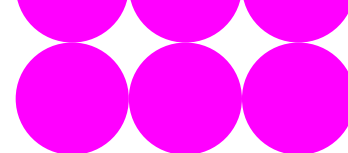
We will analyse the optimal year for reinforcement options to be delivered through considering different delivery dates, as well as constraints costs and interactions with other reinforcement options.

NESO requires TOs and other reinforcement option developers to provide cost estimates for their proposed reinforcement and upgrade options. We plan to adopt the Infrastructure and Project Authority's (IPA)⁸³ guidance on cost estimating as the core costing methodology. IPA guidance covers the use of both deterministic and probabilistic methods for estimating costs. Based on the IPA methodology, parties making submissions to the CSNP may consider the cost estimate as analogous to a Strategic Outline Case in terms of maturity. In IPA terms, in summary, this means:

- meeting the requirements of costing 'Level 0'
- aligning the estimate to a high-level schedule and major milestones
- clearly explaining inputs, assumptions, exclusions, uncertainties and risks
- presenting cost estimates as an anticipated final cost with a variable range to assert the confidence around it, built out of the component parts of the estimate:

⁸³ UK government,

assets.publishing.service.gov.uk/media/6050c9528fa8f55d324b0c84/IPA_Cost_Estimating_Guidance.pdf



- a. base cost estimate – a position of the most likely cost of each component based on available data
- b. uncertainty – the sensitivity around assumptions, tied to the maturity of the project definition
- c. risk – acknowledging the impact of probability-driven events

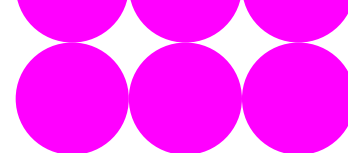
Reinforcement options must be provided with a deterministic earliest delivery date and a probability distribution, including P50 and P80 delivery dates, along with a narrative justifying the difference between them. These will provide a window within or after which the reinforcement option may be delivered. Annual expenditure profiles should be provided for each delivery date. Additional profiles may be given, such as for intervening years. Reinforcement option developers need to be realistic when specifying their P50, assuming they will act in good faith. This should include matters such as supply chain, other works being done by that developer, assets health and system access requirements. Delivery dates should be made on the assumption that the reinforcement option is to be delivered as a package of options of a size equivalent to the likely GB design. Reinforcement option developers need to consider any recent amendments to planning consent regime and funding or regulatory arrangements that have been set to enable faster delivery. Submission providers are required to provide costs for each reinforcement option for the following scenarios:

- Earliest delivery date (EDD) reflects a delivery year before P50 which needs significant risk management to be delivered, without unacceptable increases in cost.
- P50 delivery date (P50) reflects the most likely delivery year, accounting for consents and deliverability risks.
- P80 delivery date (P80) reflects the high confidence delivery year, accounting for consents and deliverability risks.

Noting the requirement for the scenarios set out above, NESO expects the assumptions and risks to be evidenced by appropriate reference class data. TOs, in particular, are expected to draw on their extensive portfolios of past reinforcement projects for such reference data. Otherwise, submission providers are expected to use appropriate externally validated reference class data where this is not available to them from their existing portfolio. The IPA guidance sets out several top-down estimating methods that may be used, based on the time available and the quality of data.

The breakdown of component assets should include costs for significant elements, such as the relevant length of overhead or underground line, new or extended substations and any reactive power compensation. For each annual expenditure profile, cost types and key milestones per the government's Transmission Acceleration Action Plan⁸⁴ should also be defined, as per Table 10. This information will support our scrutiny of the annual expenditure profiles as well as Ofgem's funding decisions. NESO requires all submitted

⁸⁴ UK government, [gov.uk/government/publications/electricity-networks-transmission-acceleration-action-plan](https://www.gov.uk/government/publications/electricity-networks-transmission-acceleration-action-plan)



cost estimates to be set out in a template mandated by us and agreed with TOs and approved by Ofgem through further discussions.

Table 10: Cost types and key milestones

Cost types	Key milestones
<p>Development costs:</p> <ul style="list-style-type: none"> • front-end engineering and design • planning and consenting • land • project management • contingency 	<ul style="list-style-type: none"> • route design • contractor procurement • pre-application • survey • detailed design • equipment procurement
<p>Construction costs:</p> <ul style="list-style-type: none"> • detailed design • procurement • construction • project management • contingency 	<ul style="list-style-type: none"> • land purchase • planning approval • regulatory approval • build
<p>Operational costs:</p> <ul style="list-style-type: none"> • maintenance • refurbishment • asset management • contingency 	

Environment and community

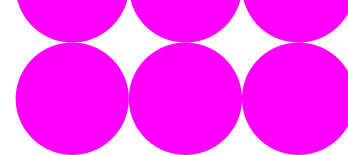
Reinforcement options that are progressed must be provided with spatial information, including a shapefile defining the spatial envelope and interface zones, to enable the consideration of the potential risks to the environment and communities in the Appraise step.

The spatial envelope is the broad geographical area in which a reinforcement option is required, encompassing the interface zones which it will connect between.

It should only include the parts of a geographical area that are required for the reinforcement options being considered, to avoid both unnecessary assessment work and distracting from relevant key concerns. It should be influenced by the careful identification and analysis of the constraints and issues, including notable topography and landform.

At this early stage, we recommend that the width of the spatial envelope is limited to 25 km where possible. This guideline will help ensure consistent comparisons of risks and allow for meaningful analysis of constraints and increased confidence in the environmental and community quantitative approach later in the Appraise phase.

Where there are known significant constraints to either side of the spatial envelope, it may need to contract. Conversely, where an option is particularly long or there are multiple



significant constraints parallel to one another, there may be a requirement to make the spatial envelope wider, and this would allow for optionality to appraise these different constraints in more detail at the project level assessment.

Option providers would need to explain the evidence and justification for the shape of the strategic spatial envelopes, linking this to the constraints and issues, the network modelling requirements and the assumptions used in the appraisal and selection of a particular reinforcement.

In addition, options should be developed with strategic avoidance or mitigation in mind. This could include:

- the strategic avoidance of significant constraints where it is clear that it would only be acceptable if the reinforcement option avoided the constraint
- the strategic undergrounding of a section of the reinforcement option where it is clear that designated constraints cannot be avoided in line with policy

Any strategic mitigation must be justified in line with relevant policy and principles and be reflected in the spatial envelope. Otherwise, the delivery body will identify opportunities for more localised mitigation measures through the delivery pipeline whilst leading public consultation, surveys and engagement.

The mitigation hierarchy is outlined in the National Policy Statement⁸⁵ (NPS) and the National Planning Framework 4⁸⁶ (NPF4) for Scotland, where removing the impact at the outset, such as through avoidance, should be considered ahead of reducing the impact, such as through mitigation.

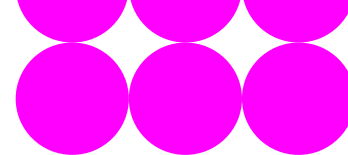
The NPS for England and Wales sets out that, although it is the UK Government's position that overhead lines should be the strong starting presumption for electricity networks developments in general, this presumption is reversed when proposed developments will cross part of a nationally designated landscape. Additionally, NPF4 states consideration should be given to underground connections where possible.

Where it is not possible to determine strategic avoidance and mitigation at this early stage, withstanding risks to the environment and communities will be considered in the Appraise step.

The provided spatial information must also include an estimated circuit length. If any strategic avoidance or mitigation results in distinct spatial envelopes and different circuit lengths that may substantially impact costs, these should be progressed as separate reinforcement options.

⁸⁵ UK government, [gov.uk/government/publications/national-policy-statement-for-electricity-networks-infrastructure-en-5](https://www.gov.uk/government/publications/national-policy-statement-for-electricity-networks-infrastructure-en-5)

⁸⁶ Scottish Government, [gov.scot/publications/national-planning-framework-4/](https://www.gov.scot/publications/national-planning-framework-4/)



Roles and responsibilities

Process for licensed parties

Following the Identify step, TOs and NESO will develop a range of reinforcement options that provide additional capability. They will also score and provide qualitative narrative of their proposed options for deliverability and operability. For environment and community assessment criteria, licensed parties will provide a shapefile of the spatial envelope, alongside an estimated circuit length. This will be accompanied by a qualitative narrative outlining any strategic avoidance or mitigation. Licensed parties will submit reinforcement options to a central NESO database.

NESO will ensure that the minimum level of design for options is reviewed periodically via engagement with key stakeholders. NESO and TOs, will consistently document the range of reinforcement options identified and the extent of strategic parameters identified for each need. To support the development of diverse reinforcement options, we will also collaborate with TOs and may suggest reinforcement options.

NESO will work with transmission owners to explore the potential for commercial solutions. Through the Develop step, NESO and TOs will undertake power system analysis on network models to determine future boundary capabilities. We will create and make available a submission template for discounted and non-discounted reinforcement options.

Third party options

Alongside publishing the initial offshore design and system needs, NESO will engage with third parties to support their readiness to develop offshore proposals or reinforcement options. Third parties will be able to submit offshore proposals or onshore reinforcement options ahead of a defined submission deadline. We will then apply an initial filter to progress those that are feasible and provide relative benefits over others in consideration of the multiple assessment criteria. We will conduct power system modelling and collaborate with third parties to ensure proposals and options that pass the filter are suitably developed.

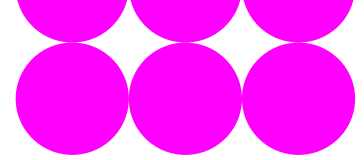
Whilst NESO will help and facilitate the development of other options proposed by third parties, we are unable to provide funding or consultancy services to the third party.

Offshore proposals

In the development of the detailed offshore design, NESO will undertake the required offshore design refinement and appraisal, along with the required supporting work. Third parties, including TOs, will be able to submit proposed design elements or amendments, which will be assessed and considered for inclusion within the detailed offshore design by NESO.

Quality assurance conducted by NESO

Neso will undertake a two-stage quality assurance process on the submitted reinforcement options which is outlined at a high level below.



An internal critique of each submission will be undertaken to assess the coherence, consistency, and completeness. This may include:

1. Cross reinforcement option comparison, to ensure that relative differences in costs, delivery dates, and risk profiles between options are logical, justified, and aligned with underlying scope and assumptions.
2. Internal comparison of reinforcement options' physical descriptions against cost submissions, to confirm that the cost and delivery programme reflect the stated scope, design maturity, and delivery approach, and that no material elements are omitted or miscounted.
3. Quality assurance of the “building blocks” underpinning costs, delivery dates, and risks. This includes review of quantities, unit rates, phasing, contingencies, optimism bias, risk allowances, and schedule logic, ensuring these are evidence based and consistently applied.

A critique across submissions to complement and provide added rigour into the quality assurance process. This may include:

1. Cross developer comparison, assessing submissions against those from other developers to identify outliers, inconsistencies, or systematic differences in approach to costing, scheduling, or risk treatment.
2. Use of external benchmarks, including industry data, comparable projects, and recognised reference classes, to test whether submitted costs and delivery dates fall within reasonable and expected ranges.
3. Reference to historic information, drawing on lessons learned and actual outturn data from previous or analogous projects to validate assumptions and identify potential optimism bias.

For the non-technical data, some of the above measures may not be appropriate so the approach can be tailored to each information type as needed. Findings from the QA will be documented and fed back to the submitting party for clarification or amendment where required.

7. Section 3: Electricity – Appraise

Producing the network design

Assessment criteria

Framework for network design appraisal

Roles and responsibilities





Producing the network design

The Appraise step follows the Develop step. The options which have been created and submitted to NESO in Develop will be systematically analysed and assessed against multiple criteria, to develop an overall network design to inform the delivery pipeline in the Deliver phase.

Through this step, we will determine a preferred network design, for both onshore and offshore, that is economic and efficient, whilst balancing risks across the environment, communities, deliverability and operability.

Consistency, robustness and transparency will underpin our application of the five assessment criteria as we appraise network designs that combine wider reinforcement options in coordination with the offshore network.

The Appraise step reflects NESO's duty to promote economy and efficiency as per the Energy Act 2023⁸⁷, whilst giving regard to the impact major infrastructure may have on the environment and communities. It also considers TOs' duties under the Electricity Act 1989⁸⁸ to develop and maintain an efficient, coordinated and economical system of electricity transmission and to have regard to and do what they reasonably can to mitigate relevant environment effects.

This section is structured as follows:

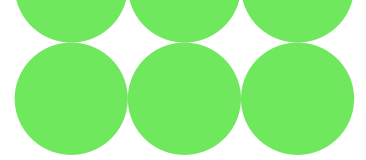
Firstly, we explore **the assessment criteria** – economic and efficient, environment, community, deliverability and operability, as well as how these are constructed and how they will be applied in the methodology. In some areas, further detail is needed to supplement the principles and method outlined in this document. These will be developed and agreed using the appropriate tiers of the CSNP governance and, where deemed appropriate, agreed with Ofgem.

Secondly, the key process steps in framework for network design appraisal:

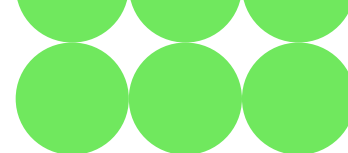
- **Creating multiple credible network designs** – We will create a range of credible network designs from the shortlisted reinforcement options. Each network design will consist of a different combination of reinforcement options. These designs must be technically feasible and economically viable. They will be developed to complement each offshore design produced from the detailed offshore design process.
- **Economic filtering** – An initial economic filter is applied to select the most economically efficient subset of network designs. This subset is then reviewed through CSNP governance.

⁸⁷ UK Government, legislation.gov.uk/ukpga/2023/52

⁸⁸ UK Government, legislation.gov.uk/ukpga/1989/29



- **ECDO scoring** – The network designs are assessed using environment, community, deliverability and operability (ECDO) criteria. Scores, supporting narratives and spatial information are used to evaluate the designs.
- **Ranking network designs** – NESO ranks the performance of each network design against each individual ECDO criterion. The top-performing designs are shortlisted for the final cost-benefit analysis (CBA).
- **Cost-benefit analysis (CBA)** – A CBA is conducted to move from the shortlist to a preferred final network design. This analysis considers both monetised and non-monetised aspects of the ECDO criteria.
- **Final selection** – The preferred network design is selected based on the CBA and supporting narratives. This design is then subjected to an adequacy stress test against potential resilience events.



Assessment criteria

For electricity transmission network, the CSNP will use five assessment criteria to undertake its appraisal, described below.



Economic and efficient

We will use economic modelling to promote network designs that are efficient, coordinated and economical and provide consumer value, including considering capital and operational expenditure, constraint costs and the societal cost of carbon.



Environment

We will use geospatial data and information to consider risks to the environment, such as to the historic environment and biodiversity.



Community

We will use geospatial data and information to consider risks to communities, such as to the local economy and recreation.



Deliverability

We will appraise deliverability, considering technology readiness, the supply chain and other factors, to ensure the preferred network design can be practically delivered.



Operability

We will appraise operability, considering operational complexity, scalability and other factors, to ensure the preferred network design can be operated in real time.

Economic and efficient

This section explains the economic assessment that will be undertaken as part of the network design appraisal.

Energy pathway

The SSEP will determine the optimal mix of generation capacity (by location) across GB to ensure that the relevant government policy and targets are met. Establishing the network design against the chosen SSEP will:

- enable the CSNP to plan the network in anticipation of future connections that will be informed by the SSEP (this will ensure the CSNP, driven by the SSEP, can plan the



wider network strategically and in anticipation of future generation and demand customers)

- align the network design with the SSEP, a plan that the UK government and devolved administrations and the regulator can endorse, to anchor the driver for the CSNP in policy
- ensure a network design is built to meet climate goals

Economic assessment tools

We will utilise our pan-European market modelling tool to carry out our cost-benefit analysis process (CBA) using the supply and demand mix from the chosen SSEP. We will provide a wide range of network options (both onshore and offshore) from TOs, third parties and our own NESO developed options. The economic information required for this analysis is outlined in the [Develop step](#).

Our pan-European model is an economic dispatch optimisation model. It can simulate all European power markets simultaneously. It includes demand, supply and infrastructure and balances supply and demand on an hourly basis. It models the hourly generation of all power stations on the system, taking into account fuel prices, historical weather patterns and operational constraints. A key feature of the model is the ability to model the GB balancing market. This enables us to forecast future constraint costs on the electricity transmissions system. The model can simulate the effect on network capability of each additional onshore and offshore reinforcement. As European power markets are modelled, we are also able to model the impact of flows on interconnectors and OHAs on constraint costs. Our pan-European market modelling tool is routinely maintained and updated with data to ensure accuracy and reliability, including inputs from the European Network of Transmission System Operators for Electricity (ENTSO-E).

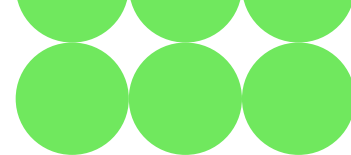
Our assessment will assume the appropriate asset life for each reinforcement, typically between 40 and 50 years, depending on the asset type. Our modelling horizon extends out 25 years, so to appropriately assess the benefit of each option we will extend the last three years of the modelling horizon to cover remaining asset life years. The impact of this assumption is reduced as forecast costs are discounted using HM Treasury Green Book's Social Time Preferential Rate (STPR)⁸⁹ to convert the forecast costs into present values. The capital cost for each reinforcement option selected is amortised over the asset life by applying the Spackman methodology⁹⁰, using the appropriate weighted average cost of capital that is also discounted using the STPR.

Analysis process

To determine the preferred network design, we will conduct a cost-benefit analysis (CBA) for each shortlisted option, monetising as many ECDO sub-criteria as practicable to support a robust comparison. During this stage, we will also be able to consider a range of dates that an individual reinforcement may become operational. HM Treasury Green Book

⁸⁹ UK government, [gov.uk/government/publications/the-green-book-appraisal-and-evaluation-in-central-government/the-green-book-2020](https://www.gov.uk/government/publications/the-green-book-appraisal-and-evaluation-in-central-government/the-green-book-2020)

⁹⁰ Ofgem, [ofgem.gov.uk/sites/default/files/docs/2011/10/discounting-for-cost-benefit-analysis-involving-private-investment-but-public-benefit.pdf](https://www.ofgem.gov.uk/sites/default/files/docs/2011/10/discounting-for-cost-benefit-analysis-involving-private-investment-but-public-benefit.pdf)



principles recommend conducting a CBA from shortlist to final selection, a practice which we have adopted in this methodology.

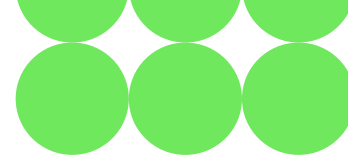
The net present value (NPV) of each design will be calculated by quantifying benefits, including the forecast reduction in constraint costs due to the inclusion of reinforcements. Additionally, we will quantify costs, such as the forecast capital expenditure (CapEx) and operational expenditure (OpEx) of the reinforcements. The NPV calculation will exclude any potential subsidy payments within constraint costs, such as a Contract for Difference (CfD) which is classed as a transfer payment. Constraint costs arise when there is insufficient capacity on the network to allow the flow of electricity from the dispatch in the day ahead market (DA). This requires us to ensure the system operates within its limits. Some generation may be reduced in certain parts of the network and other generation will be increased in other areas to ensure supply meets demand.

Other costs and benefits will be included in the economic assessment, such as the forecast reduction in the societal cost of carbon⁹¹ as increasing levels of renewable generation are connected to the system, for example. In addition to CapEx, operational expenditure (OpEx) will be a cost that we will consider as the variations in OpEx across various strategic options may be material.

Each network design will consist of a range of onshore reinforcement options and commercial solutions, along with an offshore network design. These are analysed within our pan-European model. NESO will analyse many combinations of reinforcement options. The process will be iterative, as individual reinforcements are added one at a time and we are able to model the impact on constraints and other costs over the lifetime of that reinforcement. When more than one reinforcement is available at the next stage of a path, a branching point is created on the path. As the path is expanded, many branching points may be created, resulting in a diverse range of network designs. By studying many different combinations of network reinforcements, we can develop network designs that maximise economic benefit. A range of different strategies will be employed to create the network designs to ensure that we create as broad and diverse a range of network designs as possible. We will construct a diverse range of combinations of multiple onshore and offshore reinforcements. The outputs from each iteration are compared to determine whether each additional reinforcement option provides economic benefit and to identify the combination of options that provide the maximum economic benefit. By repeating this process several times, we will be able to construct a diverse range of viable network designs that maximise the potential optionality within the strategic variations provided by TOs, NESO and third parties.

To identify the preferred network design, we will undertake a CBA for each of the shortlisted network designs, monetising as many ECDO sub-criteria as possible, to identify the preferred network design. During this stage, we will also be able to consider a range of dates that an individual reinforcement may become operational. This will be in accordance with HM Treasury Green Book principles, which recommends conducting a

⁹¹ UK government, [gov.uk/government/publications/valuing-greenhouse-gas-emissions-in-policy-appraisal/valuation-of-greenhouse-gas-emissions-for-policy-appraisal-and-evaluation](https://www.gov.uk/government/publications/valuing-greenhouse-gas-emissions-in-policy-appraisal/valuation-of-greenhouse-gas-emissions-for-policy-appraisal-and-evaluation)



CBA to move from the shortlist to a preferred final solution. More detail and examples of this can be found within the section below.

Societal costs and benefits

The CSNP will incorporate a range of economic components in the economic assessment.

We recognise that it is important to consider carbon emissions reductions through proposed projects and to factor these into the economic assessment methodology of the CSNP. To align our economic assessment with the HM Treasury Green Book, we have incorporated a calculation of the societal value of carbon resulting from network reinforcement into our cost benefit analysis. This allows the impact on CO₂ emissions to be a key consideration in our recommendations, with the definition of “consumer benefits” widened to include the benefit of lower emissions.

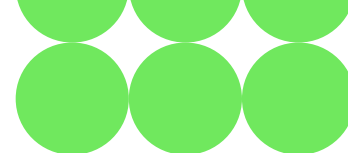
Balancing mechanism (BM) costs accrued from plants with CfDs will be extracted from the final BM costs used for investment recommendations. This is because these costs will be borne by consumers regardless of whether the plant is re-dispatched or not (through the Low Carbon Contracts Company (LCCC) if they generate or NESO if they are re-dispatched). Our BM modelling calculations also include a premium to account for potential opportunistic behaviour from market participants.

Additionally, we will work with Ofgem to consider the analysis requirements (such as considering social economic welfare) when appraising further interconnection capacity. Our ambition is to align our processes to ensure both the requirements of the wider transmission system and future cross-border capacity are being considered whilst improving transparency and facilitating a more streamlined appraisals process between NESO and Ofgem. We will work with Ofgem and will provide an update on our appraisal approach following a consultation on the future delivery approach to interconnection post-CSNP.

We will update our economic modelling to ensure it reflects any developments in the GB national electricity market. System costs, such as constraint costs and carbon costs without transfers, will continue to be our primary measure to assess the potential benefits of reinforcements. We will also consider other costs, such as consumer costs, which may provide additional insight, but these calculations will be supplementary, and we will ensure no double counting of potential benefits occurs. The economic modelling will be based on the markets as in force at the point of the economic modelling being undertaken. If there is a known, agreed and well-defined market change planned, this will be reflected in the modelling. Proposed market changes will not, by default, be considered, but would need to be considered by the CSNP’s governance and the impact agreed with Ofgem.

Determining optimal delivery

To inform our CBA, we need to assume a year in which each reinforcement option can be delivered and start providing benefit to the transmission system. When filtering network designs, we will assume the P50 delivery date of reinforcement options to ensure consistency. The P50 delivery date reflects the most likely delivery year and is therefore



neither unduly optimistic nor pessimistic. For the shortlisted network designs, we will then determine the recommended delivery date for each reinforcement option.

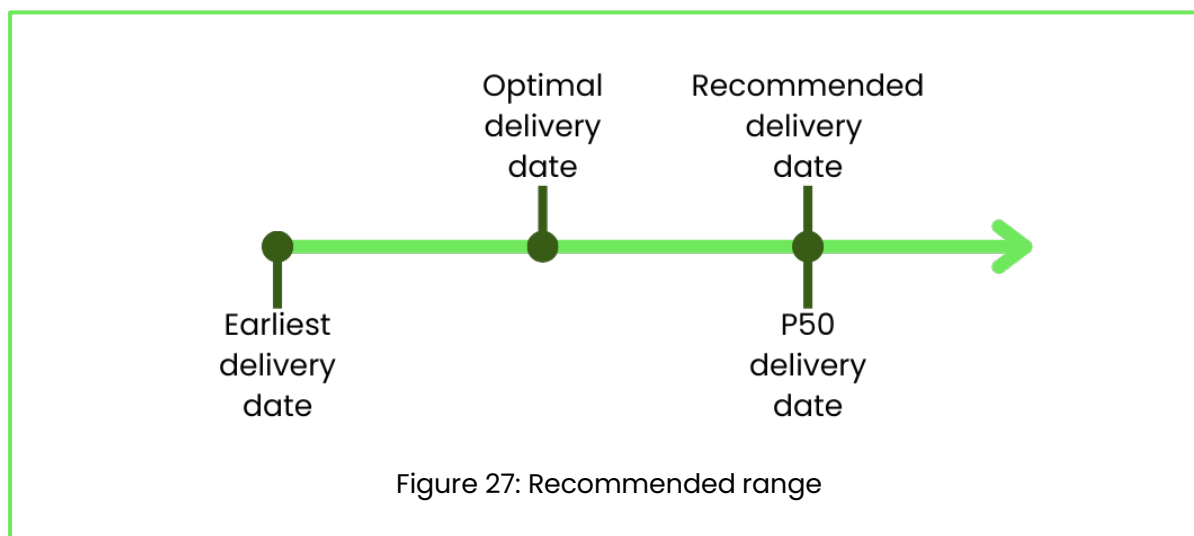
Recommended delivery date: the most economically favourable delivery year, assuming a reinforcement option cannot be delivered ahead of its P50 delivery date.

To identify the recommended delivery date, we will calculate and compare the net present value of each reinforcement option for relevant delivery years after its P50 delivery date. This will be repeated for each reinforcement option in the shortlisted network designs. We will limit our analysis to reflect any outage and sequencing interactions with other reinforcement options. The provided boundary capabilities may be assumed constant.

Once we have determined a preferred network design, we will assess the benefit of delivering each reinforcement option earlier than its P50 to identify a possible optimal delivery date.

Optimal delivery date: the most economic delivery year, assuming a reinforcement option can be delivered to between its earliest delivery date and its P50 delivery date.

Our analysis will presume the recommended delivery date of other reinforcement options, so as to not assess the concurrent earlier delivery of reinforcement options. Where we determine a possible optimal delivery date for each reinforcement option, we will recommend a range and quantify the benefit. This is illustrated in Figure 27.



Benefit-cost ratio

Ofgem will be making decisions to fund and maintain the assets over their lifetime. Benefit-cost ratios (BCRs) will provide additional information and context regarding reinforcements included within the delivery pipeline. BCR may be a useful additional economic metric to be used within the CSNP economic assessment alongside NPV for demonstrating value for money and for identifying options that may be marginal or sensitive to a change in inputs, such as capital costs. Alternatively, they may be used within sensitivity analysis, if appropriate, as detailed in the Sensitivities section.



Environment and community

This section outlines the assessment of potential environmental and community impacts and interactions onshore and offshore across GB.

Environment and community are two separate criteria and will each be considered independently. For this document, the criteria are presented together as they adopt the same methodological approach.

In addition to the high-level geospatial mapping undertaken during reinforcement option development, discussed in the [Develop chapter](#), NESO will use an impact-based appraisal risk matrix. This will use spatial modelling data and supporting narrative identified during the Develop step, supplied by the reinforcement options developer. We will also use a structured method with clear criteria for assessing the risk impact of each option. This approach will consist of a qualitative and quantitative assessment. Table 11 outlines the key terms used within the risk matrix approach.

This approach would use well defined environmental datasets and indicators to assess the impact of different solutions and options on the environment. The outputs of the assessment would comprise a graded matrix with a rating against each sub-criterion to highlight the comparative potential risk of impact.

Table 11: Glossary of key terms in impact assessment risk matrix

Key terms	Description
Sub-criteria (impact category)	A subset of the environmental or community categories representing a key topic (for example, ecology).
Impact pathway	A sequence of events through which an activity could potentially affect a receptor. In this context, this includes a description of the potential impact arising from an activity, who/what the receptors are and how the receptors could be affected.
Indicators	A feature or characteristic whose presence or scale can be measured. (for example, a SSSI site).

We will consider environment and community sub-criteria, as specified in Table 12, that are appropriate to onshore and offshore network planning and different strategic parameters.

Table 12: Proposed environmental and community impact categories for marine and terrestrial environments with potential examples of indicators

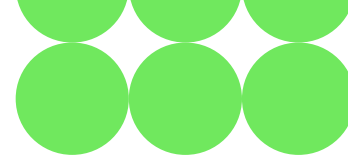
	Sub-criteria (impact category)	Potential examples of indicators
Environment	Ecology and biodiversity	Special Areas of Conservation (SACs) Special Protection Areas (SPAs)



Community		Sites of Special Scientific Interest (SSSIs) Ancient woodland Marine Conservation Zones (MCZs) Fish spawning and nursery grounds
	Flood risk	Flood Zones 2 and 3 (England and Wales) Medium/high flood risk areas (Scotland)
	Global climate	UK Peatland National Forest Inventory Woodland GB-wide
	Historic environment	World Heritage Sites UK Scheduled Monuments Listed buildings Wreck sites Historic Marine Protected Areas (Scotland) Conservation areas
	Landscape /seascape	National Parks National Landscapes (formerly AONBs) National Scenic Areas (NSAs) (Scotland)
	Local economy	Fishing activity Agricultural Land Classification (England and Wales) National scale land capability for agriculture (Scotland)
	Air quality	UK Air Quality Management Areas (AQMAs)
	Recreation and tourism	Designated bathing water sites National Trails/Scotland's Great Trails
	Community amenities	Urban Data Zones/Lower Super Output Areas (LSOAs)

This list is not exhaustive. The impact categories have been consulted on during the draft methodology consultation and align with the themes in SSEP and have been mapped against typical SEA themes. The final list will be agreed through the relevant CSNP governance forum.

Each sub-criterion will include multiple indicators, the presence of which can be measured using relevant questions and criteria. These sub-criteria will also align with the

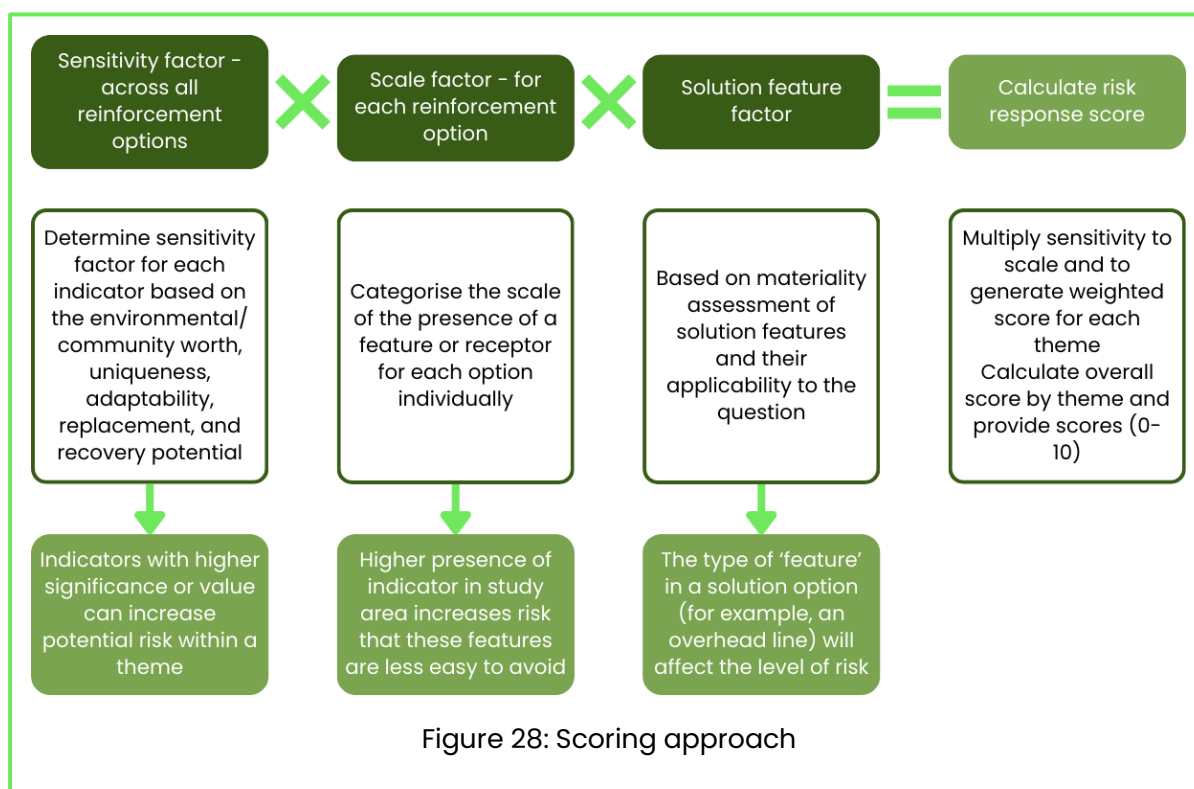


identification of key issues, which forms part of the scoping stage for the SEA process. This approach will enhance the robustness of the SEA scoping. The matrix sub-criteria have also been mapped against typical SEA themes.

The scoring approach for the risk matrix will use the following factors to calculate a risk response score (Figure 28):

- Sensitivity – based on ‘significance’ of each environment and community indicator, including uniqueness, adaptability, replacement and recovery potential. Justification for ratings by indicator is based on policy review and wider evidence on value (such as natural capital values).
- Scale factor – (at high-level information) based on presence of feature in the spatial envelope (study area) and risk adjusted for solution features. Metrics are estimated for features as a percentage of total study area or number per square kilometre.
- Solution feature factor – to adjust scores based on the likelihood that a solution feature (for example, an overhead line) will impact an indicator (for example, bird populations).

NESO will need to work with stakeholders through the relevant CSNP governance to determine relevant scores to update each of the calculation factors and refine the risk matrix approach.



The outputs of the assessment would comprise a matrix with a score or rating against each impact theme to highlight potential risks in Figure 29. The risk matrix would be considered alongside the other criteria outputs to inform decision-making. To address the issue of potential masking of a high score, a ‘red flag’ symbol will be used to highlight



where an individual indicator category has reached a maximum possible risk score. The flags reflect that there are high-risk indicators within certain categories and the underlying scores should be further scrutinised to better understand the risk drivers.

		Example A	Risk score	
		Phase	Construction	Operation
Environment	Ecology	6	5	
	Flood risk	2	2	
	Global climate	6	6	
	Heritage	5	5	
	Landscape	5	5	
Community	Recreation and tourism	5	5	
	Community amenities	2	2	
	Local economy	3	2	
	Air quality	1	0	

*Indicates that an indicator within the impact category has reached the maximum risk score

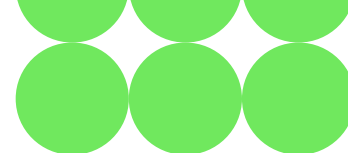
Figure 29: Example table for a single reinforcement option (for illustration only)

The risk matrix is currently in development and will require stakeholder consultation through the CSNP governance to rank the input data associated with each indicator, finalise the calculation factors and refine the tool. The indicators and factors used will be subject to CSNP governance.

We are proposing that the quantitative outputs are supplemented with a substantial qualitative narrative. This will capture additional information that may be available for options but is not reflected in the quantitative output. It would also facilitate balancing the standardised and replicable quantitative outputs with the ability to provide context-specific qualitative information, which will provide context and support the SEA, HRA and MCZ/MPA assessments and help sense-check the ranking of network designs.

Providing additional qualitative information is crucial to overcome any issues due to lack of data or specificity of the solutions at the time of appraisal. This supplementary narrative will be used during the network design appraisal.

The supplementary narrative can be used to capture:



- knowledge of whether constraints are avoidable or not (for example, a national park at the edge of a study area that is highly likely to be avoided compared to a world heritage site crossing the study area which is unavoidable)
- knowledge of mitigation measures, particularly for more mature options, that may remove or reduce the risk of impact (for example, proposed undergrounding of cables to avoid specific features)
- knowledge gained through previous option development that could suggest that the risk of impacts is higher than the quantitative outputs suggest

Deliverability and operability

Deliverability and operability are distinct criteria that will be considered independently. However, for the purposes of this document, they are presented together because they adopt the same methodological approach.

Deliverability refers to the ability to successfully deliver network reinforcement options within the given timeframes while meeting their original objectives and system requirements. It involves assessing various factors that could impact the successful delivery of a network reinforcement, such as supply chain availability, technological readiness, design and construction complexity and interactions with other projects.

Operability refers to the practical and safe operability of the future network infrastructure considering real-time operability challenges associated with network designs. It involves assessing factors such as protection and control integration complexity, complexity in integration into existing planning and operational analysis systems and scalability and adaptability of reinforcement options.

Deliverability and operability sub-criteria, along with their definitions, are provided in Tables 13 and 14 respectively. Please see [Appendix D](#) for more information on scoring for deliverability and operability. In the assessment stage, NESO will conduct deliverability and operability assessments of the network designs. Details of the network design assessments are provided below.

Deliverability sub-criteria

Table 13: Deliverability sub-criteria and their definitions

Sub-criteria	Definition
Technology readiness	The maturity of technologies used in transmission network reinforcement, assessing their industry familiarity, operational experience and deployment track record to determine their feasibility for large-scale implementation.
System access	The evaluation of the direct impact of outages on thermal limits, voltage limits and grid stability and the effectiveness of mitigation strategies in minimising disruptions.



Sub-criteria	Definition
Design and construction complexity	The challenges associated with both the design and construction of transmission network reinforcement options. For design, it includes factors such as the capacity and scale of the reinforcement option, the interdependence of components, network configuration and the requirements for consenting and planning while considering the proposed delivery date. For construction, it involves challenges related to site accessibility, managing multi-phased projects and coordinating concurrent construction activities while considering the proposed delivery date.
Supply chain	The known availability of critical components, supplier capacity and logistical challenges influencing the timely and efficient delivery of materials for transmission network reinforcements. Inter-scheme dependencies and coordination required across multiple schemes, considering shared infrastructure requirements, personnel, cascading delays and simultaneous constructions.
Interactivity	

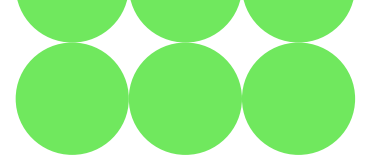
Some deliverability and operability sub-criteria listed in Table 13 and 14 may have already influenced the determination of risk-adjusted delivery dates or date ranges for options submitted to NESO. If these sub-criteria have influenced the delivery date assumptions, the scores provided to NESO should reflect the risk associated with the new delivery date to avoid double counting. For example, a sub-criterion score might have been high before adjusting for risk, but after delaying or adjusting the delivery date, the score should reflect an improvement.

As outlined in the [framework for network design appraisal section](#) later in this chapter, NESO expects transparency regarding the assumptions behind delivery date calculations.

Operability sub-criteria

Table 14: Operability sub-criteria and their definitions

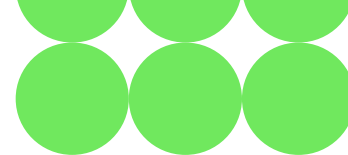
Sub-criteria	Definition
Protection and control integration complexity	Assessment of an option's complexity of integration into protection, control, monitoring or other physical systems. Scoring to be conducted through knowledge-based assessment using engineering judgement.
Network operation complexity	Assessment of an option's real-time operation needs associated with analysis tool requirements and business process, in order to operate the transmission system safely and securely, conducted through knowledge-based assessment using engineering judgement.
Scalability and adaptability	Future expansion and flexibility considering the ability to expand for future capacity needs, integrate additional energy sources



and adapt to emerging technologies or innovations and the risk of obsolescence.

We recognise that it is normal for all network designs to have some level of operability challenges, which could be addressed through various approaches, such as advanced control and protection systems, new tools, additional Network Services or changes to business procedures. While some of these solutions may involve additional costs and complexity, the purpose of this network design level operability assessment is to proactively identify these challenges through engineering judgement, enabling us to plan for a cost-efficient and safe future GB system.

The deliverability and operability sub-criteria will capture the potential advantages and challenges associated with electrical coordination of offshore networks. Given the potential for electrical coordination to increase redundancy in offshore connections and networks, it can be viewed favourably by our deliverability and operability appraisal. However, our scoring criteria also capture the challenges in delivering complex and potentially innovative technologies.



Framework for network design appraisal

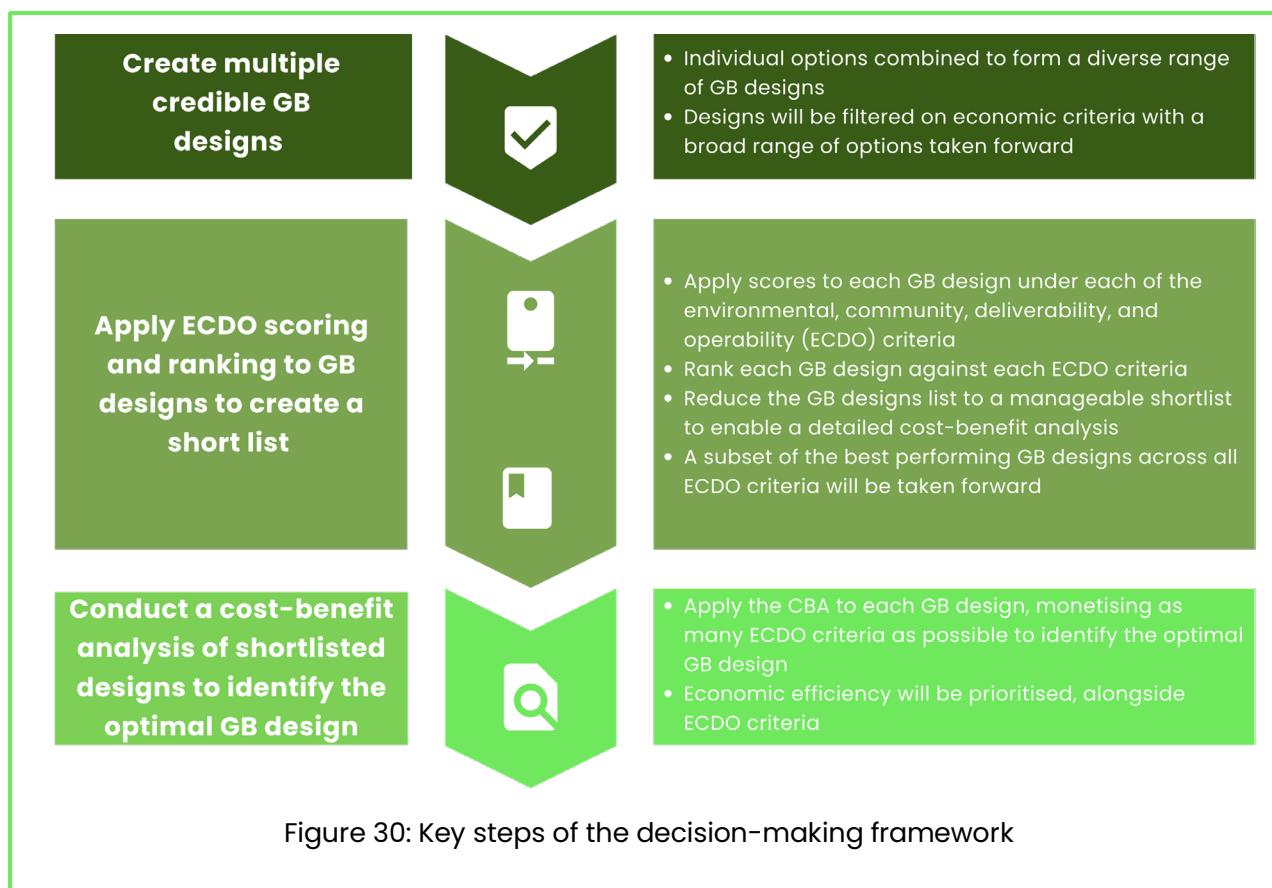
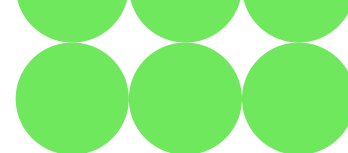
This section outlines the process NESO will follow to decide the network design that will be put forward for regulatory approval.

It is crucial to consider the cumulative impact of various reinforcement option combinations across GB as the future network's performance depends on how these individual options work together against all the assessment criteria.

The CSNP is a two-tier optioneering process. Firstly, TOs, NESO and third parties produce a diverse range of network reinforcement options to which an initial filter is applied to discount any option that is infeasible or provide less benefit than a comparable reinforcement option. This will result in a shortlist of reinforcement options. Secondly, NESO will produce a range of network designs consisting of multiple shortlisted reinforcement options. We will then select the recommended network design by using a structured appraisal and decision-making framework that is detailed in this chapter.

As NESO, we recognise the importance of justifying decisions by comparing progressed and discounted options, presenting alternatives and providing consistent, transparent, evidence-based rationale for elimination. We aim to achieve this through the network design assessment framework.

In this process, NESO accentuates importance on both quantitative and qualitative factors to reduce subjectivity and ensure a comprehensive evaluation of individual reinforcement options and option combinations that form network designs. The aim is not only to identify our preferred network design, but also to provide transparency, ensuring stakeholders clearly understanding of how the decision-making was conducted. Figure 30 summarises the stages taken to select the preferred network design.



Initially, NESO will create a range of different credible Network designs to form a long list balancing the economic efficiency of the designs with ECDO. The network designs will be constructed from a diverse range of network reinforcement options to which an initial filter is applied to discount any reinforcement option that is infeasible or provide less benefit than a comparable reinforcement option. To be credible, the network designs must be technically feasible and economically viable. This credible range of designs, at this stage, is not a maximum combination of all reinforcement options. Instead, it is as broad a range as possible of network designs that utilise as many of the network reinforcement options and that provide the identified system requirements and meet ECDO criteria for appraisal. Also, the term 'long list' should not be interpreted as a large number: the objective is to maximise the range of network designs, which will be filtered down to a short list. All options within the 25-year horizon, which pass the initial filter, will be included within the network design assessment.

Key steps of network design appraisal

This section explains the key steps of the framework NESO has developed to select the preferred network design. The framework has three steps (as outlined in Figure 30).

Create multiple credible network designs

The reinforcement options received from option developers will be combined to form a pool of technically feasible and economically viable network designs. These network

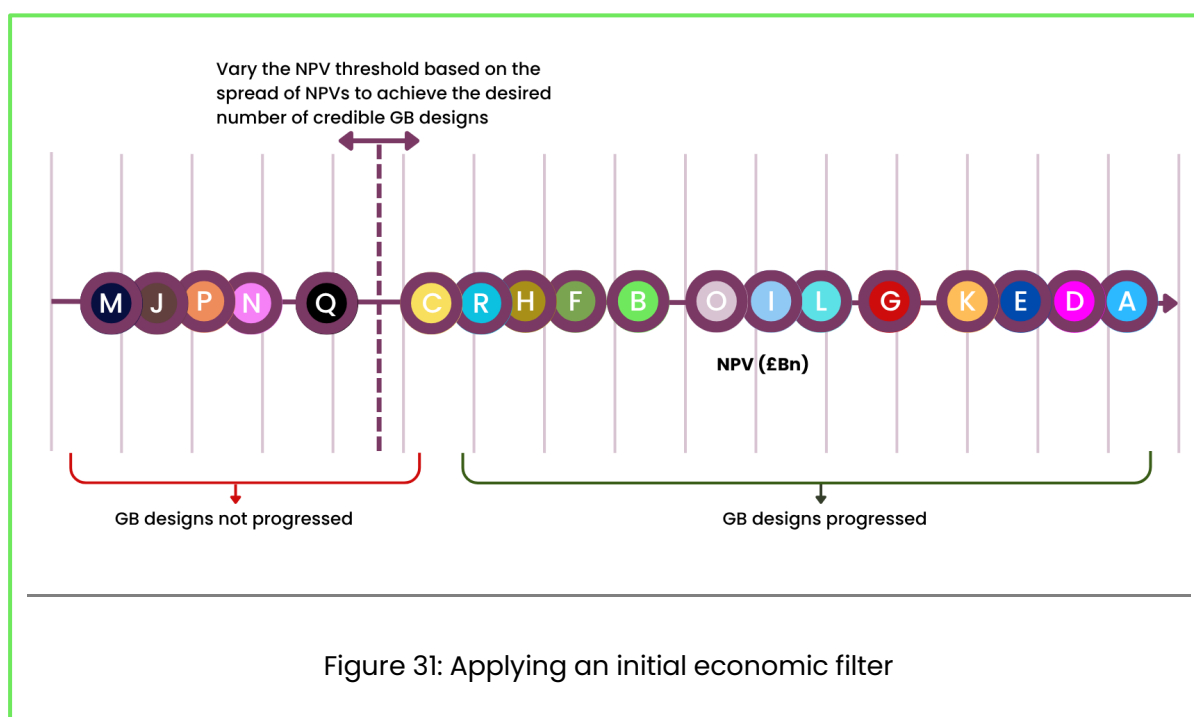


designs will aim to meet the network requirements outlined within the Identify step. This process will involve the following stages:

- The pool of network designs will be reviewed to ensure a diverse selection that balances the five assessment criteria. Evidence from each criterion will be presented and considered during the network design creation and review.
- The spread of total NPV for network designs will be analysed to identify clusters and outliers. This increases understanding of key reinforcement options by highlighting the differences in performance across GB designs. If the economic performance of the network designs is extremely close, the volume progressing to the next stage may need to increase.

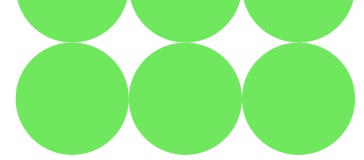
Apply initial economic filter to network designs

An initial economic filter will be applied to select the most economically efficient subset of network designs. This subset will be presented and discussed through CSNP governance to ensure it confirms its suitability before being taken further in the process. Figure 31 illustrates this concept by varying the NPV threshold as an economic filter to create an appropriately sized subset. In this example, the better performing designs are to the left of the figure. A variable threshold is required as the size of the longlist and the comparative economic performance of network designs is unknown until this stage of the process.



Apply ECDO scoring to the network designs

Reinforcement options that progress to the Appraise step will be accompanied by scores, supporting narrative and spatial information. This will support NESO's environment, community, deliverability and operability assessments of these reinforcement options. The scoring characteristics and mechanism for the ECDO sub-criterion of individual reinforcement options are detailed earlier in this chapter.



NESO will perform the network design level assessment for the ECDO sub-criterion using the available scores and narratives of each reinforcement option within each network design. The objective is to conduct a tailored evaluation, considering the interactions and dependencies between the options within each network design across all ECDO sub-criteria which can then be aggregated per criterion.

The network design level scoring system will:

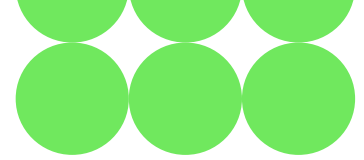
- capture the key criteria for differentiation between network designs, while considering the availability of information needed for a credible assessment
- clearly define scored characteristics to reduce subjectivity
- enable ranking of network designs against each individual assessment criterion

This scoring approach will facilitate the application of multidisciplinary professional judgement in a robust, consistent and reproducible manner. It will reduce subjectivity in narrative approaches and will be especially useful when comparing a large number of reinforcement options and multiple network designs involving multiple assessment criteria. The design level scoring approach for ECDO is detailed further in the relevant sections of this document.

Environment and community design-level scoring and ranking

Both the environment and community scoring and ranking of network designs comprises the following procedures, implemented independently for each criterion:

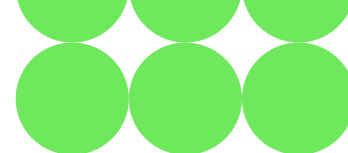
1. Gather the individual risk matrix outputs as undertaken in the [environment and community section](#) for each reinforcement option that forms part of the network design being scored.
2. Calculate the total number of flags within the network design for each sub-criterion, as shown below in Figure 32. This can be done as each flag is considered equally.
3. Calculate the separate design-level risk scores for construction and operation. To do this, the score for each reinforcement option is weighted against its proportional area of the network design. These weighted scores are then aggregated to create a score for construction and operation for each sub-criterion, shown below in Figure 32. When appropriate, estimated circuit length may be considered as a multiplication factor for the risk score.



	Network design A										
	Option 6		Option 9		Option 11		Option 16		Aggregated score		Total flags
Sub-criterion	Con	Op	Con	Op	Con	Op	Con	Op	Con	Op	
Ecology	5.8	3.1	6.8	5.8	5.1	3.4	4.7	4.4	5.7	4.1	32
Flood risk	2.8	1.9	4.9	2.2	2.1	1.8	3.3	2.7	3.2	2.0	8

Figure 32: Example of aggregated scoring for a network design

Using the previously calculated aggregated scores and the total flags, the network designs will be ranked within each sub-criterion, as shown below in Figure 33. This table, along with supporting narrative, acts as an aid to the expert judgment employed to rank the network designs from best to worst, as shown in Figure 33. These ranks are then used in the shortlisting process detailed in the [rank network designs using cumulative ECDO performance](#) below.



	Environment								
	Ecology			Flood risk			...		
	Con	Op	Flag	Con	Op	Flag	Con	Op	Flag
Network design A	2	2	2	1	1	2	2	2	1
Network design B	1	1	1	2	2	1	1	1	2

Rank	Network design
1	Network design B
2	Network design C
3	Network design A
4	Network design D

Figure 33: Example rankings for network designs

Deliverability and operability design-level scoring and ranking

Progressed reinforcement options will have scores provided for deliverability and operability following the scoring characteristics under the deliverability and operability sub-criterion provided in Appendices D.1 and D.2. The scores from reinforcement option developers are necessary at the individual option level, which is why the definitions in Tables 14 and 15 and in Appendices D.1 and D.2 refer to reinforcement options. Option developers are also required to provide supporting information, in the form of narratives, to accompany the reinforcement option scores to aid NESO's network design assessment.

NESO will conduct the network design assessment for the same sub-criteria using the scores and narratives provided by the option developers. The aim is to differentiate the designs by evaluating them directly at the network design level, considering their overall deliverability and operability. This approach allows for a tailored evaluation, considering the interactions and dependencies between options within each network design.

The network design scoring uses a linear scale, where the highest score indicates greater complexity or associated risk. The reinforcement option provider will use the provided



sub-criterion examples, with supporting narrative, to justify their score. It is also possible to mitigate against risks and provide a lower score if it is justified within by supporting narrative. For example, innovative solutions would inherently be riskier due to less operational experience; however, by taking some mitigating actions or assumptions (such as reputable suppliers or quality assurance) then a lower ranking can be scored. Further detail about deliverability and operability scoring is in Appendices D.1 and D.2.

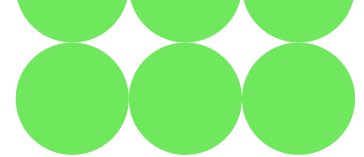
The scores of the individual deliverability and operability sub-criteria are summed to provide two total scores which would be used to rank the network designs from best to worst. Supplementary narrative information will be used during the ranking process, alongside the cumulative scores, if required, for decision-making. These ranks are then used in the shortlisting process detailed below.

Rank network designs using cumulative ECDO performance

NESO will rank the performance of each network design against each individual ECDO criterion from best to worst. NESO will assign no preference to any specific ECDO criterion during this process. This ranking exercise shows us which designs are performing well against all the criteria or are weaker in some areas. An example of this is shown in Figure 57, which shows how network design A is the best performing environmentally, but the fifth best against the community criterion. Sub-criteria and supporting narrative can be used to break ties and clarify the ranking when appropriate.

Network design	ECDO rank			
	E	C	D	O
A	1	5	4	2
B	4	7	6	9
D	2	4	5	1
E	7	2	7	6
G	8	8	2	10
I	9	9	9	5
K	6	6	8	8
L	5	10	1	7
O	3	1	3	4
R	10	3	10	3

Figure 34: ECDO ranking of network designs



NESO will reduce the network designs list to an appropriate short list for the subsequent CBA using these rankings, supported by CSNP governance. We will evaluate the score distributions across all ECDO criteria to establish thresholds for selection of top designs and eliminating non-feasible network designs. We will then select the top performing network designs that perform well across all ECDO criteria, as shown in Figure 35. These network designs will need to be within the top “X” of each criterion. The example in Figure 58 uses the top five as the metric but this may be adjusted during the appraisal depending on how the score distributions develop. If many network designs perform inconsistently across criteria, we may expand the acceptable range to include, for example, the top seven performers for each criterion. This ensures that the short list of network designs is appropriate in size. We will document the values used for filtering to maintain transparency and this information will be made available to our stakeholders when appropriate.

This approach of hurdle-based sequential filtering avoids the need for weighting ECDO, which would not be appropriate without a full multi-criteria decision analysis (MCDA) approach.

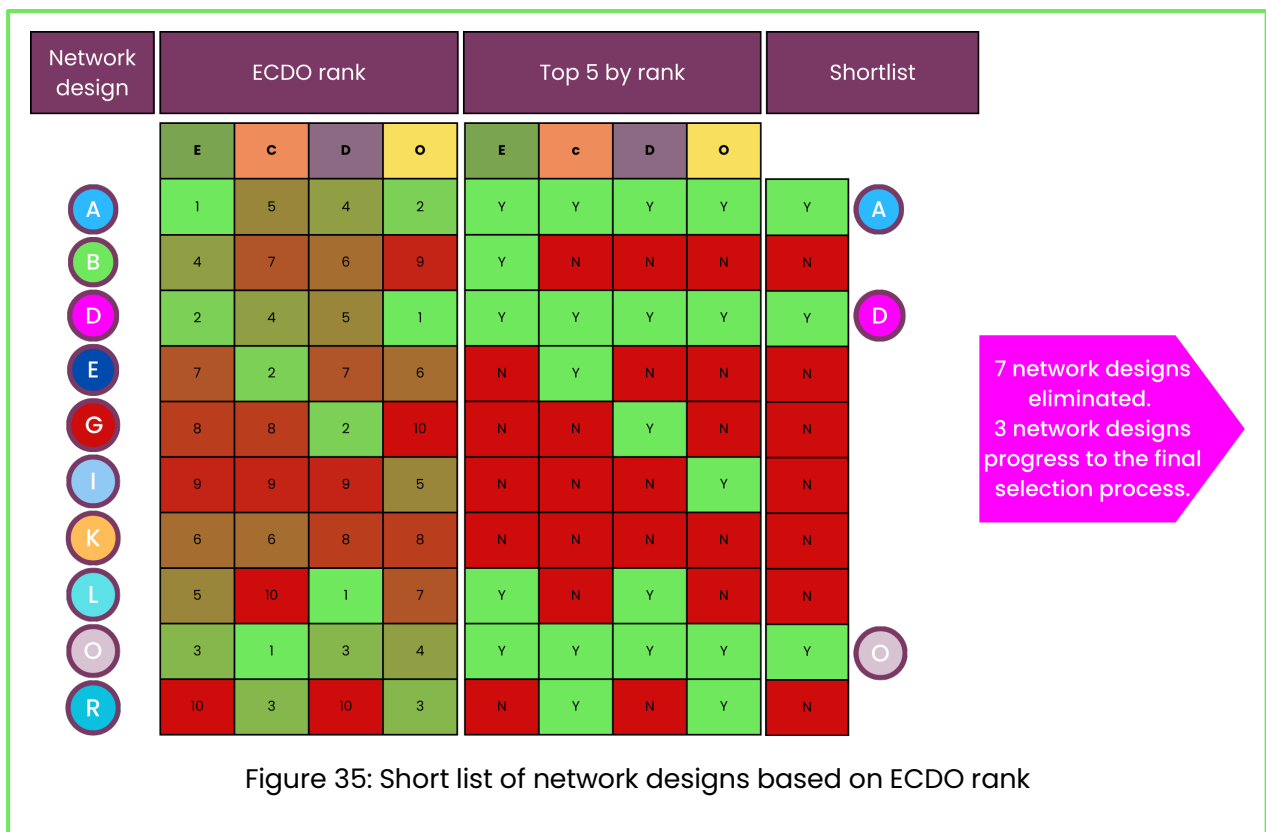
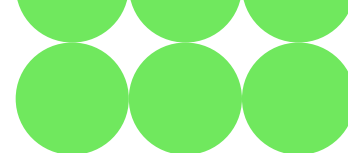


Figure 35: Short list of network designs based on ECDO rank

Conduct a cost benefit analysis to identify the preferred network design

In alignment to the HM Treasury Green Book, NESO will apply a CBA to move from the short list to a preferred final network design. We will do this by considering the same costs and method described in the [economic efficiency](#) section above and in addition to the monetised aspects of the ECDO criteria, where appropriate. This final CBA will be used in



conjunction with the non-monetisable ECDO sub-criteria and supporting narrative to come to a final preferred network design.

NESO will undertake and present an extensive review of each ECDO sub-criterion and assess whether each sub-criterion is suitable for monetisation within the final CBA, considering both robustness of input information and the risk of double counting. Upon completion of this review, we will discuss its findings with the CSNP governance to reach a decision on which sub-criteria should be monetised or considered from a qualitative perspective. This will be submitted to Ofgem for approval. We will clearly document the values and processes used for monetisation to maintain transparency. Two examples of possible monetised sub-criteria are described below.

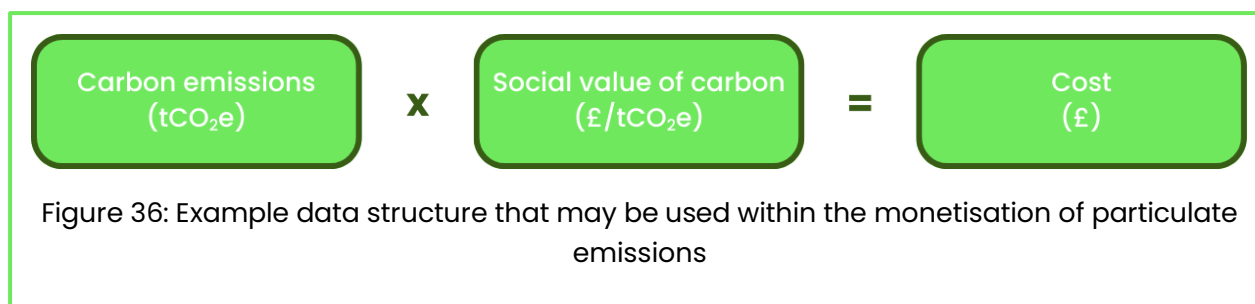
Monetisation example A: costs of carbon of reinforcement options embodied in materials and construction

One example of possible monetisation is to calculate the greenhouse gas emissions produced during construction of an asset, in addition to the embedded emissions in the materials used. We will use historical and academic information to determine the appropriate values for each project. Expert judgement may also be employed, as appropriate, and controlled through the CSNP governance.

Table 15: Example data structure that may be used within the monetisation of greenhouse gas emissions.

Asset type	Greenhouse gas emissions (tCO ₂ e)	
	Construction	Embedded carbon in materials
HVAC – substation upgrade	X1	Y1
HVAC – overground	X2	Y2
HVAC – underground	X3	Y3

In this example, the total CO₂ equivalent will be calculated and multiplied by the societal value of carbon, which is also discussed in the [social costs and benefits section](#) above. This would be undertaken for each reinforcement option within each shortlisted network design and used in the respective NPV calculation of each network design.



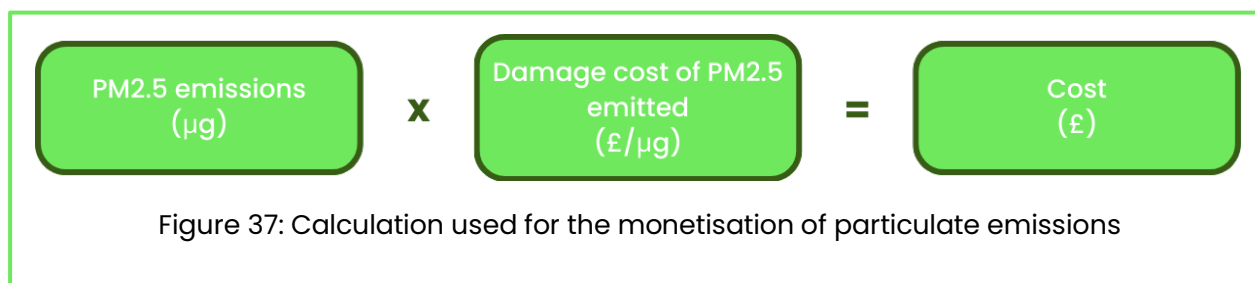
Monetisation example B: Air quality

Another example of monetisable assessment criteria is the disbenefit caused by increased emissions of particles 2.5 micrometres or less (PM2.5) due to construction of new reinforcement options. NESO will use historical and academic information to determine the appropriate values for each project. Expert judgement may also be employed, as appropriate, and controlled through the CSNP governance.

Table 16: Calculation used for the monetisation of greenhouse gas emissions

Asset type	PM2.5 emissions
	Construction
HVAC – substation upgrade	Z1 (µg/unit)
HVAC – overground	Z2 (µg/km)
HVAC – underground	Z3 (µg/km)

In this example, the total increase in PM2.5 emissions due to the construction of reinforcement options is calculated. The total is then multiplied by the damage cost of PM2.5 emitted which is provided by DEFRA⁹², for example. This would be undertaken for each reinforcement option within each shortlisted network design and used in the respective NPV calculation of each network design.



⁹² DEFRA, [gov.uk/government/publications/assess-the-impact-of-air-quality/air-quality-appraisal-damage-cost-guidance](https://www.gov.uk/government/publications/assess-the-impact-of-air-quality/air-quality-appraisal-damage-cost-guidance)



Sensitivity analysis

The options assessment process will be undertaken using the chosen SSEP pathway. The SSEP pathway will be used through the decision-making framework throughout the process, establishing multiple credible network designs through to the final CBA to identify the preferred network design.

We recognise that with the need for significant network expansion, stress-testing the decisions by considering sensitivities becomes crucial. Evidence to back the recommendation decisions is necessary to give decision makers confidence in approving the network plans.

A variety of sensitivities are possible, if prioritised by the CSNP governance and approved by Ofgem. Example sensitivities may include, but are not limited to:

- variations in capital expenditure (CapEx)
- variations in reinforcement options delivery date
- variations in interconnector flows
- different weather years used within our pan-European model
- benefit-cost ratio sensitivity assessment

Resilience events

As part of the CSNP, we will establish a set of distinct resilience events to identify, at a system-level, any strategic risks that may have a high impact on bulk power flows across the National Electricity Transmission System.

The resilience events will combine multiple credible risks, such as those resulting from assumptions on climate conditions, electricity demand, generator availability and network performance. The resilience events will be developed from existing energy pathways and selected through CSNP governance and approved by Ofgem, informed by historic and emerging risks identified through our Resilience and Emergency Management⁹³ role.



Climate
conditions



Electricity
demand



Generator
availability

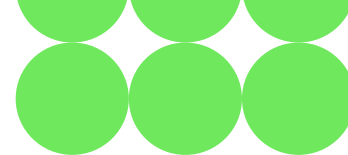


Network
performance

A potential resilience event could, for example, consider a period of higher temperature which may lead to increased electricity demand, impacted generator availability and depressed conductor ratings. We may apply scaling factors to boundary capabilities to approximate the impact of, for example, higher temperatures on network performance.

After the preferred network design is selected, we will conduct an adequacy stress test against the potential resilience events in a model. Our modelling could provide metrics on

⁹³ NESO, [neso.energy/what-we-do/resilience-emergency-management](https://www.neso.energy/what-we-do/resilience-emergency-management)



impacts such as network constraints, loss of load expectation, unserved energy and reserve margins.

The outputs of this adequacy stress test will be published with due consideration of its sensitivity and, if required, support a consideration of resilience beyond the CSNP. This will be progressed under our Resilience and Emergency Management role.

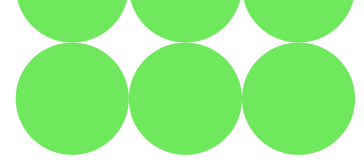
Through this, we will engage with DESNZ and Ofgem to understand whether the impacts assessed through our modelling lay within government risk appetite. If results are seen out of government's risk tolerance, we will work with them to identify solutions to mitigate these. These could include reviewing relevant standards, bolstering our response capabilities or considering existing industry activities. Our results may also inform energy modelling in future cycles of the SSEP.

It is our intention that the insight gained from consideration of resilience events will be flagged to decision and policy makers where there are matters that should be considered as variation in the network design. This will be considered by the CSNP governance process and other resilience forums.

Energy pathways

The shortlisted or chosen network design may be tested against alternative energy pathways, if deemed appropriate by CSNP governance. Alternative example energy pathways are NESO's FES, if appropriate. These will enable us to model multiple long-term strategic energy pathways that will highlight what must happen to enable clean energy.

Beyond the delivery pipeline, out to a 25-year time horizon, the chosen SSEP pathway, alternative energy pathways and other sensitivities can be used to explore a wide range of futures within the options funnel. These will illustrate different routes to expanding the network out to 25 years.



Roles and responsibilities

NESO will systematically assess reinforcement options against multiple criteria, to develop an overall network design to inform the delivery pipeline in the Deliver phase.

We will create multiple credible network designs consisting of multiple shortlisted reinforcement options and we will ensure each network design will be technically feasible, economically viable and will complement each onshore design.

Sensitivity analysis

NESO will discuss and agree the required sensitivity analysis with the CSNP governance. Subsequently, we will conduct the analysis and, if required to facilitate the analysis, may request further information from the reinforcement option developers. The results of any sensitivity analysis will be presented to the relevant CSNP governance.

8. Section 3: Electricity – Deliver

Publishing our plans and managing changes

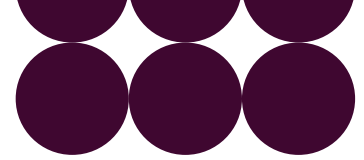
Progression and delivery pipeline

Network Competition

Change control

Roles and responsibilities





Publishing our plans and managing changes

The Deliver step is the last step of the CSNP and uses the preferred network design determined in the Appraise step. The key stages in the Deliver step are undertaken by NESO, based on the data created by the process, and culminate in our publications.

This section includes three key topics related to the delivery of the CSNP and the management of the plan after it has been produced:

- The progression and delivery pipeline section explains the criteria for how, following the Appraise step, a subset of reinforcement options within the preferred network design will progress into the delivery pipeline.
- The network competition section explores the criteria for determining which subset of reinforcement could be eligible for network competition – that could be delivered by someone other than the incumbent TOs or the transmission owners through competition.
- The change control process explores the triggers and process for managing changes and variation reinforcement options and offshore infrastructure, once they have entered the delivery pipeline. This process includes the delivery bodies of these projects in the assessment.

Details of our publications and stakeholder engagement on the final plans are included in [Section 2](#) of this methodology.








Progression and delivery pipeline

Following the Appraise step, a subset of reinforcement options within the preferred network design will progress into the delivery pipeline. These will not be reassessed, unless there are substantial changes to the reinforcement options or their needs case.

The CSNP will evidence the needs case and determine the strategic parameters of required reinforcement options in the delivery pipeline. It will identify those that meet the relevant criteria and are eligible for network competition. The delivery body could be an incumbent TO or a competitively appointed TO and will be responsible for progression through the delivery pipeline.

Delivery pipeline

	Route design	For new circuits, appraise a range of routing and siting options to form a preferred corridor through engagement.
	Design development	Undergo further design, supply chain engagement and assessment considering site surveys and land access.
	Planning and consenting	Where relevant, prepare for planning and consenting and conduct consultation.
	Application approval	Gain planning approval and undergo a full project funding assessment with Ofgem.
	Asset construction	Procure and complete construction ahead of the asset being commissioned.

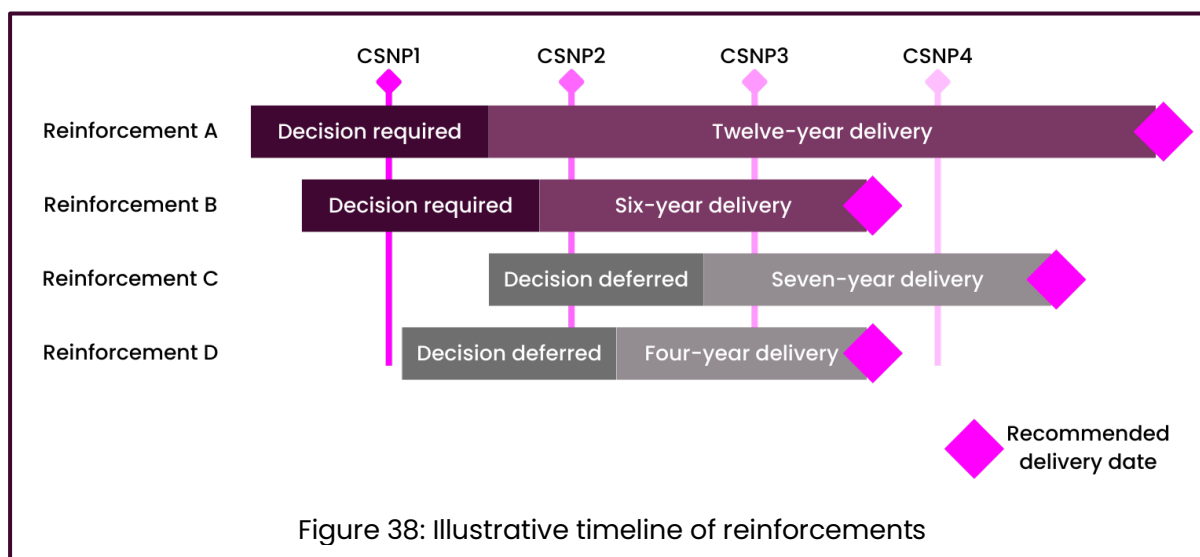
The UK government's Transmission Acceleration Action Plan⁹⁴ seeks to halve the delivery timeframe of electricity transmission network infrastructure, including the delivery pipeline stages. To help realise this, the CSNP will support quicker regulatory funding and provide greater confidence to industry and supply chains to help accelerate delivery.

⁹⁴ UK government, [gov.uk/government/publications/electricity-networks-transmission-acceleration-action-plan](https://www.gov.uk/government/publications/electricity-networks-transmission-acceleration-action-plan)



Delivery horizon

The Appraise step will determine the preferred network design. A subset of the reinforcements within the preferred network design will progress into the delivery pipeline. This will depend on their delivery timescale, minimum data requirements, needs case and whether delivery is required to begin in the following three years.



In Figure 38, Reinforcement A and Reinforcement B would progress into the delivery pipeline to ensure the timely fulfilment of their needs case. The progression of Reinforcement C and Reinforcement D would be deferred to the following CSNP, where they will be reassessed. This is because delivery is not required to begin in the three years prior to the next CSNP. This approach will ensure timely delivery by balancing anticipatory decisions with the flexibility to defer decisions when delivery is not yet required. Where a delivery range is defined, this will be considered accordingly. Network competition, as well as any relevant additional drivers, may also need to be factored into delivery timescales. Where options are not progressed into the delivery pipeline, no specific 'signal' will be provided of non-progression.

Certain projects which are not otherwise eligible for progression to the delivery pipeline may be discussed through the CSNP governance for additional support or advancement. These projects are those of key strategic importance or where there are wider benefits in delivering the project earlier than the recommended delivery date.

Offshore infrastructure within the preferred network design will progress into the delivery pipeline in a similar manner to reinforcement options. Additional consideration will be given to when certainty is required to facilitate any relevant leasing rounds for offshore generation.

Dependent reinforcements

In specific circumstances, it may be beneficial to progress reinforcements into the delivery pipeline together, even if a decision can be deferred for one reinforcement. This may be



appropriate where the benefit provided by one reinforcement is dependent on the delivery of another. This will be subject to CSNP governance, following engagement with relevant stakeholders, such as the reinforcement options developer(s), and consider the criteria in Table 17 as well as any interactions with network competition.

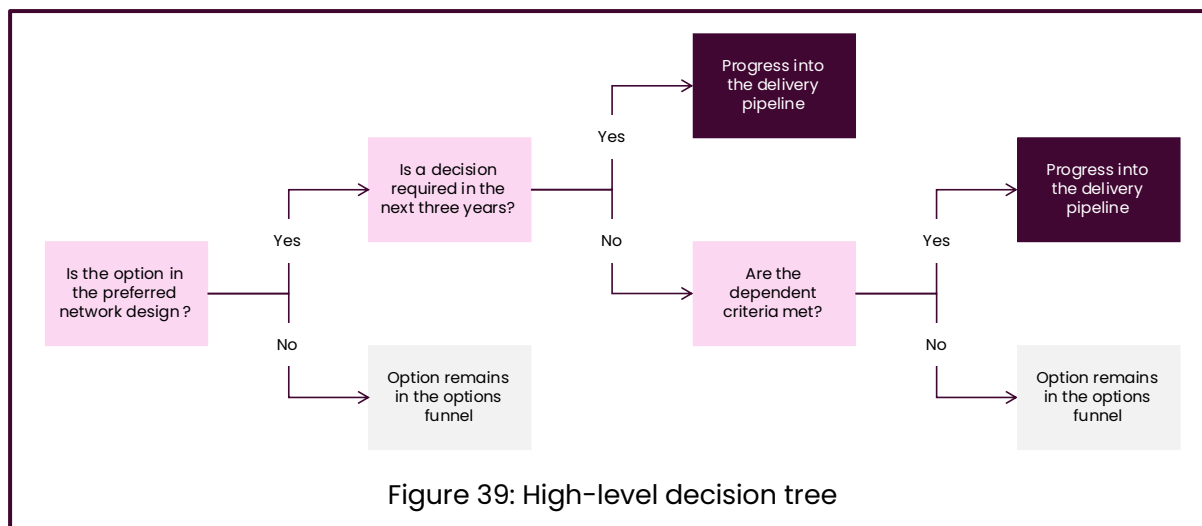
Table 17: Dependent criteria

Criterion	Description
Effective	The reinforcement provides significant benefit in combination with another reinforcement relative to its cost.
Certain	The needs case and system interactions are not expected to change, and the reinforcement is clearly favourable compared to alternatives.
Proximate	The reinforcement is in a similar area of the network to the other reinforcement.

For example, the criteria could be met where a network upgrade, with a shorter delivery timescale, unlocks the benefit provided by a more significant reinforcement with a longer delivery timescale. In this circumstance, it may be advantageous to progress the network upgrade into the delivery pipeline alongside the more significant reinforcement. This approach will provide greater certainty on future network and system requirements.

Delivery decision tree

Required reinforcements that progress into the delivery pipeline will be subject to Ofgem funding, in line with the relevant funding mechanism, and will be removed from the cyclical process. Reinforcements that are not included in the preferred network design or are not yet progressed into the delivery pipeline will remain in the options funnel for reassessment in the future. This is illustrated in Figure 39. If reinforcement options are not considered feasible, deliverable or become redundant in addition to those progressed into the delivery pipeline, these may be removed from the options funnel. This can be done through relevant engagement with incumbent TOs or competitively appointed TOs and in consideration of any relevant additional drivers.



Option selection

If the strategic parameters include multiple reinforcement options, the delivery body will select the final reinforcement option and progress through the delivery pipeline, keeping within the defined strategic parameters. Any selection by the delivery body must maintain a comparable whole-life benefit of the chosen network design. This will allow flexibility to support choices through the delivery pipeline, including for local engagement. If required by Ofgem, some reinforcement options may need further development to progress into the delivery pipeline. This development should stay within the defined strategic parameters. If, through this development, a reinforcement option substantially changes, the change control process will be initiated.



Network Competition

Competition

NESO will identify required reinforcements that could be put out to tender so that other parties, as well as incumbent TOs, can own, operate and maintain parts of the electricity transmission system. There are two types of competition, known as 'early' and 'late'. These refer to the point in the development process at which the competition is run. At the time of writing, only early competition has a mechanism for delivery via The Electricity (Early-Model Competitive Tenders for Onshore Transmission Licences) Regulations 2025⁹⁵.

Early competition⁹⁶ is a competitive process to select a bidder to deliver a specific reinforcement on GB's electricity transmission system. The process starts at the beginning of the delivery pipeline. This means organisations could compete for the design, build and ownership of onshore transmission solutions. Early competition will help encourage new ways of working and aims to seek the best delivery at a fair cost for consumers. Early competition will not facilitate solutions relating to system operation, which will be identified through the Network Services programme.

Eligibility criteria

Required reinforcements progressing into the delivery pipeline will be eligible for competition where they meet the criteria listed in Table 18 as per The Electricity (Criteria for Relevant Electricity Projects) (Transmission) Regulations 2024⁹⁷.

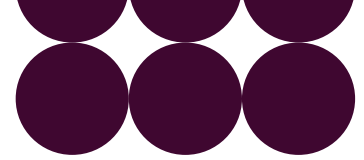
Table 18: Eligibility criteria for competition

Criterion	Early	Late	Description
Network need	✓	✓	The reinforcement must be capable, with reasonable certainty, of addressing a network need.
Novelty	✓	✓	The reinforcement is a completely new asset or is a complete replacement of an existing asset.
Separability	✓	✓	The boundaries of ownership between the reinforcement and other assets are clearly delineated.
High value		✓	The reinforcement has an expected capital expenditure of £100m or above.
Consumer benefit	✓		The reinforcement is economic to tender in consideration of associated benefits and disbenefits.

⁹⁵ UK government, legislation.gov.uk/uksi/2025/446/contents/made

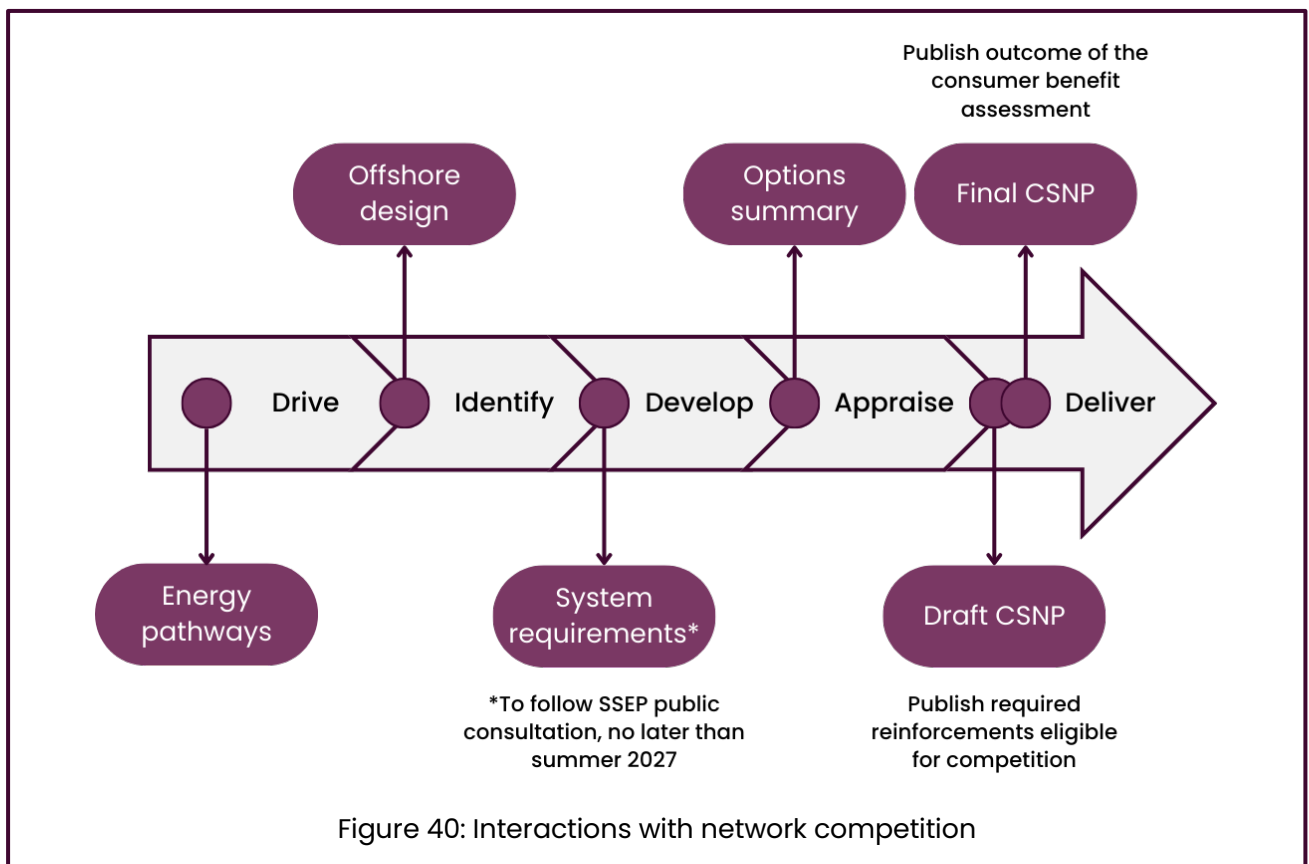
⁹⁶ NESO, neso.energy/about/our-projects/early-competition

⁹⁷ UK government, legislation.gov.uk/uksi/2024/168/made



NESO will publish reinforcements that meet eligibility criteria for both late and early competition as part of the draft CSNP publication. The outcome of the consumer benefit assessment may be published later as part of the final CSNP publication, as illustrated in Figure 40.

We will then make requests to Ofgem for any tender in accordance with The Electricity (Early-Model Competitive Tenders for Onshore Transmission Licences) Regulations 2025⁹⁸. Whilst required reinforcements may meet the eligibility criteria and be identified as such in the CSNP, it is not guaranteed these will be taken forward for competition. The confirmation of which projects will be requested by NESO for competition and subsequent approval by Ofgem is subject to the 2025 regulations and therefore will be notified separately to the publication of the CSNP.



Process

The process to test reinforcements against the eligibility criteria is outlined in Table 19. Some reinforcements that initially fail the separable criterion, in stage five, might pass this criterion if elements can be split away from the rest of the project in stage six.

⁹⁸ UK government, legislation.gov.uk/uksi/2025/446/contents/made



Table 19: Eligibility process

Stage Activity	Description
1 Gather all project costs for an area or region that meet the network need criterion. Can the projects be bundled or split?	The stage checks bundling or splitting, for example, because of the similarity of works, location and timeframes.
2 Late only – Is the value over £100m?	The first of a two-stage process, of which the second is stage four (in this table). The trigger threshold is set at £90m to highlight projects that are marginally below the £100m figure. This produces a yes/no output.
3 Is this a new asset or complete replacement?	If a project delivers completely new assets or complete replacement assets that fulfil the same function as the assets to be removed or replaced. This produces a yes/no output.
4 Late only – Are the new or complete replacement assets over £100m CapEx?	The second part of a two-stage process, of which the first is stage two (in this table). If the reinforcement has a very high proportion of new assets and high value, the reinforcement will pass this stage. For more marginal projects, we use provided cost breakdowns to calculate the value of the new assets. This produces a yes/no output.
5 Are the new assets separable?	Check if the reinforcement already has points of connection to existing assets that can be clearly delineated. Disconnectors are an example and other points, such as clamps on busbars, would also be acceptable if the point can be clearly identified. This produces a yes/no output.
6 Can the projects be bundled or split?	As for stage one, above. Note that projects that are split must have component parts that meet or exceed the £100m value threshold for late competition. Splitting might be needed to meet the separability criteria.
7 Evaluate if further electrical separation is needed.	If this stage is required, we treat any such instances on a case-by-case basis for options that pass the earlier stages and look likely to go to tender. We will consider factors such as safety and operability, as well as cost and record outcomes along with the method used.
8 Early only – Is there a net benefit to running a tender?	Check if the benefits of tendering outweigh the disbenefits of tendering. This assessment process is described in our Consumer Benefit Assessment Methodology ⁹⁹ . NESO may shortlist which projects are subject to this analysis based on

⁹⁹ NESO, [neso.energy/document/301781/download](https://www.neso.energy/document/301781/download)

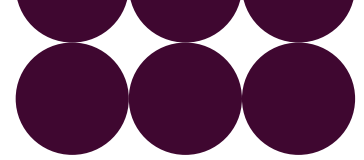


suitability for competition, for example, attractiveness to the market, optimal in-service dates and confidence of needs case.

Cost bands will be used, which give industry an indication of the value of reinforcements while maintaining confidentiality. The costs apply for new and separable elements only. Table 20 lists the agreed cost bands.

Table 20: Cost bands

Cost band
£100m - £500m
£500m - £1,000m
£1,000m - £1,500m
£1,500m - £2,000m
Greater than £2,000m



Change control

Scope

Scope – onshore networks

The needs case and strategic parameters of the reinforcements in the delivery pipeline will not be reassessed, unless there are substantial changes to the reinforcements or their needs case. In such exceptional cases, a change control process will be initiated. This process will assess the impact of any changes on the strategic plan but not evaluate specific developments through the delivery pipeline.

In dealing with any consequences or implications of change control, TOs will be subject to regulatory framework, with respect to funding and/or incentives, and competitively appointed TOs will be subject to their commercial framework¹⁰⁰. The change control process will not apply to solutions identified through the Network Services programme.

The high-level change control process is outlined in Figure 41.

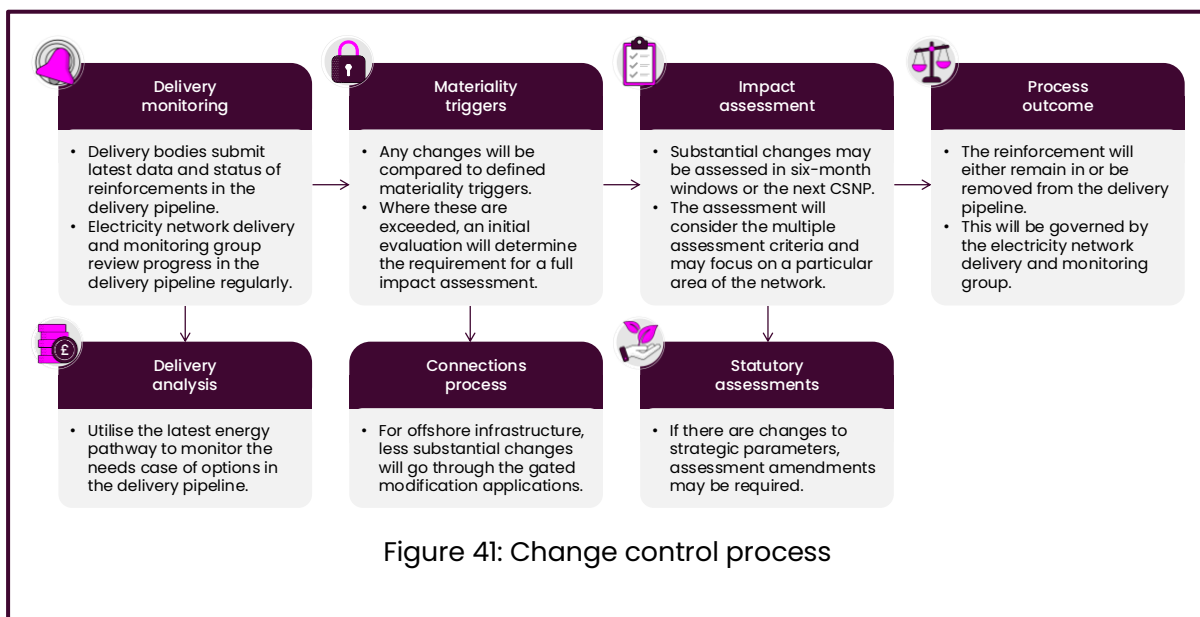
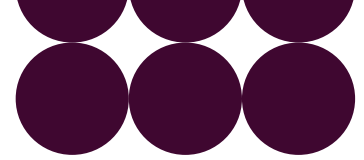


Figure 41: Change control process

Scope – offshore networks

While complementing the onshore, it is expected that the offshore change control process will be triggered by exceptional circumstances and applied as an interventive mechanism, ensuring it can run in parallel with and not duplicate or conflict with the Connections Reform gated modification process. The application of the offshore change control process is complex due to the wide range of regulatory delivery models for infrastructure within offshore networks, where each delivery model cannot be applied to

¹⁰⁰ Ofgem, [ofgem.gov.uk/consultation/consultation-onshore-electricity-transmission-early-competition-commercial-framework](https://www.ofgem.gov.uk/consultation/consultation-onshore-electricity-transmission-early-competition-commercial-framework)



the offshore change control process in the same way as one another. The offshore change control process adds value to the CSNP by effectively identifying and assessing the impact of any design changes which could undermine the strategic network plan; of particular importance is the avoidance an offshore design change materially impacts the reinforcements in the delivery pipeline.

NESO recognises that the offshore network is generally progressed by delivery bodies under the OFTO regulatory delivery model. These delivery bodies will be incentivised to deliver network infrastructure in a timely manner through the Connections Reform first-ready, first-connect model and meet the applicable delivery milestones set out in the Connections Network Design Methodology (CNDM). The capital costs for this infrastructure are managed appropriately by a competitive Contracts for Difference (CfD) allocation round owned by DESNZ and the Generator Commission Clause and OFTO divestment tender rounds owned and managed by Ofgem. The competitive nature of the OFTO regime keeps costs down for consumers. Therefore, the delivery monitoring and materiality changes for offshore change control in practice will not be applied to the equivalent onshore change control. Note that the onshore network assets which are physically located offshore and designed to provide network reinforcement only will be managed as detailed in the onshore change control process. However, there are some exceptions to this rule, such as offshore assets part of an electrically connected network and which have dual purpose, used for conveying electricity generated by offshore generators and for reinforcing the onshore network, for example. These ‘onshore’ designated electrically coordinated reinforcements will be progressed into the delivery pipeline and monitored in line with any other reinforcement, but due to their bespoke characteristics, such as enabling works complexity and stranded asset risk, there may be exceptions required, such as the requirement to reassess the needs case against latest energy pathways.

NESO is taking into consideration that Ofgem is developing an Early OFTO Build model intended to be deployed for successful CSNP offshore network projects. Due to the commercial similarities with CATO and OFTO Build delivery models, we would explore alignment of delivery monitoring requirements for these assets within the commercial framework, to ensure efficiencies and consistent processes. For OFTO build projects, any material change to the offshore strategic parameters and triggers detailed below, will initiate the change control process.

Since the final offshore design of the CSNP is unknown at the time of writing, as outlined in the [Develop section](#), the offshore change control process methodology, the exact detail and complexity of the offshore network is uncertain. As a result, the offshore change control process needs to be able to flex and fit to any unexpected change requests. Therefore, this offshore change control methodology must inherently rely upon example scenarios, in the use of Strategic Parameters and Triggers, of what may result in triggering the application of the process.

For clarity, when referring to the offshore network in the remaining sections of this methodology, we are referring to either OFTO assets or onshore reinforcement assets which are geographically positioned offshore and electrically connected offshore as part of a coordinated network, as outlined in Figure 42.

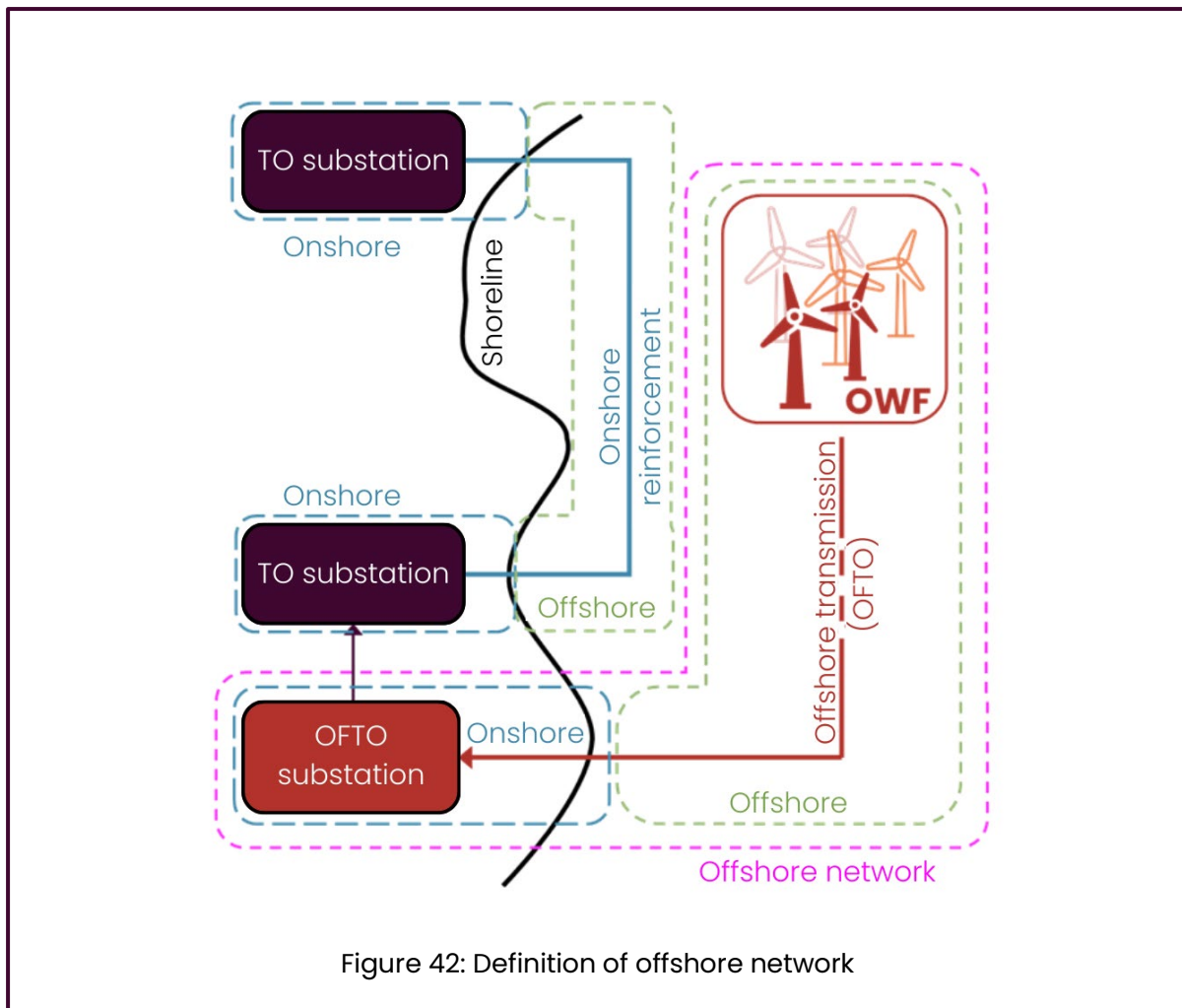
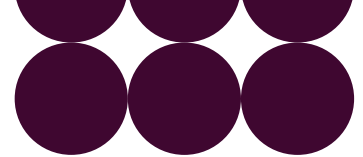


Figure 42: Definition of offshore network

Processes and details outlined within this change control section of the CSNP methodology will be further defined in the detailed Terms of Reference (ToR), expected to be formed closer in date to the final published CSNP methodology.

Materiality triggers

Materiality triggers – onshore networks

The process will be initiated under a limited set of materiality triggers that will apply to any wider reinforcements determined in the CSNP. These are outlined in Table 21 and will be subject to regular review by the electricity network delivery and monitoring group.

Table 21: Materiality triggers

Change	Trigger	Description
Strategic parameters	Any change to the strategic parameters of reinforcements.	The plan will determine the strategic parameters of reinforcements. Any change to these parameters will require a reassessment.
Electrical configuration	A material change to the electrical configuration,	A change to the selected interface zones may impact future interacting reinforcements or



	including to the interface zones or the additional boundary capability provided.	additional drivers; this will only be applicable if the strategic parameters include multiple options. A material change to the additional boundary capability provided will also necessitate reassessment.
Capital cost	A 50% increase to the total capital cost of the reinforcement.	A material change to the cost of a required reinforcement will prompt reassessment. Where a capital cost change of less than 50% could impact the reinforcement option progressed, this trigger may be flagged accordingly. The need for this lower trigger will be identified during the Appraise step.
Delivery year	A delay to the delivery year of the reinforcement.	A material delay to the delivery of a reinforcement will trigger the change control process. Where a delivery range is defined, this trigger will be redefined accordingly.

The change control process may also be initiated where there are material changes to the needs case of reinforcements. The needs case of required reinforcements, including any additional drivers, will be regularly monitored in the delivery pipeline by NESO as well as against the latest energy pathways every three years. Alongside the needs case, changes to interacting reinforcements, including to the offshore design, may also initiate the change control process. Triggers may be defined further in follow-up Terms of Reference (ToR) documentation closer to publication of the CSNP.

Parameters and materiality triggers – offshore networks

To provide certainty to the industry and investor confidence, the offshore CSNP design will align with the strategic parameters for onshore reinforcements in Table 5. However, due to the limited delivery monitoring expected for generator build OFTOs in comparison with the procedure outlined for network reinforcements, industry have responsibilities to ensure they progress delivery of their design within the strategic parameters set out by NESO in this methodology.

Spatial envelope: refers to the broad geographical area in which a connection or reinforcement is required. NESO identifies the spatial envelopes for the offshore network assets through our environmental appraisal studies and provides this information to the delivery bodies. While these spatial envelopes are subject to detailed surveyance and the progression of detailed network design, they provide a broad enough spatial corridor area for delivery bodies to optimise routing and minimise deviations to exceptional circumstances. Where misalignment with the spatial envelope is unavoidable, projects should raise this with NESO at the earliest opportunity and ensure they can provide evidenced justification through the relevant planning processes and established regulatory frameworks.

Technology type: refers to the type of transmission technology used for connections or reinforcements, such as High Voltage Alternating Current (HVAC), High Voltage Direct Current (HVDC) and its minimum capacity and voltage. There may be circumstances



delivery bodies for the offshore network may look to increase a design rated capacity or increase the voltage of assets to fit with an increase of generation capacity. Within the same technology type used (for example, HVDC or HVAC), such a change would be managed more appropriately by the Connections Reform gated modification process without the need for intervention from strategic planning. If the design change is approved through the gated modification process, delivery parties will be responsible for providing evidenced justification for this design change through the relevant planning processes and established regulatory frameworks.

Strategic design: refers to the high-level design or primary purpose of a connection or reinforcement, including whether it is coordinated with offshore assets, generators or wider infrastructure. Coordinated offshore designs require complex engineering and are often entirely dependent on all the components arriving. Removing just one generator or transmission asset introduces stranded risk and network compliance issues for the wider electrically connected network. In turn, a redesign of an electrically connected network or multipurpose interconnector could materially impact the wider network plan and reinforcements in the delivery pipeline.

Interface zones: refer to the areas of the onshore and offshore transmission system where a connection or reinforcement will connect between. There may be circumstances where the offshore network delivery bodies may look to alter the location of a connection to the transmission system. Such a change from network users would be managed more appropriately by the Connections Reform gated modification process, however there are exceptions which could trigger CSNP reassessment, which would be identified through an initial evaluation process. For circumstances where a network-led driver for interface zone change is identified, the offshore change control will be initiated.

At this early stage, an exhaustive list of all the triggers is not fully defined. Additionally, reassessment will be determined on a case-by-case basis after an initial evaluation of the specific design change and wider network impact. For guidance, we have provided some triggers which we believe may meet the threshold for reassessment. Triggers are expected to be defined further in follow-up Terms of Reference (ToR) documentation closer to the CSNP publication, for the offshore change control.

Change – customer contract termination

Trigger: any customer who forms part of a coordinated offshore network solution, terminating their connection agreement.

Description: a material impact to electrically connected customers, resulting from the termination of a contract within a coordinated offshore system and directly resulting in the coordinated network unable to maintain compliance with SQSS and Grid Code requirements and stranded assets for the remaining electrically connected generators and/or reinforcements.

Change – primary purpose of the asset altered

Trigger: any change to the primary purpose of an asset identified and recommended in the offshore design.



Description: a material impact to the overall function of the strategic design that results from a change to an asset's primary purpose, directly impacting other users, the transmission system and the intended purpose and functionality of the wider network plan. This can be applied to scenarios such as an MPI changing to a point-to-point design (interconnector + GB radial asset), non-radial to radial or shared transmission (reinforcement and generation) to singular purpose.

Change – moving of interface point across SSEP boundaries or network boundaries

Trigger: any request to move interface point with the main transmission system identified during the CSNP, which creates a connection or reinforcement connecting into a different SSEP boundary or network boundary.

Description: moving connection locations for offshore reinforcements and connections across SSEP or network boundaries could significantly compromise the network plan which is built upon the selected SSEP pathway and background spatial generation data. NESO may decide such a change would need to be reassessed alongside broader alternatives in the next CSNP.

Change – technology change

Trigger: any change to the minimum technology capacity or voltage of the transmission asset whereby no alteration to generator capacity is the driver.

Description: reducing the transmission capacities and voltages for the offshore network can significantly undermine the principles of spatial and strategic coordination, which aims to maximise transmission technology choices and optimisation with seabed leasing. This will likely result in varying the capacity across an increased number of circuits, conflict with the spatial envelope and cause significant environmental impacts.

The change control process will also be initiated where there are material changes to the offshore network not prescribed above, which consequently result in a material change to the needs case of network reinforcements in the delivery pipeline.

Delivery monitoring

Delivery monitoring – onshore networks

To ensure network delivery in line with the CSNP, NESO will monitor the delivery of electricity transmission network reinforcements in the delivery pipeline. This will build upon the electricity network delivery and monitoring group established as part of Clean Power 2030¹⁰¹. The group will support the timely identification of change and the mitigation risks through the delivery pipeline. The group is anticipated to meet every three months with representation from NESO, Ofgem, DESNZ and delivery bodies.

¹⁰¹ NESO, [neso.energy/publications/clean-power-2030](https://www.neso.energy/publications/clean-power-2030)



As part of the electricity network delivery and monitoring group, delivery bodies will be expected to submit the latest data and status of reinforcements in the delivery pipeline, as well as raise any risks on a regular basis. A reporting dashboard will log and assure any updates through the delivery pipeline, which will be flagged in accordance with the triggers outlined in Table 22. Updates may also be provided by NESO, where relevant. The electricity network delivery and monitoring group will be responsible for governing next steps. Following any updates, such as working and senior level deep dives and alongside critical policy support, NESO and Ofgem will review the requirement for reassessment following the electricity network delivery and monitoring group governance procedures. Additionally, as part of the delivery monitoring process, any CSNP sensitivities undertaken during the Appraise step will be a valuable source of analysis to reconcile and resolve delivery challenges as they may arise.

Where a reinforcement triggers the change control process, it will be reassessed through a six-monthly change control window. The windows will provide opportunity to collectively coordinate and assess any substantial changes to reinforcements or to the offshore design. NESO will reserve the right to extend or run the process outside of windows where there are potential benefits or opportunities. Depending upon the outcome of the process, the reinforcement will either remain in or be removed from the delivery pipeline.

Reinforcements will only be in-scope of the change control process up to the completion of the full project funding assessment with Ofgem. Where a change has potential for significant impact, such as across multiple boundaries or reinforcements, NESO may decide it needs to be reassessed alongside broader alternatives in the next CSNP. The six-monthly windows may also be adjusted to ensure the robustness of the Appraise step in any parallel CSNP.

Delivery monitoring – offshore networks

As outlined earlier in this section, there are established processes in the OFTO regime which facilitate competitive capital costs in the OFTO transmission market. Additionally, the Connections Reform Connections Network Design Methodology (CNDM) will ensure delivery parties deliver their projects to the prescribed milestones. The NESO CSNP network planning delivery team will engage with the NESO Connections Reform team and monitor the delivery progress of gate 2 projects. The Connections Portal will be the one version of truth for data submissions and project information.

Wider horizon scanning and strategic insights will also be required and considered, for example, of particular interest would be CfD allocation round submissions and their results, developments on seabed lease agreements and Cap and Floor interconnector mechanism, but also wider energy policy developments and emerging technology developments. Additionally, as part of the delivery monitoring process, any CSNP sensitivities undertaken during the Appraise step will be a valuable source of analysis to reconcile and resolve delivery challenges as they may arise.

The delivery monitoring will not be applied equivalent to the onshore change control. Offshore network delivery parties are reminded that deviations from the CSNP strategic parameters which do not go through a NESO CSNP reassessment will no longer be endorsed through planning by the National Policy Statements.



We advise delivery parties to engage with NESO's network planning team when materiality circumstances arise, which may trigger reassessment. The Connections Portal will be the primary central interface for such interactions.

Reassessment

To ensure an efficient, timely process, an initial evaluation will be conducted by NESO on reinforcements or connections that initiate the change control process. This will consider the impact of change, including potential delays, and determine whether a full impact assessment is required.

If a full impact assessment is required, an in-depth assessment will be conducted. This will follow a similar approach to the Appraise step, including consideration of the multiple assessment criteria as well as any additional drivers. As appropriate to the impact of change, the impact assessment may focus on a particular area or region of the network. The outcome of any impact assessment will be subject to governance. All delivery bodies directly involved in the scope of reassessment will be responsible for providing NESO with sufficient information on the context, details, data and justification for change to enable reassessment.

For each reassessment window that an impact assessment is required, the network information in Table 22 will be required from the affected TOs. Additionally, if there is a change to the strategic parameters of a reinforcement or connection in a reassessment outcome, this may require amendments to statutory environmental assessments, subject to CSNP governance. Depending on whether the changes are likely to have significant or minor environmental impacts, NESO may update the SEA, HRA and MCZ assessments within the window or as part of the next CSNP.

Wherein sufficient data is provided by the specified deadline, NESO will decide if the reassessment shall proceed in absence of all the requested information or not.

Table 22: Reassessment network data requirements

Criteria	Data requirements*
Network	<ul style="list-style-type: none"> updated boundary capabilities
Power system analysis	<ul style="list-style-type: none"> connection assessments thermal analysis studies single-line diagrams and schematics for: <ul style="list-style-type: none"> new network options substation busbar/bay arrangements where appropriate, fault level analysis
Economics	<ul style="list-style-type: none"> economic evaluations (incl. CapEx and OpEx) evidenced with supply chain/OEM quotations and correspondence where available
Environment	<ul style="list-style-type: none"> all relevant updated environmental impacts or assessments



*Exact data requirements are to be refined further in the future ToR for the change control process and are often bespoke to the related change or region.

Material changes to the strategic parameters of the offshore network are requested as change requests through a submission in the Connections Portal. NESO will manage the interaction between the connection process and the CSNP.

Material changes to reinforcements, the offshore network and interconnectors that meet the thresholds outlined will be assessed within the same six-monthly window to ensure all impacts are understood and accounted for.

It is acknowledged that each design request that is determined to require a full impact assessment will be unique to and, therefore, as a result, it will be opportune to consider the area of impact of the network for assessment. This will be determined in the initial evaluation of the submitted change request and will vary in size and areas affected, between a local change or a more wide-ranging national scale change.

Where the outcome of a change control reassessment results in a reinforcement remaining within the delivery pipeline, following confirmation it remains a cost-effective solution and, despite the delivery date changing, the reinforcement may require updates to its strategic parameters and timings.

The outcome of any impact assessment within a reassessment window will be subject to governance. The exact governance arrangements for offshore change control are expected to be finalised later, as part of the detailed Terms of Reference documentation, closer to the CSNP publication. Governance is expected to cross multiple boards within the DESNZ governance structure, for example relevant electricity network delivery and monitoring group and CSNP offshore delivery group members. A distinct governance panel for the CSNP will agree any outcomes of reassessments.

NESO will reserve the right to defer any change control request to the next CSNP process if it is determined to be of significant impact to the network and overall strategic design. This decision will support the reassessment alongside broader alternatives.

Reassessment – communication

Before starting a change control process within a reassessment window, we will inform the relevant delivery bodies, including the submitting party and other affected parties, regarding the start of a change control assessment. This will also include communicating with Ofgem and the relevant DESNZ determined governance structure.

Upon completion of a reassessment window, the results of any impact assessment carried out will be published by NESO on our website. Shortly before formally publishing the results of any reassessment window, we will also share the assessment and governance outcomes with the relevant impacted parties, including the submitting parties and other effected parties both onshore and offshore. Additionally, as part of both the governance process and communication process, the outcome of any reassessment window will be communicated to the relevant DESNZ determined governance structure.



Roles and responsibilities

Progression and delivery pipeline

We will determine reinforcements that should progress into the delivery pipeline together, even if a decision can be deferred for one reinforcement. This will be subject to CSNP governance, following engagement with relevant stakeholders, such as the reinforcement options developer(s), and consider the criteria in Table 18 as well as any interactions with network competition.

We will select the final GB network design and, using the delivery decision tree, determine which reinforcement projects should be moved into the delivery pipeline or kept within the options funnel. This will depend on their delivery timescale, minimum data requirements, needs case and whether delivery is required to begin in the following three years.

If the strategic parameters include multiple reinforcement options, the delivery body will select the final reinforcement option and progress through the delivery pipeline, keeping within the defined strategic parameters.

Network competition

NESO will identify required reinforcements that could be put out to tender so that other parties, as well as incumbent TOs, can own, operate and maintain parts of the electricity transmission system. We will also publish reinforcements that meet eligibility criteria for both late and early competition as part of the CSNP publication.

Whilst we will identify projects that meet the criteria, it is Ofgem who makes the decision on whether to proceed with a competitive tender. We will confirm which projects will be requested for competition and any subsequent approval by Ofgem is subject to The Electricity (Early-Model Competitive Tenders for Onshore Transmission Licences) Regulations 2025 and therefore will be notified separately to the publication of the CSNP.

Change control

Within the change control process, we will provide independent and impartial analysis of submitted change requests, focussing on robust analysis and outcomes aligned with the best interest of the consumer. NESO reserves the right to defer a change control request to the next CSNP process if it is determined to be of significant impact to the network and overall strategic design.

We will determine whether a full impact assessment of a submitted design change request is required if the submitted design change deviates from the established strategic parameters and the justification for the need to change is reasonable. Of the determined change requests for change control, NESO has the responsibility to follow and complete a reassessment window within the six-months. Following a reassessment window, we will follow the governance and communication steps outlined in the change control section. The delivery monitoring group are responsible for the governance of data submission updates within delivery monitoring of change control.



A distinct and relevant CSNP governance panel will be responsible to agree the outcomes of any reassessment window. They will be refined in the CSNP's change control Terms of Reference (ToR).

We will work alongside the relevant parties to develop and produce the CSNP's change control ToR. Refining of specific change control process details includes:

- network data requirements for a submission
- exact and specific governance structures for the outcomes of a reassessment window
- further refinement of offshore triggers
- more clarity on reassessment window timings post-CSNP publication

As part of the change control process, TOs and third parties are responsible for providing NESO with the relevant network data required for a reassessment. Additionally, it will be the responsibility of offshore transmission owners (OFTOs) to progress and lead the OFTO build network designs through detailed design and coordinate with offshore wind farm developers where they serve as enabling works or are electrically coordinated in the offshore network. Developers and delivery bodies are responsible for advancing the CSNP design within the strategic parameters as reasonably as possible and supporting relevant OFTOs in delivering the offshore network.

NESO will provide the outcome of any change control to Ofgem once the process has been completed and before concluding any update to the CSNP.

9. Section 4: Gas

Introduction

Drive

Identify

Develop

Appraise

Deliver





Introduction

This section sets out how we plan the gas transmission system elements of the CSNP.

Condition C12 of our gas system planner licence¹⁰² sets out specific obligations in respect of planning the National Transmission System (NTS) across a 25-year time horizon between 2025 and 2050. The NTS is the gas transmission network that covers most of GB and which is owned and operated by National Gas Transmission plc (NGT).

As well as our licence obligation to produce the CSNP, we also have licence obligations set out in condition C8 of our gas system planner licence. We expect to deliver our C8 licence obligations as part of delivering the CSNP.

Our C8 licence condition requires us to produce a Gas Network Capability Needs Report (GNCNR) and a Gas Options Advice (GOA) document covering the onshore gas transmission network. These are produced with extensive collaboration with NGT.

NGT is the system operator and owner of GB's gas transmission system, the NTS, which is made up of over 7,600 km of pipeline, 21 compressor sites and more than 500 above ground installations.

Although our gas network planning activity provides recommendations for the options to meet the relevant needs, Ofgem or other relevant parties will ultimately decide on the investments made.

Figure 43 illustrates the gas strategic network planning cycle set out by condition C8.

¹⁰² Ofgem, [ofgem.gov.uk/sites/default/files/2024-03/Annex%20G%20-%20Gas%20System%20Planner%20Licence%20Conditions.pdf](https://www.ofgem.gov.uk/sites/default/files/2024-03/Annex%20G%20-%20Gas%20System%20Planner%20Licence%20Conditions.pdf)

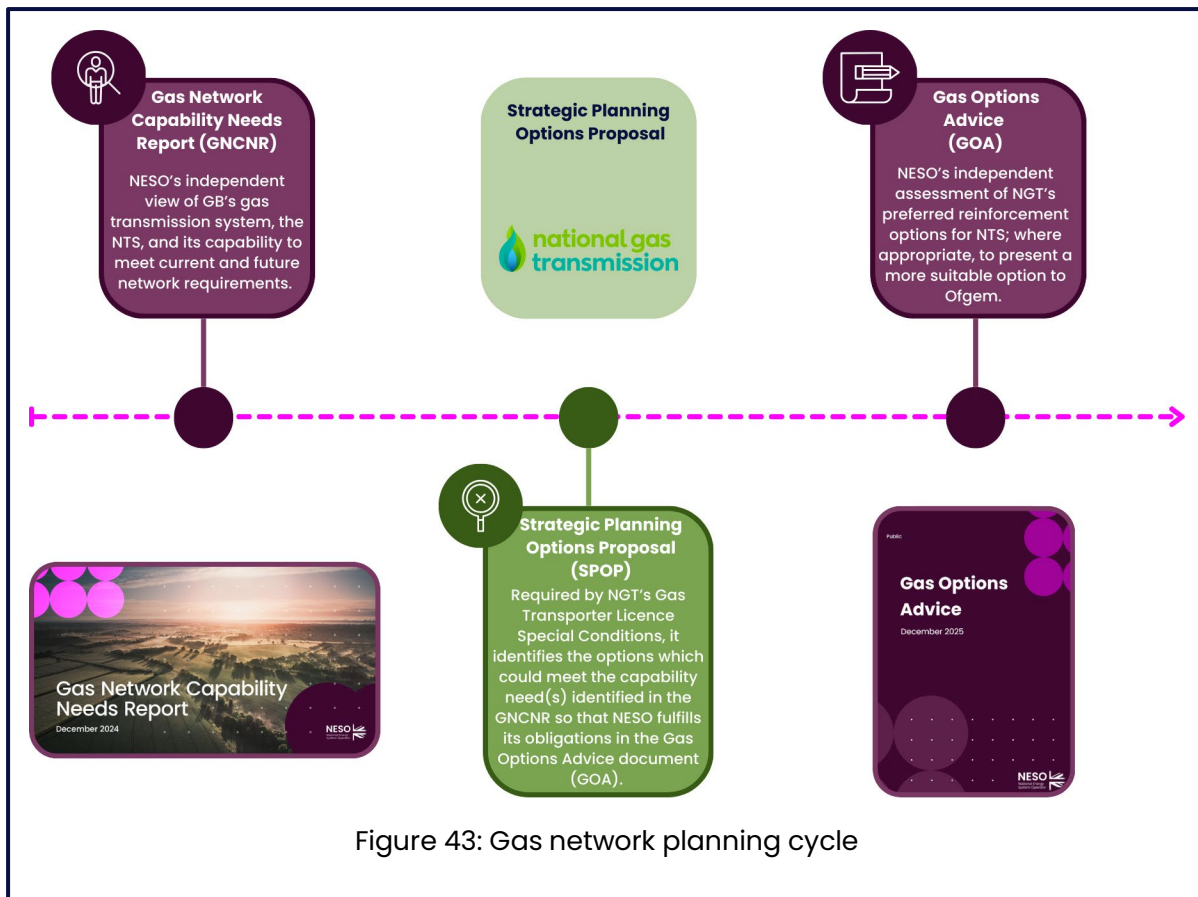
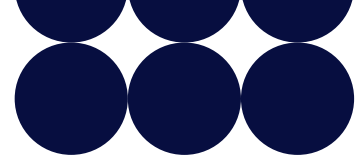


Figure 43: Gas network planning cycle

In December 2024, we published the GNCNR, which was our first gas publication. The GNCNR 's purpose is to offer an independent view of GB's gas transmission system, the NTS, and its capability to meet current and future network requirements¹⁰³. The Strategic Planning Options Proposal (SPOP) is NGT's response to the capability needs identified by NESO in the GNCNR. This is required as per Special Condition 9.10 of NGT's Gas Transporter Licence¹⁰⁴. NGT is obligated to share the SPOP with NESO and Ofgem.

In December 2025, we published the GOA¹⁰⁵, which was our second gas publication, based on our C8 licence condition and the final document of the gas strategic planning cycle. The intent of the GOA document is to give an independent assessment of NGT's proposed reinforcement options for the NTS. It can also, where appropriate, present alternative options to Ofgem. The GOA supports Ofgem and NGT in decisions on funding and progression of asset interventions for the NTS.

¹⁰³ NESO, neso.energy/what-we-do/strategic-planning/gas-network-capability-needs-report-gncnr

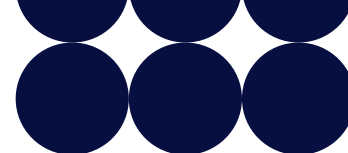
¹⁰⁴ Ofgem, ofgem.gov.uk/sites/default/files/2023-04/National%20Gas%20Transmission%20Plc%20-%20NTS%20-%20Consolidated%20Special%20Conditions%20-%20Current%20Version.pdf

¹⁰⁵ NESO, neso.energy/what-we-do/strategic-planning/gas-options-advice-go



We have used condition C8 of our gas planner licence¹⁰⁶ to inform the design of the CSNP: the Drive, Identify, Develop, Appraise and Deliver framework, for which we set out the gas network planning specifics in the remainder of this chapter.

¹⁰⁶ Ofgem, [ofgem.gov.uk/sites/default/files/2024-03/Annex%20G%20-%20Gas%20System%20Planner%20Licence%20Conditions.pdf](https://www.ofgem.gov.uk/sites/default/files/2024-03/Annex%20G%20-%20Gas%20System%20Planner%20Licence%20Conditions.pdf)



Drive

Overview

The first step in establishing gas transmission network needs is the forecasting of future customer-led flows of gas in and out of the NTS. It is these flows against which the capability of the NTS is assessed.

Predicting detailed gas market behaviour is challenging, making it difficult to forecast with certainty the sources of GB gas supply. Alongside this, the rate of decarbonisation of the heat and buildings sector – which is currently predominantly supplied by gas – is particularly uncertain.

Planning for the future

As we transition towards a future powered by clean energy, the role of a resilient and secure gas network will continue to be important.

The gas system needs to maintain appropriate levels of safety and security despite the uncertain future of the level of demand. The network needs to be adequately sized and reliable enough to meet customer demands under a variety of conditions, while supporting continued economic growth.

Future energy pathways

Spatial Strategic Energy Plan (SSEP)

The SSEP assumes a sufficient level of gas supply and gas network capability is retained to ensure that gas is available as a fuel for power generation and a feedstock for hydrogen production.

As a whole, the CSNP relies on the SSEP as an input. The SSEP provides the capacity requirements for national hydrogen and electricity systems but also assumes the gas network can meet their demand. Such demand covers fuel for power and feedstock for hydrogen production¹⁰⁷.

Future Energy Scenarios (FES)

Our FES publication provides four separate views of supply and demand (heating, industrial and power) across GB for each year from now until 2050. Three of these are net-zero compliant 'pathways' and are supplemented by a non-compliant 'scenario' (known as 'Falling Behind'). FES also includes a 10-year forecast. Demand projections are produced that cover peak winter demand conditions, considering the impact of severe

¹⁰⁷ NESO, [neso.energy/what-we-do/strategic-planning/strategic-spatial-energy-planning-ssep](https://www.neso.energy/what-we-do/strategic-planning/strategic-spatial-energy-planning-ssep)



weather. Supply projections (including LNG, continental imports via offshore interconnectors and both UK and Norwegian offshore infrastructure) are based on a combination of historical evidence and market intelligence.

We model each of these FES projections separately to identify their varying implications for NTS capability. Given the challenge of predicting detailed flow patterns, we use the FES projections as a basis to create ranges of possible supply and demand by considering variance in parameters such as weather, the day of the week and historical flow data.

The Identify step considers the FES pathways out to 2050 for its assessment of the NTS capability needs. Consequently, NGT's SPOP and CSNP Appraise also use the FES pathways, with the Appraise step assessing the relative value of each NTS investment option out to 2050. This approach ensures that future energy needs are met while taking account of future demand uncertainty and supporting economic growth.

Whilst the SSEP includes assumptions that capture the decarbonisation of the heat and buildings sector in its forecasts for electricity and hydrogen demand, it does not directly include consideration of residual heating demand in housing and industry that would continue to be supplied with gas. For this reason, the CSNP's gas network planning process primarily relies upon FES inputs, as well as it ensures consistency with gas generation profiles from SSEP data.

Pathway usage

The SSEP will determine the NTS system needs for gas-fired power generation. The CSNP gas-specific analysis is supported by FES, thereby integrating offshore requirements and enabling NESO to analyse different long-term strategic energy pathways that define system requirements.



Identify

Overview

To deliver the gas-specific system requirement analysis within the CSNP, we will use the GNCNR methodology published in December 2024. In addition, the Gas Supply Security Assessment (GSSA)¹⁰⁸ and Critical National Infrastructure (CNI) framework will be considered as part of the gas supply security assessment. This will enable us to identify any current or future system needs for capability on the gas transmission network.

'Network capability' is the term used by the gas industry to mean the maximum flow of gas that the network can physically transport to or from specific locations or zones without exceeding high pressure safety limits or compromising any equipment's safe operational tolerances, while meeting pressure obligations at offtakes. Network capability can be influenced by various factors, such as the level distribution of supply and demand around the NTS and the availability of network assets.

Where the network capability is insufficient to support the flows needed by customers at the required pressures, this can lead to a network constraint. This is either an entry or an exit constraint depending on whether it impacts gas flowing into or out of the network, respectively. When a constraint occurs, NGT may be required to take commercial or operational actions¹⁰⁹ which may have associated costs. There is a financial incentive on NGT to manage the cost of constraints. This is provided by the Capacity Constraint Management (CCM) incentive.

Zones

For the purposes of capability analysis, the NTS can be conveniently divided into seven zones¹¹⁰. The zones have been previously used in historical publications of NGT's Annual Network Capability Assessment Report (ANCAR). Each zone has distinctive gas flow requirements and characteristics.

The geographic descriptions, for instance 'South East', are provided as indicative descriptors for each zone. For example, Zone 4, commonly referred to as South Wales, covers not only South Wales but also part of the Midlands in England.

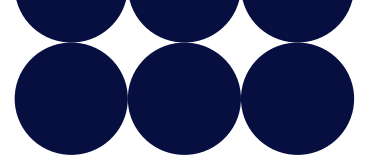
The zones are referred to as:

- Zone 1 – Scotland and the North
- Zone 2 – North West (including North Wales)

¹⁰⁸ NESO, [neso.energy/what-we-do/resilience-emergency-management/gas-supply-security-assessment](https://www.neso.energy/what-we-do/resilience-emergency-management/gas-supply-security-assessment)

¹⁰⁹ NGT, [nationalgas.com/our-businesses/system-operation/capacity/constraint-management](https://www.nationalgas.com/our-businesses/system-operation/capacity/constraint-management)

¹¹⁰ Originally defined by Ofgem in a historical RIIO process with NGT.



- Zone 3 – North East
- Zone 4 – South Wales
- Zone 5 – South West
- Zone 6 – East Midlands
- Zone 7 – South East

Gas enters the NTS via terminals and storage sites and leaves via offtakes or through injection into storage. Offtakes feed lower pressure gas to distribution networks that supply homes and businesses, as well as directly connected industrial consumers and power stations. Gas also enters and exits the NTS via interconnectors, allowing flows between GB, Ireland and continental Europe.

Figure 44 illustrates how the NTS is divided into the seven zones.

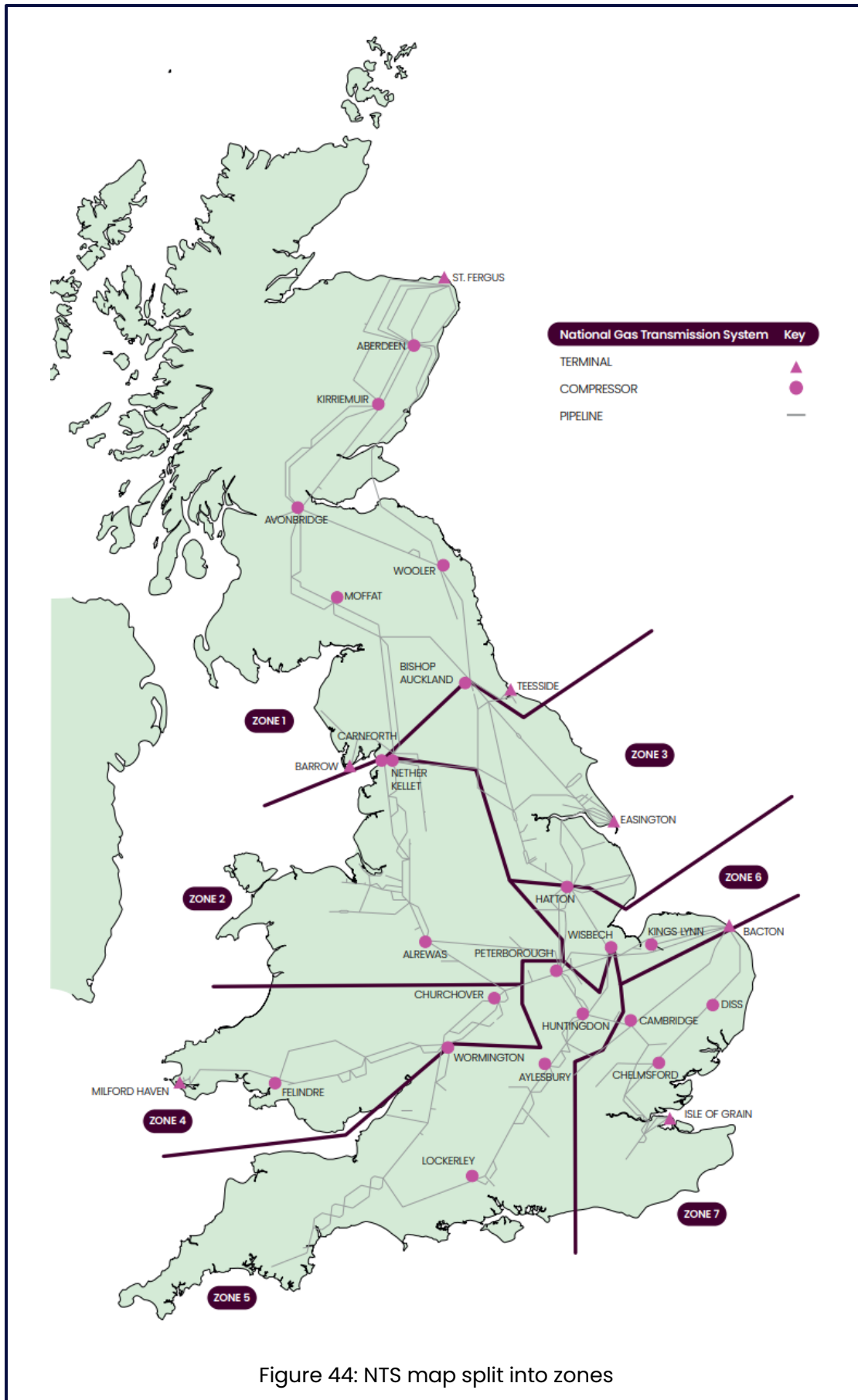
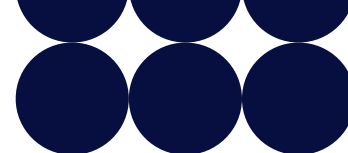


Figure 44: NTS map split into zones



Capability analysis

At NESO, we use specialist gas network analysis software to simulate gas transmission networks under a variety of conditions. We consider both steady state conditions (which assumes perfect balance between time-invariant supply and demand) and transient conditions (where supply and demand can independently change over time, creating temporal imbalances). The analysis helps us understand how the network performs and is crucial for planning the current and future needs of the gas network.

We consider both entry and exit capabilities.

There is a requirement for NGT to plan and develop the NTS as stated in the Transmission Planning Code (TPC)¹¹¹. Where a shortfall or excess in entry or exit capability is identified in our capability analysis, these will be further assessed as part of the Appraise step, considering option proposals submitted in the Develop step.

Entry capability

The methodology to determine the entry capability of the NTS is summarised below:

- A base case network model is first created in our gas network simulation software.
- To determine the entry capability of the selected zone, the supply in the zone is increased gradually from the base case supply scenario, ensuring there are no pressure or asset limit breaches.
- As the supply in the selected zone is increased, the supply in other zones is reduced (rebalanced), starting with the supply point of least interaction (the furthest supply point determined by pipeline distance). Each supply point is reduced to a reasonable minimum intake before moving on to the next nearest balancing point. In all cases, aggregate supply will remain the same after rebalancing.
- The step-size increment will continue until the scenario reaches a pressure or asset limit breach. The last supply volume into the zone before the breach is reached is defined as the maximum entry capability corresponding to the level of national demand modelled in that scenario.
- Entry capability scenarios are generated to cover a suitable range of national demand levels such that the results can be used to derive a capability 'curve' for the selected zone (for example, a relationship between zonal capability and national demand).

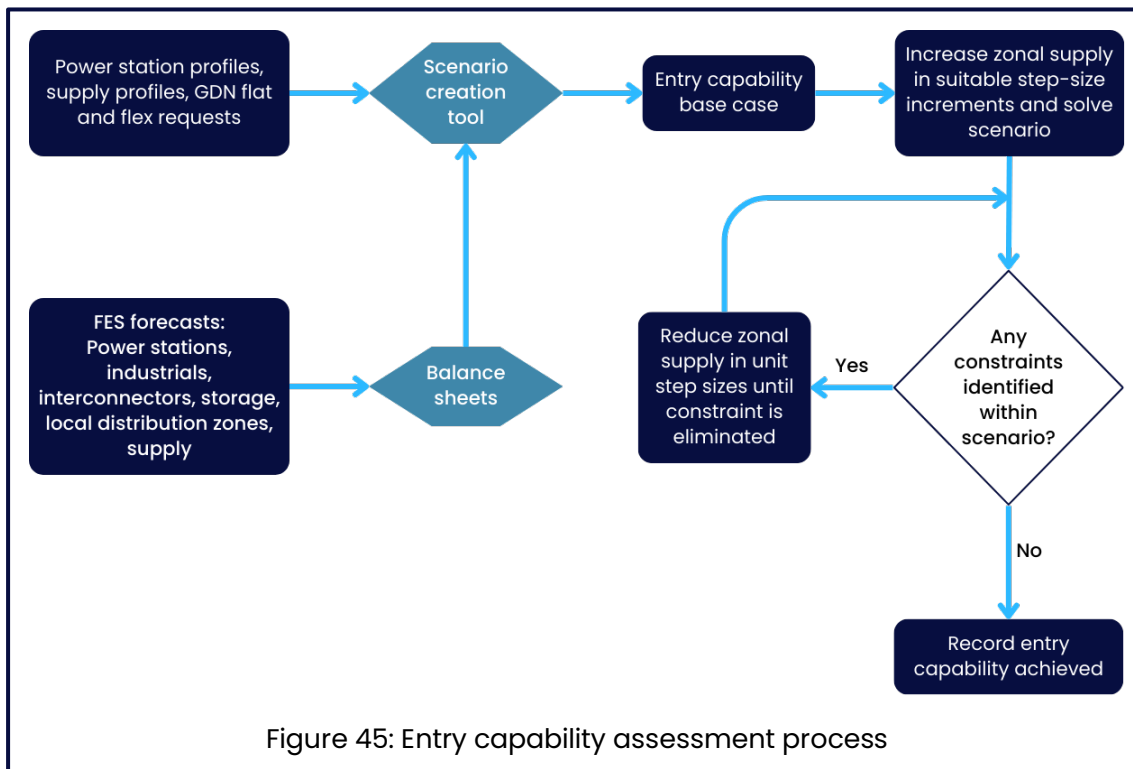
Creating the base case network model

The base network model uses supply and demand from our FES data, incorporating gas generation profiles from SSEP data. We create scenarios for a range of demand levels, covering summer, typical winter and more extreme winter conditions. These forecasts are created for each FES pathway, in line with the TPC.

¹¹¹ NGT, nationalgas.com/sites/default/files/documents/TPC%202023%20v0.4.pdf



Additional information is considered to model within-day variation: for demand, this is taken from gas distribution networks' (GDNs) forecasts of flexibility requirements and power station analysis; for supplies, we consider historical information.



Zonal supply adjustment

An entry capability assessment is carried out for each zone by increasing the supply in the zone from the assumption in the base case model gradually in suitable step-size increments. The increase in supply for each supply node in the zone is rebalanced by reducing an equivalent amount from the least interacting point determined by pipeline distance. Each balancing node is reduced to a reasonable minimum supply before moving on to the next balancing node.

The rebalancing of supply flows ensures that aggregate supply remains constant and balances demand.

The entry capability is the maximum supply into the zone that can be effectively solved within the scenario without reaching an asset or pressure limit breach.

Network assessment

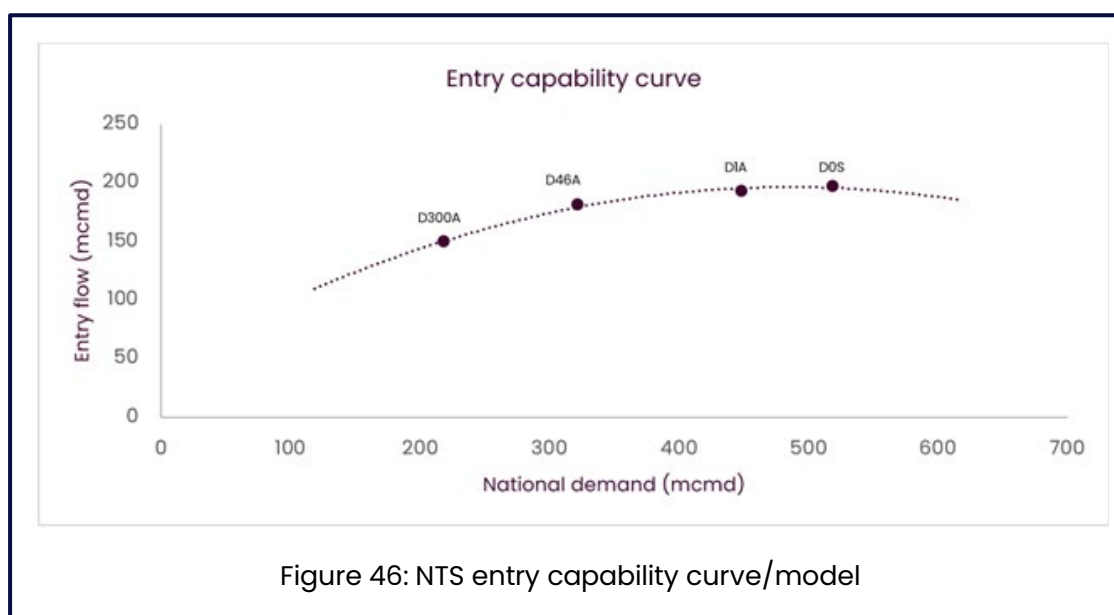
Each entry capability model is created from the base case steady state model. Then, a transient model is solved to ensure that the capability can be achieved when within-day supply profiling, power station profiling and GDN requirements are taken into consideration. Within-day and geographical balance between supply and demand is examined within the transient analysis to ensure the network can be operated within safe limits.



An entry capability model is considered solved when all exit point and other pressure requirements are met and all network components (including compressors) are operating within their design limits¹¹².

Creating the entry capability model

The results from the entry capability assessments for each modelled demand level are plotted and a model, often referred to as a 'capability curve', is derived to predict the entry capability in the zone at any demand level. The resulting model can also be used together with the flame charts for constraint analysis¹¹³. A sample of an entry capability model is shown in Figure 46.



Note on Figure 46:

- D300A = forecast 300th highest daily demand from an average weather year
- D46A = forecast 46th highest daily demand from an average weather year
- DIA = forecast highest daily demand from an average weather year
- D0S = forecast peak day demand from a severe weather year

We will ensure a reasonable stratification of demand levels is used so that an accurate model can be constructed.

Exit capability

The methodology to analyse exit capability of the NTS process is summarised as follows:

¹¹² Further details of network analysis and assumptions can be found in section 6 of the TPC: NGT, nationalgas.com/sites/default/files/documents/TPC%202023%20v0.4.pdf

¹¹³ NESO, neso.energy/what-we-do/strategic-planning/gas-network-capability-needs-report-gncnr



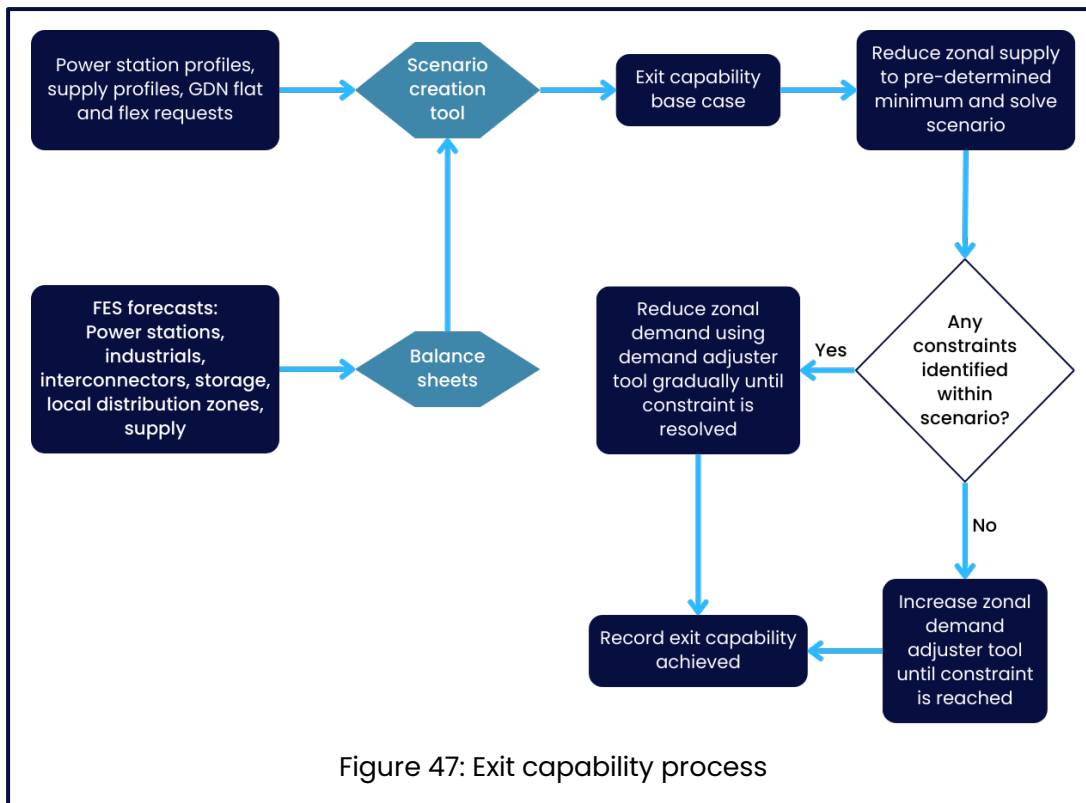
- A base case model is first created in the gas network simulation software by importing supply and demand from our FES data, having factored in gas generation profiles from SSEP data.
- To determine the exit capability of the selected zone, the supply in the zone is decreased gradually from the base supply forecast to a defined minimum, ensuring there are no pressure or asset limit breaches.
- As the supply in the selected zone is decreased, the supply in other zones is increased (rebalanced), starting with the supply point of least interaction (the furthest supply point determined by pipeline distance). In the rebalancing sequence, each supply point is increased to a defined maximum supply before moving on to the next balancing point. In all cases, aggregate supply in the model will remain the same after rebalancing (noting that there could be changes in compressor fuel demand).
- Once the supply in the zone has been reduced to minimum, the demand in the zone is increased gradually until a pressure or asset limit breach is reached. The maximum demand in the zone that can be supported without encountering a breach of limits is defined as the 'maximum exit capability'.
- Exit capability models are generated to cover a range of selected demand levels and the results used to generate an exit capability model for the selected zone.

Creating the base case network model

The base case derives its inputs from the FES supply and demand forecasts¹¹⁴ and SSEP pathway. Network analysis is carried out across a range of demand conditions.

Additional inputs required to create the base case include GDN capacity requests for the relevant gas year, supply profiles for supply terminals and power station profiles (for use in transient analysis).

¹¹⁴ National Grid, nationalgrid.com/sites/default/files/documents/8589937808-Gas%20Demand%20Forecasting%20Methodology.pdf



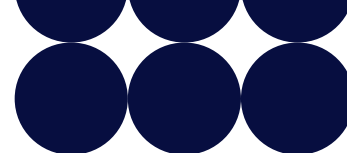
An exit capability assessment is carried out in each zone with a minimum supply assumption for that zone, creating a reasonable worst-case scenario for assessing the exit capability. The minimum supply assumption in each zone is influenced by scenario minimum flows as per FES pathways, physical network minimum operational requirement and historical minimum flows. This approach allows for an assessment of the ability to utilise compression to move gas from high supply regions of the NTS to regions with less supply.

The adjustment of flows at supply points within the relevant zone is rebalanced at the supply point of least interaction (determined by pipeline distance) to keep total supply in balance and equal to demand. The requirement for balance between demand and supply is consistent with the long-term planning analysis requirement under the TPC.

Once the minimum supply assumption is met and the network can be operated without pressure or asset limit breaches, the demand in the zone is increased gradually until a limit is reached. The increase in demand in each zone is rebalanced at other zones. The rebalancing method is to adjust the demand from zones with low interactivity – typically three or four – to the zone being assessed. Where pressure breaches occur in reducing supply in the zone to minimum, it may be necessary to reduce the demand in the zone rather than increase it.

Network assessment

Each exit capability model is created from the base case static model. A transient model is solved to ensure that the capability can be achieved when power station and GDN offtake profiles are taken into consideration.

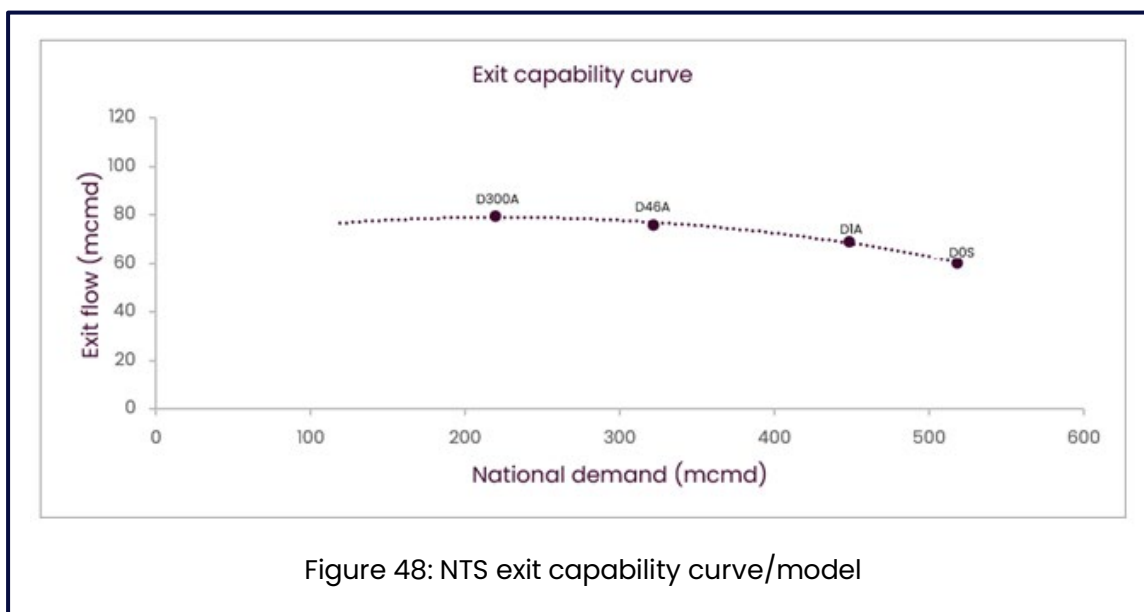


An exit capability model is considered to be solved when all exit point pressure requirements are met, pipeline Maximum Operating Pressures (MOPs) are within limits and compressors and valves are operating within design limits¹¹⁵.

Creating the exit capability model

The results from the exit capability assessment, across a range of demand days, are used to create a model of exit capability for the zone (as per entry, often referred to as a 'capability curve'). The model can be used to predict exit capability in the zone at any demand level. It can also be used together with the flame charts for constraint analysis¹¹⁶.

Figure 48 provides an example:



Note on figure 48:

- D300A = forecast 300th highest daily demand from an average weather year
- D46A = forecast 46th highest daily demand from an average weather year
- DIA = forecast highest daily demand from an average weather year
- D0S = forecast peak day demand from a severe weather year

Similarly to entry capability analysis, we will ensure a reasonable stratification of demand levels is used so that an accurate model can be constructed.

To assess the impacts of varying network conditions on the physical capability (entry and exit) of the NTS, we carry out sensitivity analysis in relevant RIIO zones or areas of the NTS. The variables considered in the sensitivity analysis may include:

- changes in Interconnector exit flows

¹¹⁵ Further details of network analysis and assumptions can be found in section 6 of the TPC: NGT, nationalgas.com/sites/default/files/documents/TPC%202023%20v0.4.pdf

¹¹⁶ NESO, neso.energy/what-we-do/strategic-planning/gas-network-capability-needs-report-gncnr



- extremely low gas terminal supplies
- changes in gas generation within-day profiles

Network capability flame charts

To visualise the capability of the NTS, we include different sets of information on a figure referred to as a 'flame chart'. This information includes:

- a heatmap showing a very large distribution of points representing the range of possible future supplies or demands in a given zone or zones. The colours in the heatmap correspond to the density of data at each point. One or more capability curves that represent the physical capability of the network to support entry or exit flows, usually for a particular zone
- a line which represents 'baseline entry' or 'baseline exit' capacity¹¹⁷
- a point representing peak day demand

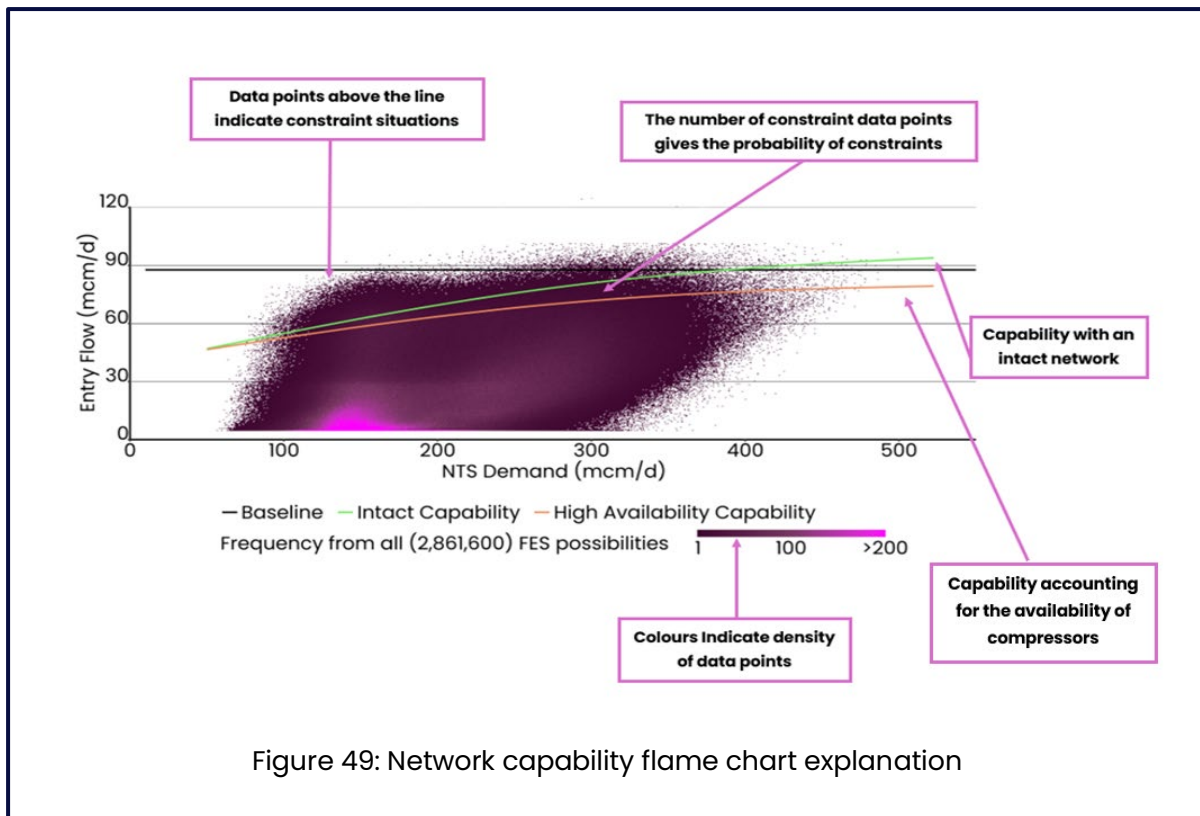
The flame chart in Figure 49 shows that there are many data points that are above the capability line. Where these points are also below the capacity baseline, they indicate the potential for network constraint. The number of data points in this region (as a proportion of the total number of data points in the chart) represents the overall probability of a network capacity constraint for the relevant zone or zones that the chart relates to. It should be noted that a network constraint is defined in terms of capability shortfall over an entire gas day (mapping to many data points), so that small clusters of points on the chart do not generally indicate constraint.

NGT is also required to plan and develop the NTS such that it meets the 1-in-20 peak day. The 1-in-20 peak day demand is the demand, in a long series of winters, at connected loads held at the levels appropriate to the winter in question that would be exceeded in one out of 20 winters, each winter being counted only once. It is more specifically defined in NGT's licence and described in the Gas Demand Forecasting Methodology¹¹⁸.

The flame charts provide a view of the shortfall or excess in capability under two different sets of assumptions: an 'intact network' (which assumes all compressors are available) and a 'high availability' condition, described in more detail below, where a subset of compressors, considered available 99% of the time based on analysis of historical availability, are used. A capability curve for each zone is derived from network analysis undertaken across a range of different national demand levels.

¹¹⁷ Capacity 'baselines' are specified in NGT's gas transmission licence.

¹¹⁸ National Grid, Gas Demand Forecasting Methodology (2020), pp 38-39, nationalgas.com/sites/default/files/documents/Gas%20Demand%20Forecasting%20Methodology%202020_v1.pdf



Compressor availability

An 'intact capability' is calculated based on an assumption that all compressor stations and other operational equipment are fully available for use. However, it is not always possible to achieve intact capability because one or more compressor units may be unavailable at any given time. There are a variety of reasons for this, which could include planned and unplanned maintenance or other asset health-based interventions. To understand the impact of lowered availability, a high availability capability analysis is carried out to reassess the network's capabilities assuming only a subset of compressors is available.

Using historical data, we compute the smallest number of units that will be available 99% of the time, that is, only 1% of the time would we expect fewer units available than this number. We then use a defined process to determine which specific compressors can be used.

In our analysis, we consider both individual compressor unit availabilities and compressor station availabilities (a compressor station has two or more compressor units). Availability data is provided to us by NGT.

Specific units are selected based on the following rules in the stated order:

1. All units at compressor stations with overall station availability less than 50% will be considered unavailable. The subset will thus be selected from the remaining compressor stations.



2. High availability (or reliability) units are selected first up until subset total is reached.
3. Priority will be given to units in compressor stations with higher availabilities where a choice is to be made between two units of the same availability.
4. Units that can be run in parallel or series with higher availability units in the same compressor station will be prioritised where a further choice is to be made between units of the same availability.

At least one unit from each compressor station should be selected, where possible, to ensure this is consistent with maintenance outage planning strategies. However, this may not be possible in situations where:

- the subset number is reached by selecting high availability units from other stations
- intact station availability is lower than the target value (50%) at one of the sites

The high availability capability curve is analysed in the same entry or exit capability flame chart to assess the potential amount of constraint days, where a constraint in a supply/demand day is above the physical NTS capability.

Supply security

To deliver a resilient transmission infrastructure, we will consider both supply security as considered in the GSSA, as well as the NTS resilience for high impact points of failure (HIPFs) and critical national infrastructure (CNI) to ensure it is sufficient to operate.

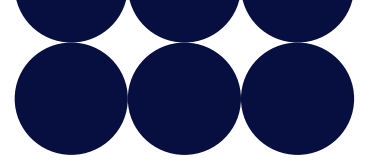
System resilience

The gas security of supply regulation requires that, in the event of a disruption of the single largest piece of infrastructure, the remaining infrastructure is sufficient to satisfy the total demand occurring during a day of exceptionally high gas demand occurring with a statistical probability of once in 20 years¹¹⁹. This requirement is measured through the N-1 infrastructure resilience standard. The infrastructure considered could be upstream of, or part of, the NTS.

The N-1 standard facilitates the following:

- ensuring the provision of gas to protected customers
- ensuring a minimum standard of infrastructure resilience
- ensuring there are adequate preparations for a gas supply emergency
- improving coordination between markets to enable regional cooperation and support
- ensuring the gas market functions for as long as possible in the event of an emergency

¹¹⁹ NGT, nationalgas.com/sites/default/files/documents/TPC%202023%20v0.4.pdf

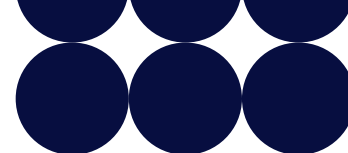


Resilience analysis should also take broader security considerations into account, such as protective security. It is important that the CSNP considers all factors that impact resilience to ensure that the gas transmission network remains reliable and resilient.

Critical national infrastructure (CNI)

The NTS system consists of a wide array of CNI assets, along with multiple systems and CNI subsectors that are distributed throughout the networks, as well as high impact points of failure on the NTS.

Given the complexity and the importance of these assets, it is crucial for the CSNP to thoroughly evaluate each component when developing its recommendations.



Develop

Overview

The Develop step of the CSNP brings a focus to those areas of the NTS where a need has previously been highlighted (Identify) and develops options with the aim of meeting these needs in a way that is cost beneficial, promoting security of supply and value for money to the consumer, as well as protecting environment and communities.

Options may be proposed by licensed network operators and third parties. NESO can also propose options where it is deemed appropriate to do so.

Options submitted are then assessed within the Appraise step of the CSNP, where our recommendations are presented to Ofgem.

Development process

SPOP overview

The SPOP is NGT's response to the capability needs identified by NESO in the GNCNR. This is required as per Special Condition 9.10 of NGT's Gas Transporter Licence¹²⁰.

The purpose of the document is to develop the options that could meet the capability needs identified in the GNCNR. Such options may involve construction, expansion, reinforcement, repurposing, replacement, decommissioning or commercial contracts. NGT will present a range of options with a cost estimate, physical specifications, technical criteria and estimated delivery timeline. NGT will also calculate the impact on the physical network capability that each option creates once implemented.

NESO and third parties

Where we consider it appropriate, additional options for enhancing the capability of the NTS may be identified by us. This may involve bilateral or multilateral discussions with GDNs for the provision of services to the NTS system operator.

We will invite third-party proposals for the construction of additional gas transmission infrastructure to meet any identified need. Any such proposals will be assessed in the same basis as options presented by NGT and recommended to Ofgem. If NESO deems them the most appropriate proposal, then funding and licensing of such options would be determined by Ofgem.

Decommissioning or repurposing

In addition to NGT's response in the SPOP, the potential of decommissioning, removal or repurposing of the NTS, or parts of it, will be reviewed to support the long-term

¹²⁰ Ofgem, [ofgem.gov.uk/sites/default/files/2023-04/National%20Gas%20Transmission%20Plc%20-%20NTS%20-%20Consolidated%20Special%20Conditions%20-%20Current%20Version.pdf](https://www.ofgem.gov.uk/sites/default/files/2023-04/National%20Gas%20Transmission%20Plc%20-%20NTS%20-%20Consolidated%20Special%20Conditions%20-%20Current%20Version.pdf)



coordinated approach of long-term network planning across GB. This will be especially relevant where repurposing options are presented to meet hydrogen network needs.

Any recommendations for asset decommissioning, removal or repurposing will be assessed during the Appraise step within CSNP publication and therefore subject to the assessment criteria, including considering the impacts on security of supply.

Submission of options

We expect the level of detail of options submitted for both the delivery pipeline and funnel of options as mentioned in the CSNP guidance document to be the same.



Appraise

Overview

The options assessment part of the gas processes within the CSNP looks to evaluate the network reinforcement options identified by NGT and any additional options proposed by NESO and third parties. We will do so in a fair, robust and transparent manner so that we can inform investment decisions needed to address NTS system needs. NESO will publish options prior to assessment, although will need to withhold confidential or commercially sensitive information. Where appropriate, we will publish non-confidential summary information instead of the full details of the options.

Our assessment framework is informed by our Gas Options Advice (GOA) methodology published September 2025¹²¹, which aims to minimise subjectivity and provide transparency in relation to any investment recommendations by considering a wide range of quantitative and qualitative factors.

The GOA methodology was consulted during May 2025 to seek input from stakeholders on a detailed options assessment process. This was part of the gas network planning process for GOA 2025. A detailed GOA methodology was published in September 2025, considering the stakeholder feedback received.

We intend to include the GOA methodology in the 2027 CSNP methodology along with feedback from the CSNP methodology consultation.

The options assessed under Appraise could be proposed either by NGT in the SPOP or be put forward by NESO or third parties, as noted above. Such options can involve minimal or no construction, expansion, reinforcement or replacement of the NTS. In addition, options that relate to rules, codes and legislation that underpin the regulatory framework or operation of pipeline systems may be considered, as well as options related to the practices, services and commercial arrangements within the energy market.

The assessment may be carried out on either a single option element or a combination of option elements that have the potential to enhance NTS entry capability, exit capability or a combination of both, or that may reduce excess capability alongside a reduction in operational costs. In some cases, options may involve removal of assets from the NTS for alternative use, whereby the investment is offset by benefits derived from such use.

NESO will make recommendations from the options assessment and will provide an explanation of how its conclusions were reached.

Should we identify any change to our view of the NTS physical capability or forecast flows following the publication of Identify, these changes will be clearly stated in Appraise. Focus will be placed on any significant changes that could impact NESO's view of the options and the recommendations put forward.

¹²¹ NESO, [neso.energy/document/369406/download](https://www.neso.energy/document/369406/download)



The Appraise step will provide a detailed analysis of each investment proposal based on whether the option meets the need and how it performs in terms of economic, environmental, social and deliverability aspects of the assessment. NESO and NGT might hold different views on the proposals put forward. Any material differences will be identified along with their implications, subject to confidentiality.

We will ensure coordination between network plans for each energy vector when evaluating options. Where there are impacts from a gas network option on the electricity or hydrogen networks, these will need to be evaluated and reviewed for consistency with the corresponding network plan.

Decision-making framework

We will carry out an assessment of all investment options identified. This evaluation will result in the recommendation of preferred options.

We consider each element by assessing the following aspects:

- direct economic impacts (CapEx and OpEx)
- environmental and community (whole system HRA, SEA and MCZ assessment)
- emissions costs
- security of supply
- deliverability
- operability

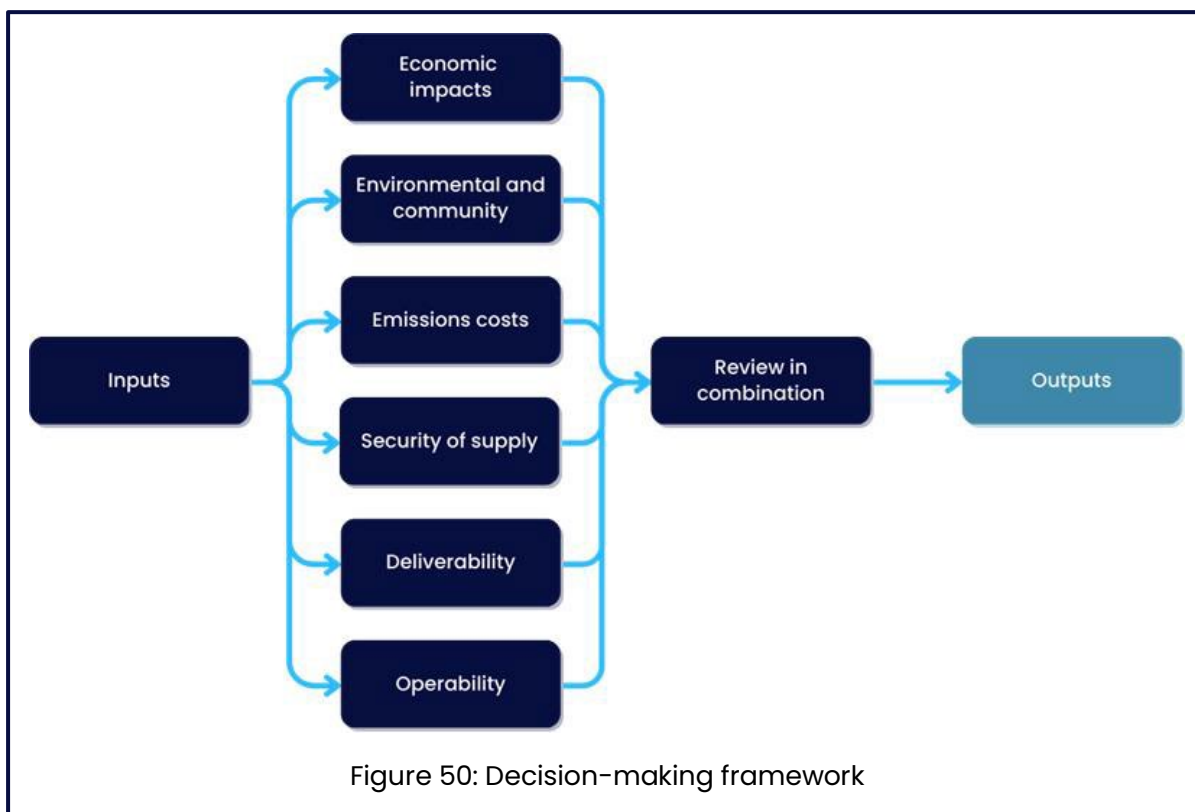


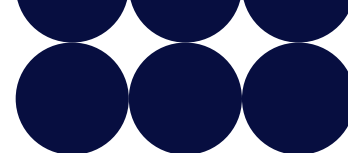
Figure 50: Decision-making framework



Each aspect will either be considered within an econometric net-present value (NPV) assessment or via non-economic assessments based on the criteria for each aspect as described Table 23.

Table 23: In-scope criteria to be included in the CSNP assessment

CSNP criteria	Assessment categories	Description	CSNP assessment
Economic impacts	Capital costs	Costs associated with the design, planning, building and decommissioning (at the end of the assumed operational life) of the investment options	NPV
	Operating costs	Costs associated with the operation and maintenance of the investment options	NPV
	Network constraint costs	Costs that NGT incurs when gas flows on the NTS are constrained – they serve as a benchmark against the capital and operating costs in the economic assessment	NPV
Environmental and community	Environmental and community	Impacts of implementing the option against HRA and SEA legislation	Whole system HRA, SEA and MCZ assessment
Emissions	Emissions costs	The social cost of carbon emissions that are incurred as part of an investment option	NPV
Security of supply	Security of supply impacts	The reduction in network capability constraints costs and potential mitigations for security of supply	NPV and security of supply assessment
Deliverability	Design complexity, technology readiness and supply chain	The proposed option design complexity, technology readiness and supply chain in implementation against proposed timeframe	Deliverability assessment
Operability	Complexity of operating	The proposed option design operational complexity when installed into NTS and operation sign-off impact against proposed timeframe	Operability assessment



Economic impacts

Capital and operational costs

For each option, we calculate the total cost of investment over the expected life of the relevant assets (the direct economic impacts of a given proposal).

When assessing the direct costs of an option, we will consider:

- capital investment costs for designing, constructing and commissioning any new assets on the NTS, as well as its eventual decommissioning
- expenditure associated with operating and maintaining the newly commissioned assets, which could include the changes to both fixed operational costs and variable costs, such as fuel
- increase or reduction in operational costs over the same duration due to the removal (decommissioning) of assets
- contractual costs associated with third-party services aimed at offsetting network constraints

Where an option requires the installing of new assets and in line with the recommendations included in HM Treasury's Green Book¹²², we will include the cost of decommissioning those assets from the NTS at the end of their assumed operational life.

Environment and community

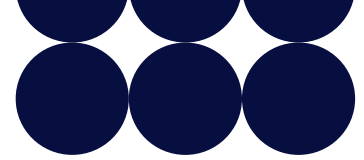
Any investment option that involves a change to the physical makeup of the NTS could have local and wider environmental and community impacts. This includes impacts resulting from the construction itself, the longer-term effects of the installed assets and of changes to the operation of the network.

Environment and community are two separate criteria and will each be considered independently. For this document, the criteria are presented together as they adopt the same methodological approach.

NESO will identify and select optimal network projects required for delivery and provide its best view of the relative merits of each proposed option, whilst minimising any detrimental effects on the environment. We are aligned with the UK government's commitment to the protection and enhancement of the environment. The approach to appraising environment and community impacts will follow the same methodology as outlined in the Electricity section.

This approach will consist of a qualitative and quantitative assessment. The quantitative assessment will use well defined environmental datasets and indicators to assess the impact of different options on environment and community. The outputs of the

¹²² UK government, [gov.uk/government/collections/the-green-book-and-accompanying-guidance-and-documents](https://www.gov.uk/government/collections/the-green-book-and-accompanying-guidance-and-documents)



assessment would include a graded matrix with a rating against each criterion to highlight the comparative potential risk of impact along with a qualitative narrative.

Environmental assessments enable us to evaluate the potential impact that investment proposals could have on the environment and to compare options based on their relative impact. We will undertake environmental assessments on a consistent basis across gas, electricity and hydrogen where possible, including an SEA and HRA.

At the early appraisal stage, options under consideration are defined at a broad level. We expect decisions on the required location and detailed design will come at a later stage of the investment cycle.

Emissions costs

For each option, we calculate the total cost of emissions over the expected life of the relevant assets (the direct economic impacts of a given proposal).

When assessing the environmental emissions costs of an option, we will consider:

- **greenhouse gas (GHG) emissions**, recognising that there is a social cost of greenhouse gas emissions incurred in construction and a cost or benefit due to changes to network operation
- **NO_x emissions**, which represent a group of chemical compounds known as nitrogen oxides, which are significant air pollutants that can have an adverse effect on the environment and on human health
- **particles 2.5 micrometres or less (PM2.5) emissions**, which refer to fine particulate matter with a diameter of 2.5 micrometres or less that can have an adverse effect on the environment and on human health

Greenhouse gas emissions

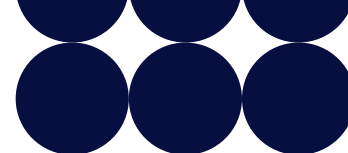
We will use HM Treasury's Green Book guidance to quantify the cost of environmental impacts, particularly regarding the cost of GHG emissions.

Compressor station operation is a significant source of GHG emissions on the NTS. We will use our network analysis of options and our forecast of future flow patterns to identify changes in compressor utilisation. This in turn enables us to quantify corresponding changes to compressor fleet carbon emissions.

We will also consider estimated emissions due to the construction process as well as any impact from changes to ongoing maintenance activities.

Fugitive methane emissions are the unintentional release of methane in the atmosphere from equipment over time. This can happen during the production, processing, storage and transportation of natural gas and other hydrocarbons and these will be considered where applicable. We will also consider impacts on any intentional methane release.

To the extent that these emissions can be quantified and costed (for example, adopting a social cost of emissions), they will be included in our economic assessment.



NOx emissions

NOx emissions arise from combustion processes within compressor stations and can be a significant local air pollutant with harmful effects on the environment and on human health. Based on an assessment of changes to compressor utilisation associated with investment options, we will estimate any significant changes to NOx emissions.

PM2.5 emissions

PM2.5 emissions arise from construction processes undertaken on the NTS and can be a significant local air pollutant with harmful effects on the environment and on human health. Based on the assessment of options proposed with construction requirements, we will estimate any significant changes to PM2.5 emissions.

Security of supply

The NTS provides an ongoing benefit to the consumer by enabling a safe and secure supply to homes and businesses. For our social impact assessment, we will consider whether proposals support the ability of NGT to maintain a resilient and secure gas supply.

Where an option is designed to increase entry capability, its relative benefit in terms of increased security of supply (in terms of available volumes of gas) can be estimated with reference to market intelligence about future supply and storage volumes and their sources.

These will be quantified within the NPV assessment, where the monetised reduction in constraints costs will be calculated for the relevant buy-back or locational action. Any residual benefit (representing any forecasts of flow above NGT's entry capacity obligation) will be separately quantified.

For options designed to increase exit capability, we intend to work closely with NGT and the GDNs to evaluate the security of supply implications of exit constraints and the relative benefits or risks associated with investment options. Where we determine that an option carries a significant security of supply safety risk, it will be discounted.

Aspects of security of supply that will be assessed through the qualitative assessment will be the benefit of any residual constraint reduction and any relevant potential mitigations included in NESO's GSSA¹²³. We will assess the options using the matrix benefit scale in Table 24.

Table 24: Security of supply scale

¹²³ NESO, [neso.energy/what-we-do/resilience-emergency-management/gas-supply-security-assessment](https://www.neso.energy/what-we-do/resilience-emergency-management/gas-supply-security-assessment)



Network security of supply		
Benefit scoring ¹²⁴	NTS capability constraint reduction	Security of supply benefit
Maximum	100%	maximum potential mitigations for security of supply risk
Very high	>90%	very high potential mitigations for security of supply risk
High	>70%	high potential mitigations for security of supply risk
Moderate	>30%	moderate potential mitigations for security of supply risk
Low	>10%	low potential mitigations for security of supply risk
Very low	<10%	very low potential mitigations for security of supply risk

Deliverability

To carry out the deliverability assessment, we apply a framework against each option, considering a range of factors:

- **Design complexity** – the complexity of the options that could lead to constraints against the delivery timeline.
- **Technology readiness** – the assessment of the maturity of the technology being presented that could lead to a need for further justification for safety reasons or standards compliance.
- **Supply chain** – the assessment of the readiness, availability of components and supplier contracts that could lead to constraints against the delivery timeline.

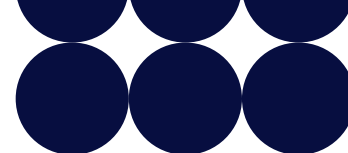
We will score these factors using the deliverability qualitative matrix.

Design complexity assessment

The design complexity framework ranking in Table 25 provides an overview of the qualitative approach used when considering the feasibility of each proposal.

Table 25: Complexity framework

¹²⁴ The network security of supply benefit scale will be scored from 0-5, where maximum benefit is 0 and very low benefit is 5.



Complexity scoring ¹²⁵	Design complexity
Lowest	<ul style="list-style-type: none"> • upgrades to current NTS assets with designs that have minimal complexity and minimal disruption when implemented • no or very low emissions increase when maintaining assets • similar projects have been undertaken on NTS • no or minimal risk of delays to programme delivery
Very low	<ul style="list-style-type: none"> • upgrades to current and new build NTS current assets with designs have very low complexity and very low disruption when implemented • very low emissions increase when maintaining assets • similar projects have been undertaken on NTS • very low risk of delays to programme delivery
Low	<ul style="list-style-type: none"> • upgrades to current and new build NTS current assets with designs have low complexity and low disruption when implemented • low emissions increase when maintaining assets • similar projects have been undertaken on NTS • low risk of delays to programme delivery
Moderate	<ul style="list-style-type: none"> • upgrades to current and new build NTS current assets with designs have moderate complexity and moderate disruption when implemented • moderate emissions increase when maintaining assets • similar projects have been undertaken on equivalent gas transmission owners • moderate risk of delays to programme delivery
High	<ul style="list-style-type: none"> • upgrades to current and new build NTS current assets with designs are very complex and/or that can lead to disruptions • high emissions increase when maintaining assets • new project on NTS that has only been through a design and test phase • high risk of delays to programme delivery
Very high	<ul style="list-style-type: none"> • upgrades to current and new build NTS current assets with designs are very complex and disruptive • very high emissions increase when maintaining assets • new project on NTS that has only been in design phase • high risk of delays to programme delivery

Technology readiness assessment

The technology readiness risk framework ranking in Table 26 provides an overview of the qualitative approach used when considering the feasibility of each proposal.

Table 26: Technology readiness risk framework

¹²⁵ The design complexity scale will be scored from 0–5, where lowest complexity is 0 and very high complexity is 5.



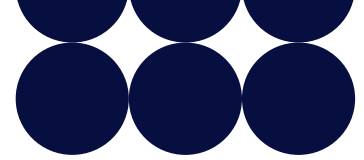
Risk scoring ¹²⁶	Technology readiness
No or lowest	The design components technology: <ul style="list-style-type: none"> • will be mature technology that has been used on the NTS for over 10 years • will bear no to low risk of operational testing sign-off delays • is compliant with current standards/safety requirements
Very low	The design components technology: <ul style="list-style-type: none"> • will be technology that has used on the NTS for a five to ten-year period • will bear a very low risk of operational testing sign-off delays • is compliant with current standards/safety requirements
Low	The design components technology: <ul style="list-style-type: none"> • will be new technology that has only been used on the NTS for less than five years • will bear a low risk of operational testing sign-off delays • is compliant with current standards/safety requirements
Moderate	The design components technology: <ul style="list-style-type: none"> • will be technology that use by equivalent gas transmission system operators, but not on the NTS • will bear a moderate risk of operational testing sign-off delays • is compliant with current standards/safety requirements
High	The design components technology: <ul style="list-style-type: none"> • will be emerging technology that has not been used beyond testing phase, therefore is unproven in real operations • will bear a high risk of operational testing sign-off delays • would require further justification to ensure compliance with current standards/safety requirements
Very high	The design components technology: <ul style="list-style-type: none"> • will be new technology that has not been used beyond design phase, therefore is unproven in real operations • will bear a very high risk of operational testing sign-off delays • would require further justification to ensure compliance with current standards/safety requirements

Supply chain assessment

The supply chain risk framework ranking in Table 27 provides an overview of the qualitative approach used when considering the feasibility of each proposal.

Table 27: Supply chain risk framework

¹²⁶ The technology readiness risk scale will be scored from 0-5, where no or low risk is 0 and very high risk is 5.



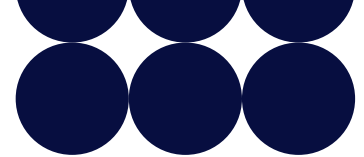
Risk scoring ¹²⁷	Supply chain
No or lowest	The design components: <ul style="list-style-type: none"> • are current NTS components readily available for production and procurement • have established supplier contracts in place for project start • bear no or low risk of project delivery delay
Very low	The design components: <ul style="list-style-type: none"> • are current NTS components available for production and procurement • have established supplier contracts currently in procurement for project start • bear a very low risk of project delivery delay
Low	The design components: <ul style="list-style-type: none"> • are current NTS components that have limited availability for production and procurement • have established supplier contracts that require procurement to be undertaken or clear strategy to be in place for project start • bear a low risk of project delivery delay
Moderate	The design components: <ul style="list-style-type: none"> • are current NTS components that are ad-hoc to NTS • are only standard components that are available for project start • have ad-hoc supplier contracts required for procurement to be undertaken for project start • bear a moderate risk of project delivery delay
High	The design components: <ul style="list-style-type: none"> • are emerging technology that requires ad-hoc testing and production • have ad-hoc supplier contracts required for procurement to be undertaken for project start • bear high risk of project delivery delay
Very high	The design components: <ul style="list-style-type: none"> • are specialised new innovative technology that requires ad-hoc design, testing and production • have ad-hoc supplier contracts required for procurement to be undertaken for project start • bear a very high risk of project delivery delay

Operability

The operability risk framework ranking in Table 28 provides an overview of the qualitative approach used when considering the feasibility of each proposal.

Table 28: Operability framework

¹²⁷ The supply chain risk scale will be scored from 0–5, where no or low risk is 0 and very high risk is 5.



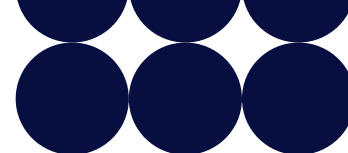
Risk scoring ¹²⁸	Operability
No or lowest	<p>The operability of the proposed option on the NTS:</p> <ul style="list-style-type: none"> • is very simple to operate within current NTS operating parameters • asset requires monitoring of operating flow or pressures (such as new feeder) but no moving parts • bears no or low risk to operational sign-off and project delivery timeline
Very low	<p>The operability of the proposed option on the NTS:</p> <ul style="list-style-type: none"> • is simple to operate within current NTS operating parameters • asset requires monitoring and controlling of operating flow or pressures (such as flow control valve, block valve etc.) with limited controllable conditions • bears a very low risk to operational sign-off and project delivery timeline
Low	<p>The operability of the proposed option on the NTS:</p> <ul style="list-style-type: none"> • is simple to operate within current NTS operating parameters • asset requires monitoring and controlling of operating flow or pressures (such as compressor stations etc.) with a range of controllable conditions • bears a low risk to operational sign-off and project delivery timeline
Moderate	<p>The operability of the proposed option on the NTS:</p> <ul style="list-style-type: none"> • is moderately difficult to operate within NTS operating parameters as a combination of above assets • may require additional operational training for NTS system operators • bears a moderate risk to operational sign-off and project delivery timeline
High	<p>The operability of the proposed option on the NTS:</p> <ul style="list-style-type: none"> • is difficult to operate as complex design within NTS operating parameters • requires additional operational training for NTS system operators • bears a high risk to operational sign-off and project delivery timeline
Very high	<p>The operability of the proposed option on the NTS:</p> <ul style="list-style-type: none"> • is very difficult to operate as complex design or outside current NTS operating parameters • requires additional operational training for NTS system operators • bears a very high risk to operational sign-off and project delivery timeline

Economic assessment

Net present value (NPV) methodology

We will compare different options by considering the NPV of their monetised costs and benefits, over an expected lifetime. If the discounted benefits of an option outweigh the

¹²⁸ The operability risk scale will be scored from 0-5, where no or low risk is 0 and very high risk is 5.



discounted costs of an option over its lifetime, it will have a positive NPV. All options will be compared to a base case 'do nothing' option.

Constraint costs, described in more detail below, may occur if NGT cannot meet its contractual obligations at supply and demand points on the NTS. If they occur, those costs could impact consumer bills. Some intervention options could reduce these costs. The options may include commercial contracts to manage the location of supply and demand, changes to the commercial arrangements (such as the 'Uniform Network Code'¹²⁹) or physical investment on the network, therefore presenting financial trade-offs that will be assessed through the NPV analysis.

Some options may present other financial trade-offs; for example, the replacement of a compressor unit where the benefit is the assessment of emission reductions or a removal of assets which reduces operational costs. These financial trade-offs will also be considered in the NPV analysis.

FES and SSEP pathways

The investment options will be assessed against the range of FES pathways as well as the SSEP pathway's unabated gas demand profiles, to ensure NTS resilience and a continued ability to meet the 1-in-20 security of supply standard.

To ensure ongoing security of supply, whilst options will be assessed against all FES pathways, we will consider security aspects on the pathway with the highest gas demand, which may not be net-zero compliant.

Asset life assumption

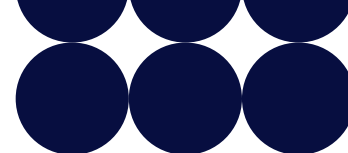
Key assets installed on the NTS (such as compressors, pipes and valves) are usually assumed to have a design life of up to 45 years¹³⁰. However, the economic life of gas network assets is currently uncertain and is dependent on the pace of progress towards net zero and its corresponding implications for the NTS. For example, the future of any proposed assets may partly depend on whether they would be needed for future hydrogen applications post-2050.

For the purposes of our analysis, 2050 will be considered as the earliest decommissioning year for newly installed assets. Depending on the indications from FES and other sources, the assumed asset life may be extended beyond 2050 on a case-by-case basis.

As FES data does not extend beyond 2050, it is not possible to assess the constraint risk beyond this point using such data. For this reason, where necessary to consider the impact of an option, we will extrapolate ongoing costs and benefits beyond 2050.

¹²⁹ The Uniform Network Code (UNC) is the contractual basis of commercial arrangements for the transportation and supply of natural gas in GB. Joint Office of Gas Transporters, [gasgovernance.co.uk/UNC](https://www.gasgovernance.co.uk/UNC)

¹³⁰ NESO intends to run sensitivity analysis during the economic assessment for asset life.



Assessing investment options against the base

To assess options that are designed to meet the network capability needs, we begin by establishing our reference (base case), which we define as the case where there is no intervention planned to change network capability (for example, when it is a 'do nothing' option). For the base case, we calculate costs associated with the projected volume of constraints based on the existing network.

For each investment option, we re-project the volume and cost of constraints to account for any change in capability or any commercial tools that mitigate against constraint¹³¹. The constraint cost for each option is then compared with the base case constraint cost, and any reduction is defined as a benefit for that investment option.

For the base case and each option, costs and benefits will be discounted at a social time preference rate, over the period to 2050, or beyond this date where appropriate.

The following summarises the elements used in the NPV calculation:

- **Option costs** – Any build costs, operating costs, decommissioning costs, environmental and social costs where these have been monetised or the cost of commercial action via contracts with third parties.
- **Constraint costs from each option** – Calculated by determining the network capability impact of each option under the FES pathways.
- **Base case constraint costs** – The situation where there is no intervention on the NTS (the 'do nothing' option).
- **Constraint cost savings** – Calculated by comparing the constraint costs from one option to the base case constraint costs.
- **Compressor operational costs and savings** – Calculated by estimating usage based on comparing the compression requirements with FES pathway data to determine volumes relating to fuel, carbon and NOx.

NPV calculation

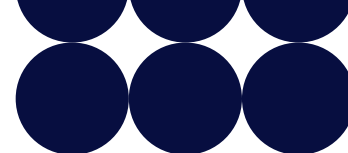
Option costs

A gas unit cost library has been developed in collaboration with Jacobs¹³², which is benchmarked against a wide range of industry data. The unit cost library will assist NESO in the valuation of any asset build costs (new build, repurposing or modification), operating costs and decommissioning costs for all investment options.

The units cost library will also be used to evaluate the costing of options presented by NGT within SPOP. Via SPOP, NGT will share all relevant capability and costing information and relevant details of commercial agreements, as per their SPOP licence conditions.

¹³¹ NESO intends to update unit cost library for each CSNP three-year cycle.

¹³² Jacobs are a consultancy firm who have been supporting NESO in the creation of our gas unit cost library: [jacobs.com](https://www.jacobs.com)



More details are available in the gas unit cost library methodology on the NESO website¹³³.

The investment option cost elements fall into the following asset classes and types of investment:

- Transmission pipelines:
 - New build, uprating, repurposing, replacement and decommissioning
- Above ground installations (AGIs):
 - New build, repurposing and replacement
- Compressor stations:
 - New build, replacement, uprating, flow reversal and re-wheeling
- Regulators:
 - Resizing (modification), replacement or new installation

These types of investments comprise the following cost elements:

- Capital expenditures (CapEx):
 - materials
 - construction (labour)
 - land costs
 - permitting and regulatory fees
 - miscellaneous
- Operational expenditure (OpEx):¹³⁴
 - asset operation and maintenance cost (excluding compressor fuel)
- Environmental costs:
 - Cost of CO₂ equivalent emissions (CO₂e) due to construction and decommissioning of assets, which will be aligned with HM Treasury Green Book guidance

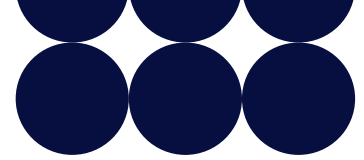
Constraint costs

Constraints costs on the NTS will be assessed for both entry and exit capability requirements depending on the investment option. The costs are derived from the volume of constraints in each case.

Constraint volumes, that is, gas flow volumes that would need to be constrained, are calculated by looking at each projected demand/flow point (each 'dot' on a flame chart) above the intact capability curve and taking the difference, although ignoring volumes

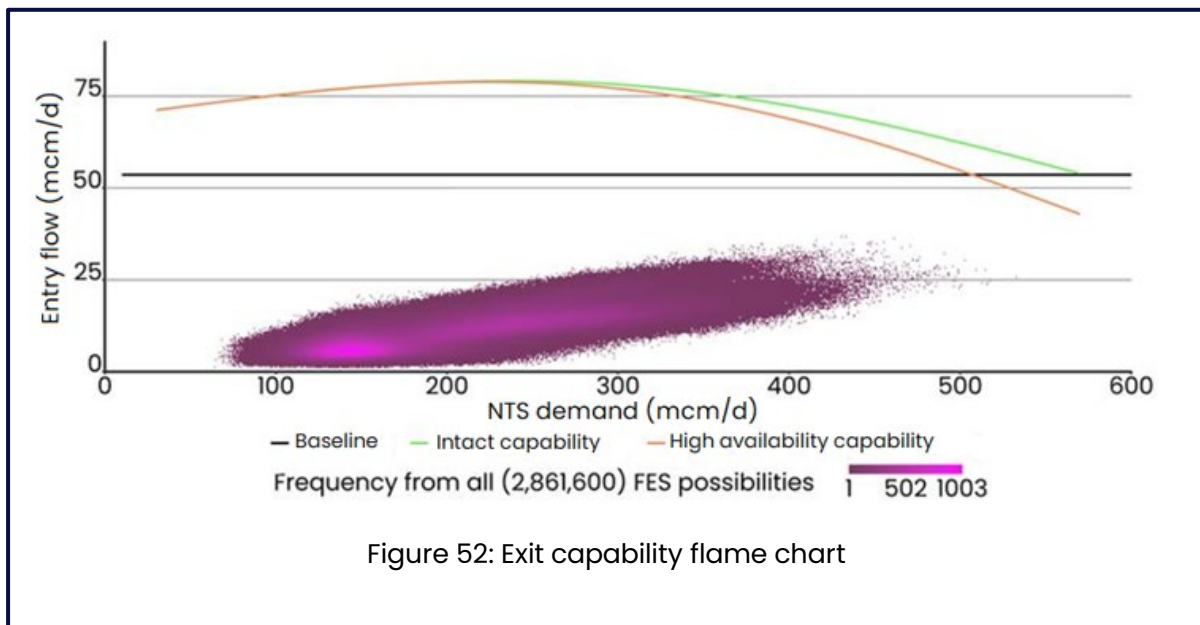
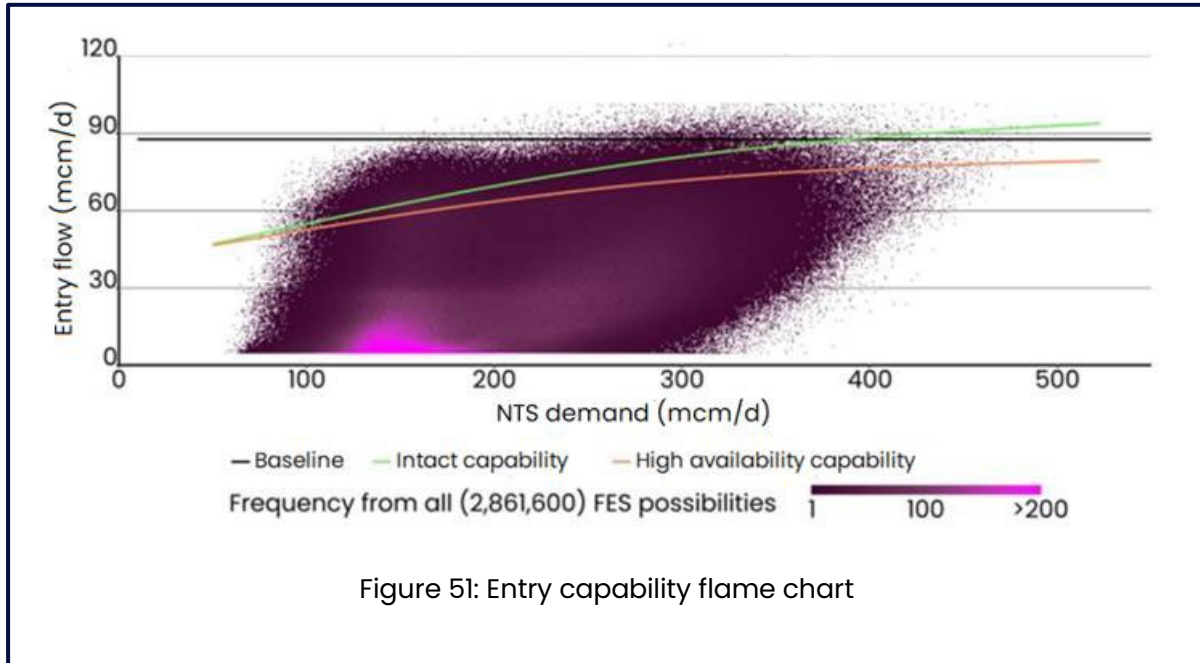
¹³³ NESO, [neso.energy/what-we-do/strategic-planning/gas-options-advice-go](https://www.neso.energy/what-we-do/strategic-planning/gas-options-advice-go)

¹³⁴ Impacts on compressor fuel costs are considered separately.

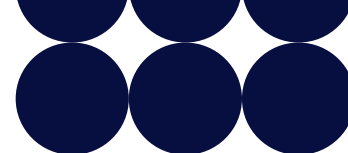


that are above the capacity baseline. Capacity baselines are specified for entry and exit capacities in NGT's transporter licence¹³⁵.

Constraint volumes are calculated for each entry capacity zone and each exit capacity zone for each FES pathway. Example flame charts for each are shown in Figures 51 and 52.



¹³⁵ NGT, nationalgas.com/our-businesses/entry-capacity



Entry constraint costs

Entry constraints are managed commercially by NGT, through a variety of means which may include locational actions (such as buying and selling gas) or through buying back capacity rights for the relevant period of time. In both cases, the constraint cost is based on the wholesale gas price. To calculate the cost associated with forecast constraint volumes, we need to estimate the future price of gas. For this we use DESNZ's price assumptions¹³⁶. We assume a ratio of locational actions and buybacks, as well as premia which are applied to trade prices. We have yet to define these parameters and expect to agree detailed parameters with Ofgem in due course, consulting with NGT where appropriate.

Exit constraint costs

Similar principles apply as for entry constraint management, in terms of market prices and incentives. However, there are some additional options typically available to NGT:

- exercise of interruptible exit capacity (where a relevant contract is in place)
- calculation of any existing constraint management contract regular costs
- unsold capacity would be withheld in a zonal region
- locational buy actions
- the buy-back of exit capacity rights

We have yet to define these and expect to agree detailed parameters with Ofgem by December 2026, following appropriate engagement with NGT and relevant GDNs.

Base case costs

This is defined as a 'do nothing' option where costs (other than constraint costs) are assumed to be zero.

Compressor costs

An option may change how NTS compressors operate and how often they are used. This will affect compressor fuel usage, as well as carbon and NOx emissions. Compressor usage is estimated based on a similar principle to the way the constraints are calculated, comparing forecast flow data with assumed thresholds at which each compressor is required to operate.

The usage estimates allow us to calculate volume of fuel, carbon and NOx and to apply the relevant prices, DESNZ fuel price assumptions, HM Treasury Green book prices and DEFRA's pollution damage costs respectively.

Constraint cost savings

These are calculated by comparing the constraint cost of an investment option to the base case constraint costs.

¹³⁶ UK government, [gov.uk/government/publications/energy-and-emissions-projections-2022-to-2040](https://www.gov.uk/government/publications/energy-and-emissions-projections-2022-to-2040) (Annex M)



Review in combination

For each investment option proposed, each element of the assessment (economic, environmental and community, emissions, security of supply, deliverability and operability) will be used to inform the recommendation on option(s) to Ofgem.

However, if there are unmitigable or significant environmental and community or societal impacts associated with an option, we will consider the balance of impacts across the set of assessments. All relevant data, assumptions and calculations will be shared with Ofgem to demonstrate that NESO's recommendation is unbiased and transparent.

In future iterations of the CSNP, we will review previous investment recommendations, updating the progress of these and, where relevant, the benefit of each option.

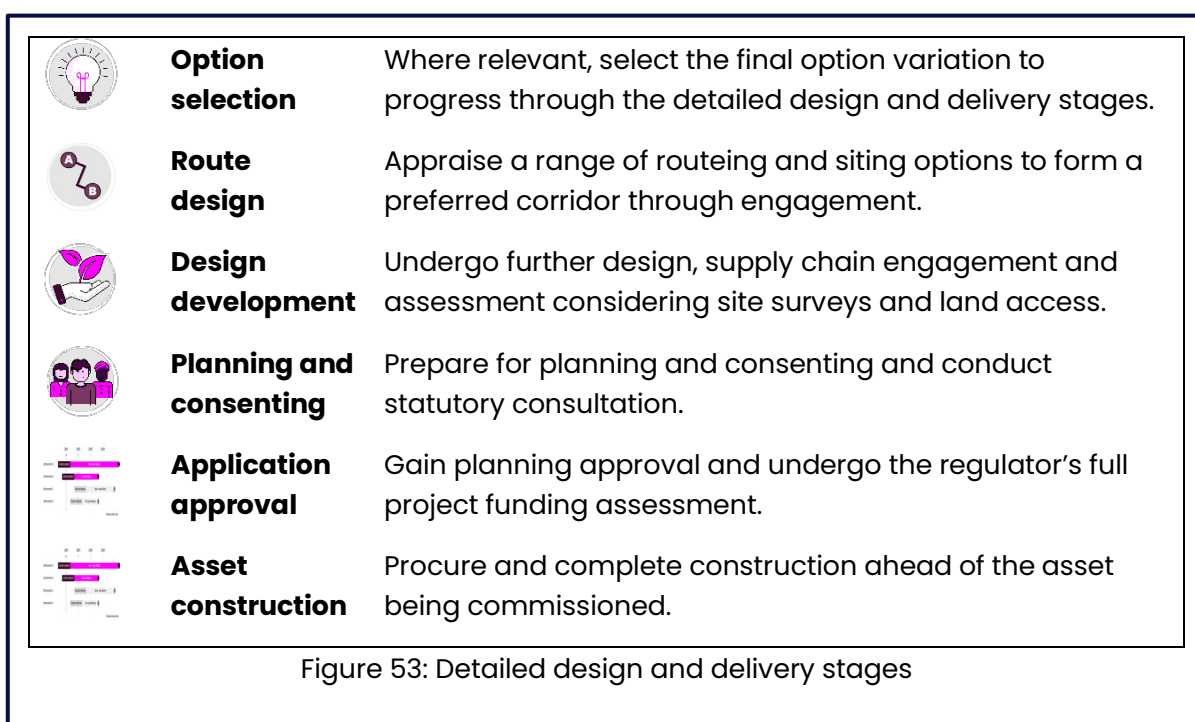


Deliver

Overview

The CSNP publication will provide recommendations, along with an explanation of how the conclusions were reached, to Ofgem, who are the expected body to make relevant decisions. We intend to provide updates on the progress of options that are recommended in subsequent CSNP iterations.

NESO is not the decision-maker in this process, and we will not be undertaking a formal delivery phase for the options proposed. Nonetheless, we expect that any reinforcement options being developed will follow the design and delivery stages outlined in Figure 53.



Review of previous proposals

We will review all outcomes of previous CSNP publications, updating on progress and status of each project to ensure that advice is still relevant. Where advice changes through each iteration, this will be communicated to the regulator, who makes the relevant NTS funding decisions.

Where advice changes, we will ensure that the process for change control is discussed with Ofgem and the relevant parties. These changes will be categorised as:

- **minimal change** – where the initial recommendation requires a small change to the proposed option (for example, a small increase routing change to a new build feeder)



- **substantial change** - where the initial recommendation requires a large change (for example, a change in diameter to a new build feeder), additional new build asset (additional new feeder, compressor unit or station) or new proposed option

We will assess the above on a case-by-case basis.

10. Section 5: Hydrogen

Introduction

Drive

Identify

Develop

Appraise

Deliver





Introduction

The CSNP will plan strategic hydrogen networks and storage from initial network development within industrial clusters through to the requirements for a potential national hydrogen network. It will consider hydrogen network requirements at different scales and the specific projects that could meet those needs.

This section sets out how we plan the hydrogen system within the CSNP. We detail the approach taken within each of the key steps common across the methodology and how this differs for hydrogen, where there is no existing national network, unlike for electricity and gas.

NESO's primary duty under the Energy Act 2023 gives us the focus of decarbonising the energy system, cost effectively and securely. Condition C12 of NESO's Gas System Planner licence¹³⁷ requires us to produce the CSNP, which is defined (in Condition A1) as being "the coordinated strategic plan for long-term development of the electricity transmission and natural gas transmission systems, accounting for hydrogen and other energy vectors." In December 2023, Ofgem's decision on the framework for the Future System Operator's Centralised Strategic Network Plan¹³⁸ reaffirmed a goal for the CSNP to include analysis of proposed hydrogen networks.

Hydrogen is an emerging sector, without established network planning processes. In autumn 2025, we conducted a series of workshops with hydrogen industry stakeholders to take on board feedback and refine our approach. Where appropriate, we have made changes and clarifications to the draft methodology¹³⁹ to reflect the feedback received during both the summer 2025 consultation and the workshops. Further detail on this is set out in [Appendix A](#).

Given the early stage of the hydrogen network development, outputs from this methodology should not be interpreted as deterministic. The CSNP does not prescribe specific investment decisions but provides a strategic evidence base to inform future policy, regulatory and commercial decisions as the hydrogen system evolves. We will continue to work closely with DESNZ and Ofgem to ensure alignment between NESO's strategic planning and the overarching policy framework for hydrogen including their continued development of the hydrogen transport and storage business models with consideration of the effect this may have on our current and future methodologies.

¹³⁷ Ofgem, [ofgem.gov.uk/sites/default/files/2024-03/Annex%20G%20-%20Gas%20System%20Planner%20Licence%20Conditions.pdf](https://www.ofgem.gov.uk/sites/default/files/2024-03/Annex%20G%20-%20Gas%20System%20Planner%20Licence%20Conditions.pdf)

¹³⁸ Ofgem, [ofgem.gov.uk/sites/default/files/2023-12/Decision%20on%20the%20framework%20for%20the%20Future%20System%20Operators%20Centralised%20Strategic%20Network%20Plan.pdf](https://www.ofgem.gov.uk/sites/default/files/2023-12/Decision%20on%20the%20framework%20for%20the%20Future%20System%20Operators%20Centralised%20Strategic%20Network%20Plan.pdf)

¹³⁹ NESO, [neso.energy/document/363521/download](https://www.neso.energy/document/363521/download)



Approach to hydrogen network planning

Hydrogen network planning requires consideration of hydrogen supply, demand and infrastructure at different levels of granularity. There is no concept of transmission and distribution for hydrogen as there is in gas and electricity networks. While the CSNP for electricity and gas solely covers transmission networks, for hydrogen we have had to develop a definition for the scope of the CSNP. We are working with the UK Government which has developed hydrogen business models. These have launched or are in development and support hydrogen production, transport, storage and use for power generation.

Within the CSNP, we intend to develop our hydrogen network plan by focusing on the development of a strategic network and its growth across a 25-year time horizon between 2025 and 2050. We recognise the need to consider a range of potential hydrogen production locations, given that hydrogen supply locations are likely to be significantly more diverse and distributed than existing gas supply. However, under the hydrogen production business models (HPBMs), there are likely to be early hydrogen 'point-to-point' pipelines with above-ground storage, connecting isolated hydrogen production to demand. Where these do not have any impact beyond the specific projects they connect to, they will not need to be strategically planned as part of the hydrogen network. However, associated electricity demand would need to be considered on the electricity side.

Within this plan, we are focusing on network development to transport pure hydrogen within GB. The role of offshore assets as well as interconnectors are not being directly considered at this stage. Furthermore, hydrogen blending into the natural gas network is not considered directly within the hydrogen network plan. However, we will need to consider how potential on-site hydrogen blending by customers to use hydrogen to meet only a portion of their demand may affect their hydrogen needs, as well as the potential use of blending as an offtaker of last resort or strategic enabler for initial hydrogen supply projects while local demand ramps up. Subject to the outcome of government decisions on hydrogen blending¹⁴⁰, we will consider how this may need to be incorporated into our gas network planning process when considering future CSNP methodologies. Likewise, with the evolution of the hydrogen sector, our consideration of offshore assets and interconnectors may evolve in future CSNP cycles.

NESO's strategic planning of hydrogen transport and storage infrastructure will help inform DESNZ decisions relating to any future allocation rounds of the hydrogen transport business model (HTBM) and hydrogen storage business model (HSBM) beyond the announced round, noting that this may also be relevant for other hydrogen business models. The strategic network focus within the CSNP means that infrastructure modelled

¹⁴⁰ UK government, assets.publishing.service.gov.uk/media/687f554f88c74f0fd15c9725/transmission-blending-consultation-document.pdf



here is expected to be of sufficient capacity and significance to support networks beyond initial point to point developments. This is in line with conditions outlined by DESNZ in order to be considered for support under current or future rounds of the HTBM and HSBM. Where hydrogen production projects supported through early hydrogen allocation rounds (HARs) could also have important systemic impacts, they should also be included, most notably those relating to HAR hydrogen network development in and around the industrial clusters.

We propose to split hydrogen network planning into three scales:

- **National strategic view models** – National-level network models to determine hydrogen network needs. These should be informed by the hydrogen flows between zones from the Strategic Spatial Energy Planning (SSEP) outputs.
- **Industrial cluster systems models** – We will consider initial hydrogen supply and demand projects. These assess physical and performance characteristics of the proposed system and test against various usage scenarios.
- **Broader industrial view models** – These will be informed by the first two approaches as well as NESO's Regional Energy Strategic Plans (RESPs) and will consider the buildout of hydrogen networks beyond initial supply and demand connections within clusters and how they can be connected together with strategic storage sites and a wider national network.

There will be interactions between the three scales. While they provide separate starting points for understanding hydrogen needs, we will be building network models to join these together, where appropriate, to understand flows across the whole strategic network.

National strategic view models

The SSEP will define whether there is a strategic need for a national hydrogen network. It will also consider the need for hydrogen storage within each modelled zone, subject to geographic constraints on where this can be developed. We will build hydraulic models informed by the hydrogen flows between zones from the SSEP outputs, which will allow us to provide greater precision on potential connection points, diameters, operating pressures and other physical characteristics. These models will also allow us to consider more detailed representations of supply and demand characteristics and the need for the network to provide balancing services, the need or opportunity for using compression to improve network efficiency and to consider operation of storage facilities.

While the CSNP framework is applied consistently across gas, electricity and hydrogen, the absence of an existing hydrogen transmission system means that for hydrogen we necessarily adopt a more exploratory and developmental approach. Where differences to the gas and electricity methodologies occur, these reflect hydrogen-specific uncertainty rather than differences in governance intent.

Industrial cluster system models

Industrial cluster system models will provide a place-based analysis to inform early strategic direction for hydrogen for the buildout of regional hydrogen infrastructure within clusters.



Starting from the initial hydrogen- and CCS-enabled and funded industrial cluster systems¹⁴¹, we will develop hydraulic models of the proposed hydrogen networks emerging within industrial clusters. Some of these clusters will also include local hydrogen storage development. The models can be used to assess physical and performance characteristics of the proposed system such as diameters, operating pressure regimes, capacities and linepack. The models can also test against various usage scenarios and be used to study the impact of load and system growth.

All SEP network plans currently developed by NESO are continuously refined so that their outputs can be aligned and utilised effectively, ensuring that regional context is aligned to national views.

Broader industrial view models

There is a need to consider the buildout of hydrogen networks beyond initial supply and demand connections within clusters and how and when they might be integrated within a wider strategic national network. This will need to be underpinned by both the broader strategic view emerging from the SSEP and the development of initial hydrogen supply and demand projects within industrial clusters. We will also need to consider further identified hydrogen demand that could subsequently connect to the initial industrial clusters.

The SSEP will help determine the scale of any required national hydrogen network and therefore help shape the scope of this level of hydrogen network planning, whether it includes connections of clusters to a national network or solely considers the potential for more localised inter-cluster connections. The UK government continues to review the case for a national hydrogen network; modelling outputs of the CSNP may be used to inform on and support this needs case.

Interaction with transport and storage business models

DESNZ first set out its intent for NESO to take on formal strategic planning responsibilities for hydrogen transport and storage infrastructure in August 2023¹⁴². In December 2023, DESNZ's Hydrogen Transport and Storage Networks Pathway¹⁴³ set a further ambition for this to happen from 2026, subject to further policy development. This was further reinforced in the Hydrogen Strategy Updates to the Market in December 2024¹⁴⁴ and July 2025¹⁴⁵ and the Hydrogen Infrastructure Strategic Planning Policy Statement in October

¹⁴¹ Industrial clusters are often defined as geographically concentrated areas of co-located energy-intensive industry.

¹⁴² UK government, assets.publishing.service.gov.uk/media/67571058f1e6b277c4f79a76/hydrogen-strategy-update-to-the-market-august-2023.pdf

¹⁴³ UK government, gov.uk/government/publications/hydrogen-transport-and-storage-networks-pathway

¹⁴⁴ UK government, gov.uk/government/publications/hydrogen-strategy-update-to-the-market-december-2024

¹⁴⁵ UK government, assets.publishing.service.gov.uk/media/6880b2139fab8e2e86160efe/hydrogen-update-to-the-market-2025.pdf



2025¹⁴⁶. In line with this, and NESO's licence requirements to consider hydrogen as part of coordinated strategic planning, we have been working on the inclusion of hydrogen across our SEP outputs, including the SSEP, RESP and the CSNP.

The early stages of the development of hydrogen systems in GB will involve government support mechanisms across the hydrogen supply chain. Decisions on providing support will be made by the UK government through the relevant hydrogen business models. The first allocation rounds for the HTBM and HSBM are expected to launch in the first half of 2026 as highlighted in the July 2025 Update to the Market, which is too early for them to be informed by final outputs from the first CSNP. We will, however, engage with DESNZ to ensure that any early insights from our work can be fed into their decision-making process. We will work with DESNZ to ensure that NESO's strategic planning outputs, including the CSNP, can be used to inform the design and assessment of future hydrogen business model allocations.

Noting the holistic and coordinated approach to strategic planning provided by our plans, in the recent Hydrogen Infrastructure Strategic Planning Policy Statement DESNZ has reiterated its intention to have due regard to the final CSNP publication and our other strategic plans. This includes development of their overall strategy for the hydrogen economy and design of future allocations of the HTBM, HSBM, HPBM and hydrogen to power business model (H2PBM), beginning with any allocations launched after publication of the first SSEP due in autumn 2027.

We will continue to engage with industry via the Hydrogen Delivery Council¹⁴⁷ and its working groups as DESNZ develops and refines strategies, plans and policies for the hydrogen sector. This will enable greater certainty on early hydrogen network evolution and government's strategic objectives beyond that. This engagement will ensure that industry feedback is considered in the development of a nascent network planning process.

Treatment of hydrogen storage

Background – storage in the gas (methane) market

In the GB gas market, we have commercial storage, which comprises geological storage facilities controlled by storage operators (sometimes owned by specific gas shippers) that provide flexibility services to gas market participants – liquefied natural gas (LNG) facilities also provide similar flexibility services. This is supplemented by the storage embedded within the gas network and controlled by the licensed gas transporters which provides within-day flexibility to allow for a difference in the rate of flow into and out of the gas network over the course of a gas day. Typically, this is linepack (gas stored within the pipelines by virtue of its pressure) but can also include low-pressure gas storage. Storage within the network also provides the network operators with operational flexibility. This

¹⁴⁶ UK government, assets.publishing.service.gov.uk/media/68de854fdadf7616351e4d77/hydrogen-infrastructure-strategic-planning-policy-statement.pdf

¹⁴⁷ UK government, gov.uk/government/groups/hydrogen-delivery-council



storage is typically not available to the market, nor the need for it addressable by the market.

The operation of commercial storage facilities is driven by the expected price of gas day-to-day and season-to-season. Commercial storage provides a range of services to the gas market, allowing participants to respond to a variety of situations, for example day-to-day variation in weather and consumption and supply outages. Commercial gas storage is used by shippers to both balance their own physical position and also to provide services to the traded gas market more broadly. Additionally, the NTS system operator, National Gas Transmission (NGT), may procure some commercial storage for operational or emergency management reasons.

The value of gas storage in a liquid, traded market can be characterised by two dimensions: the total amount of gas that can be stored in the facility and the rate at which gas can be injected into and withdrawn from the facility during the market's balancing period. The former of these characteristics is of primary importance when considering long-duration factors such as seasonality; the latter is of primary importance when considering shorter-duration factors such as daily balancing, the difference between weekend and weekday demand levels, the impact of weather and the ability to respond to unforeseen supply or demand shocks.

In other gas markets, a third category of gas storage is sometimes present which is centrally planned and controlled and used to cover extreme circumstances. This is often referred to 'strategic storage'. We note that, whilst gas storage in the GB gas market was originally centrally planned (prior to vertical separation in 1996), it is not centrally planned or coordinated and is currently left entirely to the gas market participants through normal market activity. Gas (methane) storage planning therefore does not form part of the CSNP. It is however considered within other NESO publications such as the Gas Supply Security Assessment¹⁴⁸, which has a responsibility to consider mitigations and remediations should the risk to security materialise¹⁴⁹.

Application of these concepts to the hydrogen system

No low-carbon hydrogen market exists, but hydrogen storage is likely to be a vital part of a hydrogen system in the future. The lower energy density of hydrogen, compared to natural gas, provides a lower level of linepack within the hydrogen network, suggesting greater need for standalone storage. The inclusion of hydrogen storage within the CSNP reflects its anticipated role in supporting system resilience and whole-system efficiency during early market development. Subsequent appraisal of storage options should therefore be interpreted in the context of these system-wide benefits, alongside economic considerations.

¹⁴⁸ NESO, [neso.energy/what-we-do/resilience-emergency-management/gas-supply-security-assessment](https://www.neso.energy/what-we-do/resilience-emergency-management/gas-supply-security-assessment)

¹⁴⁹ The potential for conflicts of advice across relevant NESO publications is managed through the consideration of supply security within the gas section of the CSNP.



Drive

The purpose of the Drive step is to collect and process different data inputs for hydrogen demand, supply and storage. This stage informs the needs for hydrogen transport and storage identified, developed and appraised through the other CSNP steps.

The extent of the future role of hydrogen in the energy system is uncertain, as is the future level and makeup of supply and demand, as reflected by different pathways. For each pathway, both the spatial distribution and the level of hydrogen infrastructure required to deliver the optimal whole energy network may vary significantly.

Economic analysis conducted within the input energy pathways will help optimise the location of hydrogen supply and demand. This will then inform the requirement for hydrogen transfer between different areas of the country. This section outlines the different data sources and input pathways to the CSNP.

Hydrogen network planning within the CSNP will be primarily driven by the SSEP. Due to be published in 2027, the SSEP will set out the need for hydrogen transport within GB. FES and other stakeholder data will be used to supplement information from the SSEP and to explore a range of potential hydrogen supply and demand outcomes around the single SSEP pathway.

Supply and demand

Different datasets are required for the hydrogen supply and demand data for our three models:

- **National strategic view model** – This model will use data from SSEP available at a zonal level from 2030 to 2050, which is consistent with the approach taken by the CSNP for electricity. This will be supplemented by FES to provide sensitivity around the uncertainty associated with hydrogen and the reliance of the CSNP for gas on FES. The model offers a long-term view of hydrogen network needs, which will be further supplemented with the short- and medium-term models discussed below.
- **Industrial cluster system model** – The cluster model will be based on short-term granular data that includes specific site or project level information. This includes hydrogen supply projects, demand customers and storage projects and the network routes connecting specific locations of these sites. Where possible, data will come from NESO's existing datasets or from external stakeholders who already hold the information or engage with end-users.
- **Broader industrial view model** – The data will include information on hydrogen supply, demand and storage at both site and national levels. It will go beyond the



initial industrial cluster system, considering potential regional and connection to national networks.

Additional details on the datasets we will consider in our three models are outlined below.

Strategic Spatial Energy Plan (SSEP)

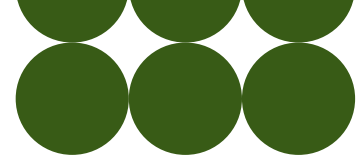
The SSEP will plan across GB and map potential locations, quantities and types of electricity and hydrogen production and storage infrastructure from 2030 to 2050. It will consider interactions between hydrogen and electricity systems, including electrolytic hydrogen production and hydrogen to power, as well as the role of hydrogen transport and storage within the whole energy system. These technologies will be spatially optimised on a zonal basis. The SSEP will include demand such as the use of hydrogen as a feedstock chemical, an energy vector for heat, power and transport and a precursor for hydrogen-derived fuels. It will also consider natural gas demand as a feedstock for hydrogen production from methane reformation. Hydrogen-related technologies considered within the SSEP modelling are set out in Table 29.

Table 29: Hydrogen production, storage and transport technologies considered within the SSEP

Hydrogen production	Hydrogen storage	Transport
Proton exchange membrane (PEM) electrolyzers	Salt caverns	Transmission pipelines
Autothermal reforming (ATRs) with CCS	Depleted gas fields	Trucking/tube trailers
Hydrogen from biomass with CCS	Lined rock caverns	
Steam methane reformers (SMRs) with CCS	Above ground tanks	

Although hydrogen transmission and distribution are not clearly defined, the SSEP adopts assumptions on the transportation of hydrogen to plan alongside electricity transmission and evaluate future needs. In the SSEP, data sources and assumptions primarily come from DESNZ¹⁵⁰. SSEP's initial economic modelling assessment assumes a single cost for pipelines; this cost is associated with new build hydrogen transport. This is due to the uncertainty over when existing assets will become available for retrofit to hydrogen and the uncertainty of the cost of retrofitting transmission pipelines relative to new build, which can vary over 2030–2050 depending on the characteristics of each pipeline. The use of a singular cost for transmission capacity aligns with the approach used for the power sector, which does not differentiate overhead, underground or subsea cables. Beyond this, sensitivity analysis will be carried out to understand whether varying hydrogen pipeline costs leads to a different outcome. This is needed to ensure the robustness of the modelling outputs. This will result in a clear view of high-level hydrogen network needs

¹⁵⁰ NESO, [neso.energy/document/371386/download](https://www.neso.energy/document/371386/download)



established through SSEP in the Drive stage, the options for which can be evaluated within the CSNP. While a singular cost is assumed for hydrogen pipelines in the Drive stage of the CSNP for hydrogen, we expect to obtain the costs and life for both repurposed and new-build options from third-party submissions during the Develop stage. Where possible, these inputs will be used along with cost library values for new-build and repurposed assets in the Appraise stage of the CSNP for hydrogen.

The SSEP will establish a single pathway covering hydrogen production, storage and flows across boundaries. The modelling outputs will include required hydrogen transport capacities between zones for the pathway. The outputs will also provide the capacities of hydrogen storage, different hydrogen production technologies and hydrogen-to-power (H2P) plants required within each zone. These outputs are a result of the SSEP's spatial and economic optimisation. The capacities of electrolyzers and H2P plants required in each zone are a result of the co-optimisation of hydrogen and electricity systems. These will be used to inform the core hydrogen transport and storage needs for the national strategic view.

As outlined in the SSEP methodology¹⁵¹, the main source of data inputs into the SSEP economic modelling is from DESNZ. To facilitate transparency of the SSEP process, the economic data inputs (or a list of datasets used in the SSEP) will be published alongside the draft and final SSEP documents, where possible. This will allow transparency of the assumptions from the SSEP that underpin the CSNP.

There is substantial uncertainty around the future of a global hydrogen market, with the long-term supply and demand balance of major economies and their resulting role in hydrogen trade still unclear. For this reason, the SSEP has not considered international hydrogen import and export via pipeline or shipping in the current iteration. The first iteration of the CSNP therefore also does not include cross-border import and export of hydrogen as it builds on SSEP modelling outputs in which GB supply meets GB demand. Whether future CSNP iterations consider hydrogen trade will depend on if this is incorporated into the next SSEP cycle. These SSEP details are included to address gaps in understanding of hydrogen data inputs, which were highlighted through engagement with hydrogen industry stakeholders in autumn 2025 and subsequent internal and external reviews.

FES pathways

The FES pathways provide four separate views of supply and demand across GB for each year from now until 2050. FES 2025 also provides a 10-year forecast. FES therefore sets out a range of outcomes for future hydrogen supply and demand, with datasets and methodologies underpinned by an extensive programme of stakeholder engagement.

We will use assumptions and methods from FES to inform our national strategic view, industrial cluster system and broader industrial view models where appropriate. While the

¹⁵¹ NESO, [neso.energy/document/360501/download](https://www.neso.energy/document/360501/download)



SSEP is the primary input to our national strategic view model to establish hydrogen network needs, use of FES will allow us to explore network needs against higher or lower hydrogen demand where appropriate. Datasets from FES, such as the hydrogen asset database containing site-level information on hydrogen supply projects, can be used to support the industrial cluster system and broader industrial view models. This way we can ensure that our hydrogen network planning is flexible against the backdrop of uncertainty of future hydrogen supply and demand, while using credible datasets and reliable methods. Where appropriate, we will determine the most suitable approach for integrating the data produced through the CSNP hydrogen process into the FES process.

Natural gas network planning is primarily underpinned by FES alongside natural gas demand for power generation and hydrogen production within the SSEP. The use of FES will allow the hydrogen and natural gas systems to be planned on a coordinated basis, accounting for the potential repurposing of gas network assets to transport hydrogen.

Other inputs

Where possible, we will supplement assumptions on regional demand with more granular project level data to support more granular modelling of our industrial cluster systems and broader industrial view models. We will apply insights from the Cost Optimisation Modelling for Industrial Technologies (COMIT), used by the UK Government to shape industrial decarbonisation pathways, to enhance our modelling approach. The COMIT model assesses site-level decarbonisation options for industrial sectors and identifies the most cost-effective combination when optimised at GB level. These outputs may be aggregated at cluster level to improve overall reliability.

We also expect some project data to come forward through local engagement from the RESP development, which will also feed into future iterations of the SSEP. While we intend to work closely with RESP teams to align our regional data and assumptions where possible, this is unlikely to be mature enough to provide all required information on the timescales required for the first iteration of the CSNP. Due to the absence of a formal feedback loop between CSNP and RESP at this stage, we intend to set up a process to share data and insights across our teams and ensure coherence wherever possible.

We work closely with the UK Government on how the hydrogen business models interact and inform our strategic plans. We will consider how we can best incorporate any associated information related to hydrogen business model submissions to inform our assumptions related to specific projects and will also incorporate any relevant updates from the UK Government's hydrogen strategy. We will look to review the projected hydrogen demand against the direction provided by DESNZ hydrogen strategy priority. Additionally, we will use the outputs from the Climate Change Committee's (CCC) Seventh Carbon Budget (CB7), where appropriate.

We have engaged with network operators to understand the forecast data used to support their project developments. We are currently awaiting some of this data and will continue these engagements to simplify inputs. We also engaged with hydrogen industry stakeholders in autumn 2025 through a series of workshops to identify the additional



datasets and sources that should be considered for hydrogen modelling. Based on this engagement and our wider work, we have identified the following stakeholder categories:

- cluster leads and other regional organisations (such as Scottish Enterprise)
- developers of hydrogen and CCS infrastructure
- other relevant stakeholders identified during the workshops

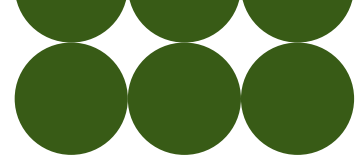
We will engage with these stakeholders, focusing on the following themes:

- Timelines and dependencies - Development schedules for key projects and associated policy or infrastructure dependencies.
- Assumptions and data - Hydrogen production, transport, storage and offtake expectations. This will involve gathering data from existing analysis, including information on new-build and repurposed options as well as hydrogen blending.
- Demand drivers - Anchor projects and site-level demand forecasts for industrial users.

The workshop with hydrogen stakeholders in autumn 2025 provided a direction to engage with key stakeholders and establish a coordinated approach with other workstreams to create a single source of data. We have had initial engagement with some stakeholders in these categories and on the identified themes. During the Drive process, we will apply a more structured approach as follows:

- We will work closely with NESO workstreams (such as RESPs) to ensure coherence. This includes activities such as engaging with teams to identify shared objectives, establish coherent processes and, where appropriate, develop a collaborative engagement plan.
- Engagement will take place through online sessions to finalise the data and initial assumptions that the identified groups can provide.
- After each session, we will share templates for data submission. Non-disclosure agreements will be prepared where confidential data is involved.
- Collected data will be processed and resulting assumptions will be shared with stakeholders for validation. We will determine the most appropriate way to share supply and demand data with stakeholders during our interactions, ensuring it is aggregated sufficiently to maintain confidentiality.

While the engagements in the Drive step are expected to be carried out prior to the SSEP publication, we will consider whether further engagement is needed as we progress with the methodology. The proposed engagement approach will ensure that bottom-up data is systematically aggregated and incorporated into the network needs case via the industrial cluster system and broader industrial view models. We will assess how it compares to the needs case established by the SSEP, which will inform our national strategic view model. This activity will also ensure that the inputs provided to the Identify step of the CSNP process are robust and transparent.



Resilience and security of supply

Resilience will be integrated into the CSNP by using energy pathways with embedded resilience. The SSEP methodology¹⁵² sets out its approach to weather and security of supply. These sensitivities will give us a view of how input variations affect potential hydrogen flows between zones. We will also account for resilience in our modelling through the consideration of sensitivities around project supply and demand data and the effect on network flows.

In the early stages of hydrogen network development, network resilience is likely to be more limited; our primary focus in this initial iteration of the CSNP will be on the role of storage in providing resilience to the hydrogen system. Detailed assessment of injection, withdrawal and operational risks will be the responsibility of asset operators. We will incorporate the assessment of security of supply qualitatively in the Appraise step of our methodology.

¹⁵² NESO, [neso.energy/document/360501/download](https://www.neso.energy/document/360501/download)



Identify

To transport hydrogen from where it is produced to where it is needed and manage imbalance between supply and demand, hydrogen networks and storage will be needed at some level. This step will set out those requirements.

As GB decarbonises, there will be a role for hydrogen to meet future demand in some sectors. The distribution of hydrogen supply, demand and storage sites will drive the need for some level of network required to connect these various locations.

Given the absence of an existing hydrogen transmission network, identified system needs are derived from modelling assumptions and scenario analysis rather than observed network constraints. These needs will be refined iteratively based on input from the energy pathways we are considering from the SSEP and FES. To get hydrogen from where it is produced to where it is used, a hydrogen network will require sufficient transfer capability to move this energy. This could start small with point-to-point supply, expanding to hydrogen networks, then wider networks within clusters, then connections between clusters where they are most critical and, lastly, if there is any justification for a national network.

We will need to develop hydraulic models of the potential hydrogen network at this stage to better understand potential flows and the impact on the required physical characteristics of the network. We will identify suitable existing software for this process and carry out analysis of potential hydrogen network needs.

We will produce a system requirements publication at the end of this step, setting out hydrogen network requirements including the evolution of these requirements between today and 2050. This will give sufficient detail for third parties to develop hydrogen network and storage options to be considered within our Appraisal process and potential phasing of projects.

We will be engaging with stakeholders around the system requirements publication and in the Develop step. We will also provide guidance for participants on their submissions:

- minimum organisational requirements for option submission relating to stakeholder licence ownerships or their experience in hydrogen infrastructure projects
- physical capability needs for the hydrogen network by defining physical characteristics such as pipeline diameters and operating pressures
- total annual minimum, typical and peak inter-zonal energy flows expected for each year
- options submission window, which will open following publication of the system requirements have been published



- estimating costs for suitable options and strategic choices such as new build or repurposed assets so that different routing considerations can be coherently assessed

We will establish standardised documentation and templates for filtering option submissions. Any options that are not progressed will be transparently documented, including a technical description of the reinforcement option, justification for filtering in relation to the requirements in the working documents and corresponding evidence. More detail on working documents to be published is given in the [Develop step](#).

Boundary zones

A hydrogen network will allow the transport of hydrogen between locations for production, demand and storage. On the gas and electricity transmission systems, we analyse the available capacity to move energy across network boundaries. Boundaries split the network into multiple parts that enable the assessment of network capacity between areas where limitations may be encountered. These boundaries are established based on existing network conditions and where constraints occur today and in the future. For hydrogen there are no existing network constraints, so we need to consider the most appropriate way to model the network needs.

Hydrogen network flows will be influenced by both existing gas and electricity network capability. Using electrolysis to produce hydrogen and transporting it using a hydrogen network provides an alternative way to move energy within GB compared to using the electricity transmission network. This means that it is important to be able to analyse hydrogen flows across electricity network boundaries in order to evaluate whole-system options for GB energy networks. The potential for the repurposing of portions of the gas transmission network to transport hydrogen means that boundaries and constraints on the gas network may also be important to the development of hydrogen network options. The boundary zones used for gas transmission network analysis (Figure 44, under “zones” in section 4, Identify step) do not align with the zones used to model the electricity network (Figure 54).

We have chosen to align the boundaries considered for hydrogen with those used for electricity network analysis as this will ensure that the whole plan is coherent and we are able to build on the SSEP analysis of economic trade-offs between electricity and hydrogen network growth. Gas network options can then be analysed to understand how they could be repurposed to meet these hydrogen transport needs between zones and the corresponding impact on the gas network of removal of the gas asset analysed separately to understand the deliverability of that repurposed option.

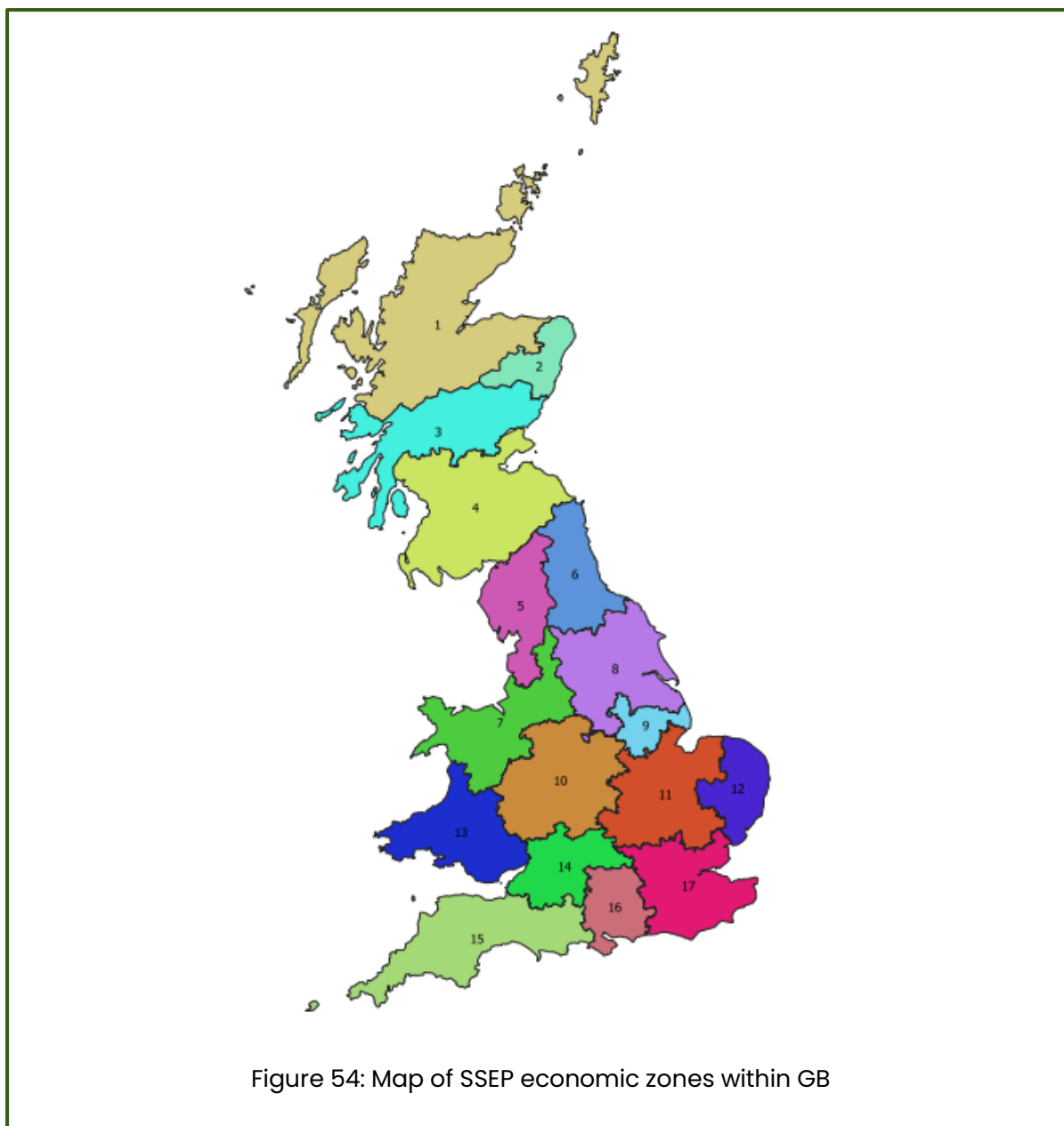


Figure 54: Map of SSEP economic zones within GB

The SSEP is based on 17 economic modelling zones primarily designed to reflect existing boundaries on the electricity system, but which has split northern England into two zones to test whether a trans-Pennine hydrogen pipeline might be required. We will use the same boundary zones used within the SSEP for hydrogen network analysis, specifically to inform our national strategic view models. Aligning to the modelled electricity network boundaries allows for whole system evaluation of trade-offs of the most cost-effective way to move energy across already constrained electricity network boundaries. We can then consider how gas assets crossing those boundaries could be repurposed to transport hydrogen and use our gas network modelling capability to understand the impact of the removal of those gas assets from the gas network.

Within the CSNP, we consider only onshore hydrogen infrastructure; where offshore hydrogen storage projects are developed, these will be modelled based on their intended



onshore connection point and its surrounding zone. The boundaries used may evolve over time depending on future network needs.

Initial industrial clusters are developed in specific locations around existing industrial demand. While these might form the initial kernel of a zone, with growth out beyond this, we would expect the bulk of network development associated with each of these clusters to take place within a single SSEP economic zone. For our consideration of industrial cluster systems, our view is that a zonal definition is not helpful at this stage of hydrogen network planning. We will identify boundaries and constraints as we develop our analysis in this area.

Network analysis

We intend to carry out network analysis using hydraulic network modelling software to analyse potential hydrogen network configurations and simulate hydrogen networks under different conditions. We will develop both steady state models (where the flows of hydrogen are constant over a reference timeframe) and transient models (where anticipated production and consumption profiles are considered). This will help us understand how the modelled network performs and help establish the capability requirements for a future hydrogen network. Initial hydrogen network analysis is likely to be simpler than methane network analysis, as the initial hydrogen network models will be less complex than the current gas network configuration.

Initial industrial systems

The initial evolution of the hydrogen system is likely to be based around vertically arranged structures designed to connect a small number of specific production facilities with a small number of industrial consumers and potentially power generation and storage. It is unlikely that a liquid traded market will materialise in these situations.

NESO expects that the characteristics of each user (typical and extreme production/consumption patterns, sensitivity to external stimulus such as weather or market prices, etc.) will be considered by the project developer(s) in developing the cluster plan. For hydrogen, these considerations must be explicitly built into the design of both the transport network and the associated storage requirements. This means that matters which in the gas market are covered by both storage in the network (such as linepack) and commercial storage will be considered when designing both the transport and storage requirements for the system.

Many early industrial consumers are likely to initially retain gas (methane) supply, as back-up or to optimise hydrogen use and blend on-site. Assuming that hydrogen production could be turned down or off should the need arise, it may be that the need for hydrogen storage in these systems is limited initially in some circumstances. We will explore the impact of assumptions of retaining methane connections on the ability to repurpose gas network infrastructure.

The industrial cluster approach will be a bottom-up view from clusters of local hydrogen demand/supply. Inputs from DESNZ modelled industrial site-by-site modelling (COMIT),

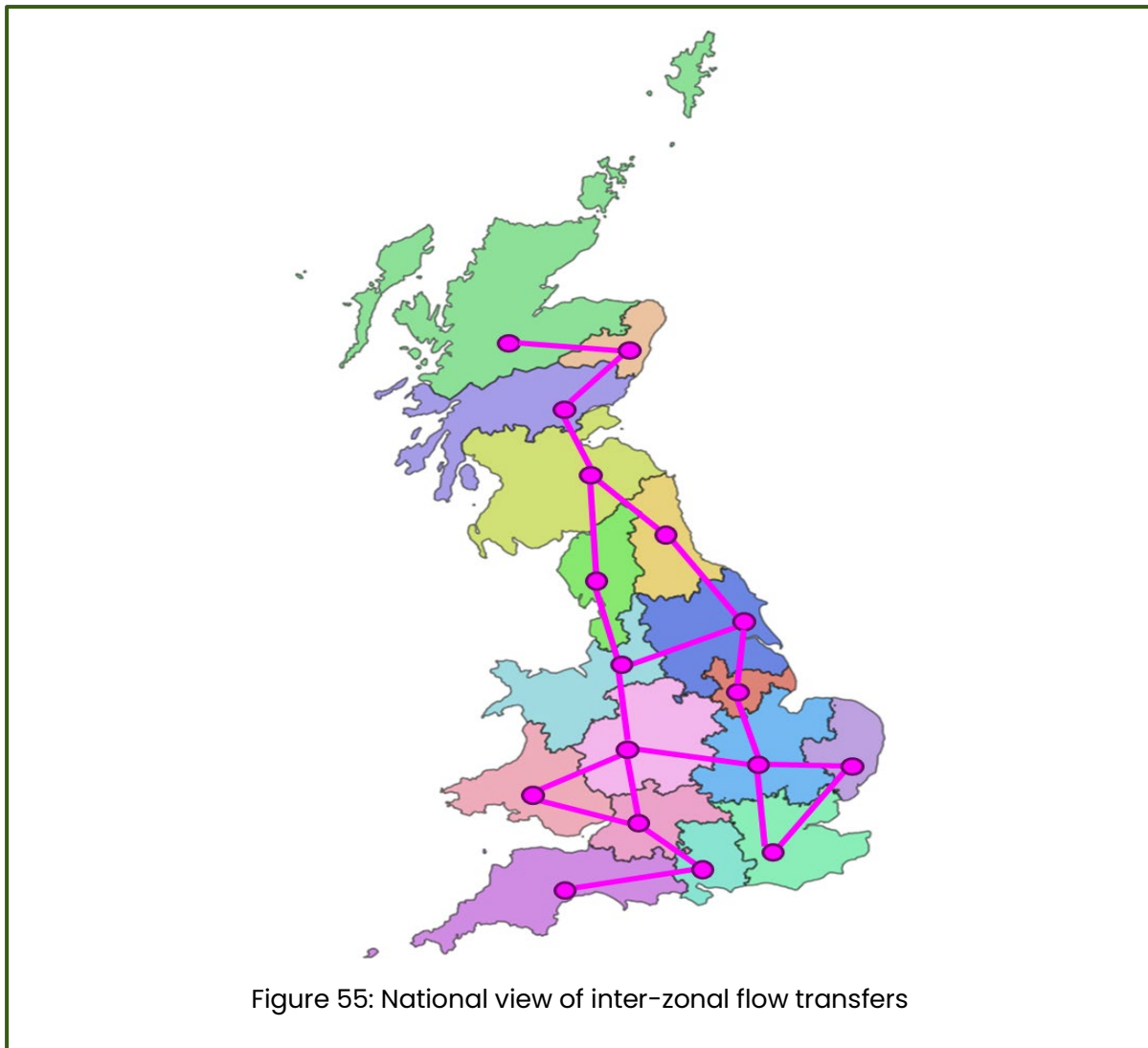
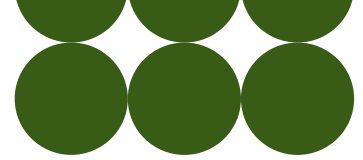


FES hydrogen project supply database and other stakeholder data will be used to model individual offtakes within the industrial clusters. These individual offtakes will be aggregated to single nodes within each zone which will in turn inform the national view of inter-zonal transfers as seen in Figure 55.

National strategic view

The SSEP will define whether there is a strategic need for a national hydrogen network. It will also consider the need for hydrogen storage within each modelled zone, subject to geographic constraints on where this can be developed. The SSEP will model the period between 2030 to 2050, starting from a 2030 which will comprise the network and generation included in the UK government's Clean Power 2030 Action Plan and projects which have regulatory funding. It will provide a view of hydrogen flows across boundaries during this time horizon. Flows across some boundaries may be low or zero, indicating that there is not a need for hydrogen transport between that pair of zones.

When evaluating network needs, we will need to consider the maximum flow across boundaries across the full-time horizon so that the hydrogen network can be future-proofed and developed with sufficient capacity to meet future needs, not just those related to short-term project development. The SSEP will be considering the trade-offs between different types of storage across electricity, gas (via gas-fired power generation and hydrogen produced from methane reformation) and the hydrogen systems. The SSEP will also produce views on the possible location and capacities for both electrolysis and hydrogen-fuelled power generation, to maximise whole energy system value. The SSEP will therefore identify a requirement for hydrogen storage that is strategic in nature and designed to cope with seasonality and variations due to weather.



Using the SSEP outputs of the hydrogen flows between zones, we will:

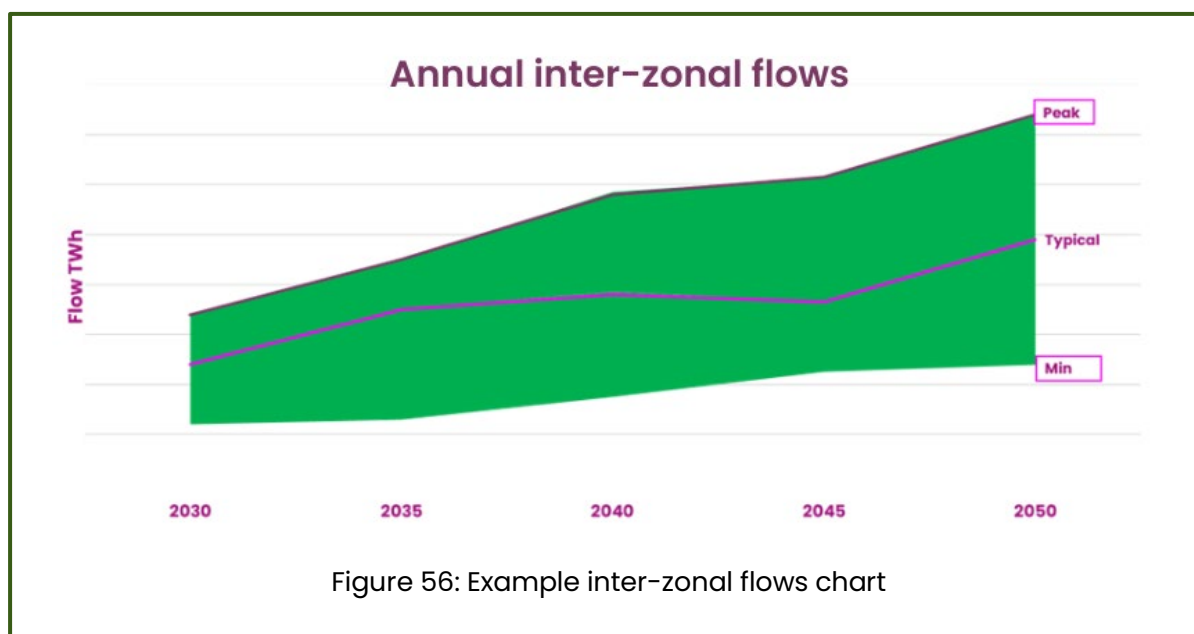
- produce a high-level view of capacity needs, while working with industry to develop agreed guiding engineering standards to adhere to
- develop initial hydraulic models which will provide us with a better definition of physical characteristics such as diameters and operating pressures
- provide an indicative view of typical and peak energy inter-zonal flows around supply/demand against weather scenario sensitivities particularly related to electrolysis and hydrogen to power
- consider more detailed representations of supply and demand characteristics and, through linepack studies, the need or ability for the network to provide balancing services, the need or opportunity for using compression to improve network efficiency and the need to consider interactions with storage facilities
- evaluate potential donor pipelines from the natural gas networks for suitability (given pressure, diameter, linepack cycling constraints)



- explore the growth of the hydrogen network over time, considering phasing of different connections

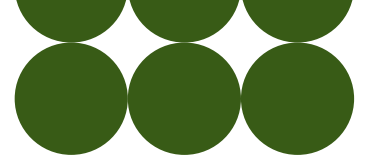
These models will set the basis for the analysis that will identify the hydrogen network system needs. We will consider appropriate sensitivities around the inputs from the SSEP to understand variation around our central expectation for annual and peak network flows.

Figure 56 illustrates the annual energy flows across a boundary by showing the minimum, typical and peak energy flows expected for each year. The horizon covered by the chart will extend out to 2050. We will explore these details for each zonal transfer considered. However, it is likely that not all zones will have a hydrogen uptake.



Broader industrial view

We will consider how hydrogen networks will need to evolve beyond initial industrial clusters. This will involve modelling of projects under development in and around clusters and the potential for connection to initial cluster networks. The supply and demand inputs from the Drive process will highlight the potential locations from which hydrogen needs to be transported out of the industrial clusters. Subject to the outputs of the SSEP defining the scale of any required national hydrogen network, it will include the transport of hydrogen for connection of clusters to a national network or the potential for connection together of specific clusters. We will develop network models based on these requirements and explore the need for hydrogen networks and storage against our supply and demand inputs, before sharing our expectations on the potential network development needs. The constraints on gas transmission, if any, arising from the potential network within each SSEP zone will inform whether additional boundaries are required or whether the existing ones need to be restructured. Inter-zonal transfers across these boundaries will be addressed in a manner consistent with our national strategic view model.



Hydrogen network standards

The Health and Safety Executive (HSE) is the independent regulator for workplace health and safety. When working with hydrogen, the safety of employees and the public must be ensured, in line with existing duties under the Health and Safety at Work etc. Act 1974 and subsidiary legislation. In the absence of an established safety regime for hydrogen transportation that is equivalent to gas transportation, we propose producing a set of consistent minimum technical requirements that options would need to meet. We will contribute to ongoing work in this space from DESNZ, the HSE, gas networks and the Institution of Gas Engineers and Managers (IGEM) to agree these minimum requirements. We will seek to adopt existing standards, definitions and practices where possible.



Develop

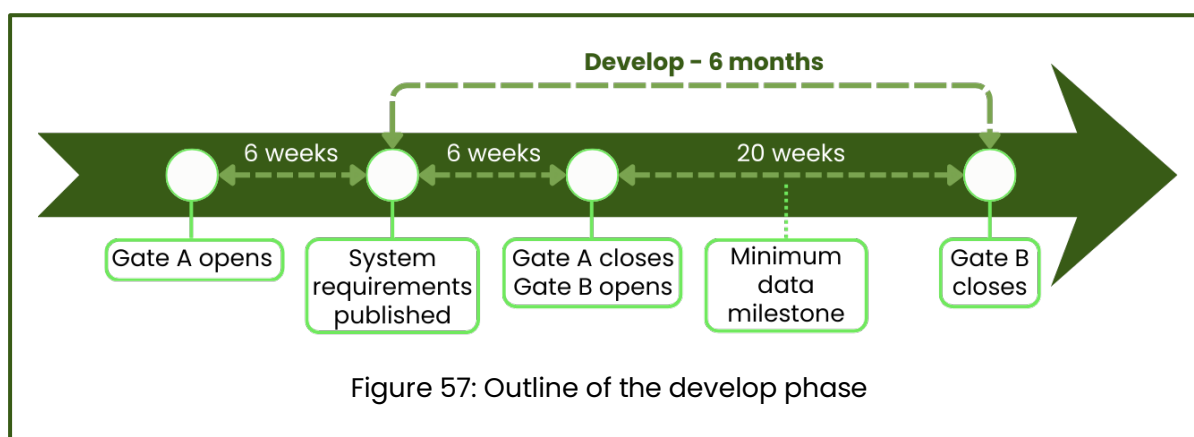
The Develop step outlines the approach for developing options that could meet the system requirements outlined in the Identify step and the roles of NESO and third parties in this process.

The hydrogen network capability needs identified as part of our system requirements analysis will identify the physical capability needs for a future strategic national hydrogen network. Following the Identify step, parties can identify a range of network and storage options that could meet this need, for NESO to subsequently consider. Those able to present hydrogen network options could include licensed gas network asset owners such as NGT or GDNs, as well as third parties across the hydrogen sector. Options developed could include new build hydrogen network, storage assets or the repurposing of existing gas network assets to transport or store hydrogen.

We have worked with stakeholders to test a suitable options development process to ensure a consistent, robust and transparent approach to identifying suitable options and strategic choices such as new build or repurposed assets and so that different routing considerations can be coherently assessed. The process will broadly align to that utilised by third-party electricity submissions. However, due to the expected lower number of submissions relative to electricity, filtering of options shall be kept to a minimum to allow for the consideration and comparison of the greatest number of options.

The precise mechanism and form of data submission to NESO of options will be defined, along with timetable for the submission of draft and final options to be considered through the CSNP governance, based on the information in this methodology.

High-level approach/gate process



The Develop phase will be split into two gates, as seen in Figure 57. Progression through gates will require the completion of forms and the submission of evidence and technical data by applicants. The overall process utilised by each gate will be broadly similar and



will be managed in a single platform. The requirements of each gate will be published in “working documents” prior to their opening, ensuring clear communication of expectations for participants and for NESO. Feedback and clarifications will be enabled from both sides from the publication of the documents through to gate closure and will be tracked within the platform. Where appropriate, meetings between NESO and applicants may be requested through the portal and these occurrences will be limited per party to ensure equitableness.

Upon gate closure, applicants may be omitted. Any options that are not progressed will be transparently documented, including a technical description of the option, justification for filtering in relation to the requirements in the working documents and corresponding evidence. We will establish standardised documentation and templates to ensure the filter is applied consistently. NESO may request additional information or decide to progress filtered options if it sees benefit.

The duration of each gate, submission requirements as well as the feedback mechanisms are being developed in collaboration with stakeholders to ensure a transparent and appropriate process.

Initial filtering/Gate A

All applicants wishing to submit options will need to meet minimum organisational requirements relating to their current licence ownerships or their experience in hydrogen infrastructure projects. An initial pre-filtering gate, Gate A (figure 78), will be utilised to ensure these conditions are met and will be opened prior to system requirements being published.

Following the publication of the system requirements document, during Gate A, NESO will also request applicants to submit a project synopsis summarising the option being brought forward, its maturity and its associated system requirement. This will provide NESO with an early view of options being submitted. This submission will not be assessed.

Option development/Gate B

Gate B will accumulate all information needed to carry out the subsequent Appraise process. Data will be gathered iteratively with a formalised feedback mechanism, allowing queries to be submitted and tracked from both sides.

During Gate B, NESO will look to carry out initial network modelling in order to identify network solutions. Data submitted during Gate B will be combined with the indicative network models produced as part of the Identify step to produce variations of initial network models. These models will be used to assess the capability of the network options submitted and will be compared against the capabilities needs highlighted in the system requirements document. In the event requirements are not being met, NESO will look to bring forward their own options to feed into the Appraise step. In future iterations of the CSNP, we would anticipate developers taking options brought forward by NESO and developing them further.

The modelling outlined above will require certain technical data, the submission of which will be required within Gate B. This will allow NESO the necessary time to identify system needs not being met and develop their own options. The data required will form a



minimum data submission, which will be outlined prior to the gate opening. The submission of the minimum technical data will be its own milestone within Gate B but prior to gate closure.

Options submitted to NESO will vary in their maturity and detail. During Gate B, NESO will support applicants with reference to standardised and consistent assumptions when there are gaps in certain data fields. There will be some required data that applicants will have to provide in order to progress from Gate B. Clear communications outlining mandatory data fields and the non-mandatory fields NESO will support, will be published prior to Gate B opening.

Any options that are not progressed will be transparently documented, including a technical description of the reinforcement option, justification for filtering and corresponding evidence. We will establish standardised documentation and templates to ensure the filter is applied consistently. NESO may request additional information or decide to progress filtered options if it sees benefit.

Other considerations

Operability and strategic options

As the hydrogen system develops and a market emerges, there could be opportunities for providing additional security of supply or growing additional demand where there is additional storage available to the emerging market. We will therefore seek to identify opportunities for bringing forward options for delivering hydrogen storage where there is an apparent system benefit.

Repurposing or new build

We encourage the development of a variety of options, including options delivered by new build and repurposed assets for the transport of hydrogen to meet capability needs. One will not be given priority over the other; where both new build and repurposed options have been developed that meet the same requirement, they should both be put forward to the Appraise stage.

Where options are identified that include repurposing of gas network assets, we intend to consider the impact of the removal of these assets from the existing or future gas network. Both economic and qualitative assessments will be carried out in the Appraise step to ensure risks are highlighted and standards are met in the event an asset is removed from the gas system. NESO will also model repurposed assets steady-state and transient behaviour under hydrogen conditions, as well as ensuring the entry and exit capabilities are both safe and resilient. This will ensure that network development is done on a coordinated, whole-system basis ensuring security of supply.

Options based on repurposing of existing gas network assets will be economically evaluated against new build assets. Asset owners of existing gas network assets suitable for repurposing, such as NGT and the GDNs, would be expected to identify these options and bring them forward. We would expect a party proposing to use re-purposed assets to have explored the impact of removal of the asset from the existing natural gas network.



Network modelling

As options are submitted, we will integrate their information into our network models, applying this across each of the different network scales described below.

Industrial cluster systems

We are expecting to review the developers' plans and to construct models of the cluster systems to test the potential characteristics of each user in that system. We will use these models to understand the network operation and flows of the cluster systems and to consider the performance of any alternative facilities that may have been proposed, either by third parties or by NESO, for networks and storage.

National strategic view

We will build the characteristics of submitted options into our national network models to understand how these meet the needs identified in the previous step, how these characteristics might affect network flows and to develop overall network configurations.

For storage, we will consider the results of the SSEP and assess any options proposed internally or by third parties by considering both the longer- and shorter-durational factors. Options might include above-ground steel containment or geological storage. It might be that we need to consider combinations of options so that the underlying need can be met. We will not conduct a more detailed commercial evaluation of proposed storage options. Our assessment will aim to identify the most economically effective option or combination of options that meet the needs identified.

Broader industrial view

For the broader industrial view analysis, similar to the initial industrial cluster analysis, we will consider developers' (and any other) network and storage options submitted and assess them against anticipated production and consumption profiles. However, the analysis will be supplemented by national strategic view analysis, and we will also consider whether there are synergies in aligning needs and/or options. We will consider how options submitted meet the hydrogen network needs produced as part of the Identify step. Furthermore, we will seek to analyse the impact on both new and existing electricity and natural gas infrastructure with guidance from "Valuing infrastructure spend: Supplementary guidance to the Green Book", notably the guidance on evaluating interdependence and resilience.

Throughout Develop and Appraise, we will adhere to the principles of transparency, robustness, consistency and reproducibility. We will ensure coordination between network plans for each energy type when evaluating options. Where there are impacts from a hydrogen option on the electricity or gas networks, these will need to be evaluated and reviewed for consistency with the corresponding network plan.



Appraise

This chapter sets out the approach NESO will take to evaluate network designs developed during the Develop step, with the aim of identifying an optimal network solution.

The Appraise step will deliver a comprehensive assessment of each design, considering economic, environmental, community, deliverability and, where feasible, operability aspects. It will provide the evidence base for setting out the most appropriate options for the development of an optimal GB hydrogen network. The same decision framework will be applied to the three modelling granularities we outlined previously: industrial cluster systems, national level and broader industrial view.

Our options assessment process will follow a consistent approach to that used for gas and electricity where possible, while taking into consideration the greater level of uncertainty associated with an emerging hydrogen network. HMT's Green Book supplementary guidance documents will also be considered as reference materials¹⁵³. For hydrogen, we intend to provide analysis of hydrogen network options to identify optimal solutions at the end of this step. In contrast to electricity and gas (where a defined minimum or "do-nothing" baseline exists for comparative purposes), the hydrogen network does not yet possess an equivalent reference case within the CSNP framework. To address this, we may consider alternative baselines, such as the use of hydrogen transport by road (for example, trucked hydrogen) or proceed without a baseline option where this is methodologically appropriate.

Recognising the uncertainty inherent in early-stage hydrogen network development, economic appraisal outputs should be interpreted comparatively rather than as precise measures of absolute value. Sensitivity analysis will also be undertaken to support confidence in decision-making.

The economic assessment, together with evaluations of environmental impacts, community impacts and risks related to deliverability and operability, will be used to substantiate the selection of the optimal hydrogen network option. We will engage with DESNZ to ensure that any emerging insights from our work contribute to their ongoing policy and investment decisions.

¹⁵³ For capital and operating expenditure within the economic assessment, NESO may consider using "Valuing Infrastructure Spend: Supplementary Guidance to the Green Book." For emissions, NESO may refer to "Valuation of Energy Use and Greenhouse Gas (GHG) Emissions" or "Accounting for the Effects of Climate Change."



Decision-making framework

We will conduct a thorough evaluation of all investment options identified during the Develop step. These may include individual submissions or combinations of options, depending on the capability requirements of the hydrogen network. The five assessment criteria will be used to undertake its appraisal, described below.

Economic

Economic modelling, using cost-benefit analysis based on net present value (NPV), will be employed to inform and promote network designs that are efficient, well-coordinated and economically optimised, thereby delivering demonstrable value to consumers. The analysis will encompass direct economic impacts, including capital and operational expenditure, any potential commercial benefits and the costs associated with carbon and other emissions. Furthermore, it will incorporate monetised assessments of environmental and community impacts, as well as considerations of deliverability and operability, collectively referred to as 'ECDO'¹⁵⁴.



Environment

We will use geospatial data and information to consider risks associated with emissions, as well as impacts to factors such as historic environment and biodiversity.



Deliverability

We will appraise deliverability, considering technology readiness, the supply chain and other factors to ensure the preferred network design can be practically delivered.



Community

We will use geospatial data and information to consider risks to communities, such as to local economy and recreation.



Operability

In the absence of a well-established hydrogen market, the opportunity for consideration of operability will be limited, but where possible this will be considered at a high level.

¹⁵⁴ The ECDO matrix is also applied in the electricity and gas methodologies within the CSNP. While the overarching framework remains consistent, the detailed methodology for hydrogen will differ.



Appraisal assessment

Table 30 provides a breakdown of details we will consider when assessing the options.

Table 30: CSNP appraisal criteria and assessments

CSNP Criteria	Assessment categories	Description	NPV or Assessment
Economic	Direct economic – capital costs	Costs associated with the design, planning, building and decommissioning (at the end of the assumed operational life) of the investment options	NPV
Economic	Direct economic – operating costs	Costs associated with the operation and maintenance of the investment options	NPV
Economic	Commercial benefits	Costs when hydrogen flows on the proposed hydrogen network constrained	NPV
Economic	Impact on existing gas network	Costs occurred on gas network from re-purposed pipeline (constraints, emissions, maintenance)	NPV
Economic	Monetisation from ECDO – emission costs	The cost of carbon emissions as part of community impact incurred as part of an investment option	NPV
Economic	Monetisation from ECDO – benefit on electricity network constraint	The benefit of developing hydrogen network on managing electricity constraint as part of community impact	NPV
Environment and community	Environment and community	The impacts of implementing the option against HRA and SEA legislation	ECDO risk assessment, whole system HRA, SEA, and MCZ assessment
Environment and community	Community	The extent to which these options ensure network security of supply, promote and maintain safety for the consumer	ECDO assessment
Deliverability	Deliverability	The likely complexity in implementing the option and the technology readiness	ECDO assessment
Operability	Operability	In the absence of a well-established hydrogen market, the limitation of opportunity for consideration of operability, but considered, where possible, at a high level.	To be developed

The content of the assessment types will be outlined in subsequent sections. The exact context of consideration will vary depending on the view being considered.



Economic

Economic modelling is conducted using cost–benefit analysis (CBA), with net present value (NPV) employed to quantify and compare the costs and benefits of proposed interventions. The assessment captures direct economic impacts, including capital expenditure (CapEx) and operational expenditure (OpEx), societal carbon costs as part of community impact, associated commercial costs and other monetised effects of environmental and community impacts, alongside considerations of deliverability and operability (ECDO). Analysis will be carried out in line with guidance and assumptions from HM Treasury’s Green Book¹⁵⁵.

Unlike gas and electricity economic assessments, where network constraint costs typically represent a significant component of the analysis, hydrogen systems do not yet operate within a fully developed market framework. As a result, network constraints and the associated constraint costs are not currently well characterised for hydrogen networks. We will explore the most appropriate approach for incorporating the associated commercial impacts into the economic assessment.

1. Direct economic assessment

Capital and operational costs associated with an option are assessed to further understand the financial costs of an option over its expected life (the direct economic impacts of a given proposal).

When assessing the direct costs of an option, we will consider:

- capital investment costs for designing, constructing and commissioning any new assets on, as well as its eventual decommissioning cost
- capital investment costs for repurposing assets on the gas networks
- expenditure associated with operating and maintaining the newly commissioned assets or repurposed assets for their expected life, which could include the changes to both fixed operational costs and variable costs, such as fuel
- economic factors associated with managing imbalance on the hydrogen network if required

Where an option requires the installing of new assets, in line with the recommendations included in HM Treasury’s Green Book, we will include the cost of decommissioning those assets from the hydrogen network at the end of their assumed operational life.

1.1. Capital expenditure (CapEx)

1.1.1. Option costs

It is NESO’s intention to develop a hydrogen unit cost library. The unit cost library will assist NESO in the valuation of any asset build costs (new build, repurposing or modification),

¹⁵⁵ UK government, [gov.uk/government/collections/the-green-book-and-accompanying-guidance-and-documents](https://www.gov.uk/government/collections/the-green-book-and-accompanying-guidance-and-documents)



operating costs and decommissioning costs for all investment options submitted during the Develop step.

The unit cost library will also be used as a comparison against the costing of options presented by parties bringing options forward. The methodology for developing the unit cost library will align with that described in the gas methodology where possible. It should be noted that the cost for hydrogen assets will likely hold greater uncertainty than those for gas. Further details will be released regarding this unit cost library as it is developed.

In addition to incorporating hydrogen decommissioning costs into the economic assessment, the analysis should also capture the cost savings realised when existing gas assets are repurposed for hydrogen use rather than decommissioned in later years. Typically, end-of-life gas assets incur decommissioning costs; repurposing removes this requirement, generating savings that contribute to the wider whole energy consumer benefit. The detailed methodology for quantifying these impacts will be further developed in collaboration with the gas network plan.

1.1.2. Decommissioning cost - asset life assumption

Key assets installed on the NTS (such as compressors, pipes and valves) are usually assumed to have a design life of up to 45 years. However, the useful life of hydrogen network assets is currently uncertain, particularly given potentially different assumptions for new build or repurposed assets. We would not expect new build hydrogen assets to be decommissioned ahead of 2050, but we will agree best practice assumptions for decommissioning cost modelling with industry in this area.

1.2. Operating expenditure (OpEx)

OpEx comprises site operating costs, compressor fuel costs, site maintenance costs and any other relevant operating costs as required. The maintenance costs of repurposed gas assets may differ from new build assets and would therefore be assessed accordingly.

1.2.1. Compressor fuel costs

Options may affect compressor fuel usage. Changes in compressor fuel use will be estimated by reference to calculations in our network analysis models and DESNZ fuel price assumptions. The modelling of additional breakdown costs will utilise the previously referenced cost library and further developed with industry where appropriate.

2. Commercial benefits

Hydrogen constraint costs are not currently a directly measurable metric. Accordingly, we propose to develop an alternative metric to evaluate the effective commercial benefits of the available options. This metric may, for example, be informed by the costs of alternative transport arrangements, such as the use of hydrogen tube trailers or by assessing the impacts on other components of the vertical value chain, including both producers and consumers. We will explore ways to incorporate these commercial benefits into the economic assessment.



3. Impact on existing gas network

For re-purposed gas pipeline options, additional costs may arise from operational constraints, compressor-related emissions and increased maintenance requirements across the existing gas network. Although such constraints are expected to be minimal, any material limitations could affect the feasibility of re-purposing. If any capacity constraints are identified through gas network planning activities, NESO may quantify their associated impacts for inclusion in the hydrogen economic assessment.

Re-purposing the pipeline for hydrogen may also require existing gas network compressors to operate at higher duty levels to maintain system performance. This could increase emissions and accelerate maintenance activities. We will engage with applicants to confirm whether these costs have been included in their re-purposing submissions and, if so, assess them accordingly within the economic assessment. Where they have not, we will determine an appropriate method for quantifying these impacts for integration into the economic assessment.

4. Other monetisation from ECDO

In addition to conducting a direct economic assessment and evaluating constraint costs, we will also assess the potential for monetising from ECDO, including emissions costs and other whole-system impacts of network options, such as their impact on security of supply, in line with the HM Treasury Green Book, noting that the lack of an existing market makes economic assessment more challenging.

4.1. Environmental impact – emissions costs

For each option we calculate the total cost of greenhouse gas, nitrogen oxides and particles 2.5 micrometres or less (PM2.5) emissions over the expected life of the relevant assets (the direct economic impacts of a given proposal). While different hydrogen production technologies are likely to have different levels of environmental impact, these are not captured here as these trade-offs are assessed within the SSEP.

When assessing the environmental emissions costs of an option, we will consider:

- **greenhouse gas (GHG) emissions**, recognising that cost of greenhouse gas emissions incurred in construction and changes to network operation
- **NO_x emissions**, which represent a group of chemical compounds known as nitrogen oxides, which are significant air pollutants and are regulated by the UK Government
- **particles 2.5 micrometres or less (PM2.5) emissions, which are** particulate matter with a diameter of 2.5 micrometres or less and may be produced during construction works. We will seek to align our approach with the electricity team to ensure consistency in how the costs of PM2.5 emissions are quantified

Greenhouse gas emissions

We will use HMT's Green Book supplementary guidance to quantify the cost of environmental impacts, particularly regarding the cost of GHG emissions.



Compressor station operation is a major source of GHG emissions on gas networks. In the natural gas transmission system, compressors release methane through leaks from components such as rod packing, seals, vents and isolation valves during both operation and idle periods and they produce CO₂ emissions from burning natural gas to power engines and turbines. A future hydrogen network is likely to use hydrogen- or electricity-driven compressors, which would substantially reduce emissions by avoiding fuel-related methane leakage and CO₂ from combustion. However, emissions would not be eliminated entirely, as residual hydrogen leakage from compressor components and indirect emissions from hydrogen or electricity production would remain. We will use our network analysis of options and our forecast of future flow patterns to quantify the effect of compressor-derived GHG emissions and the fuel cost on the emerging hydrogen network.

We will also consider estimated emissions due to the construction process, as well as any impact from changes to ongoing maintenance activities.

Though not defined as a GHG, hydrogen can react with compounds responsible for breaking down methane, prolonging methane's atmospheric lifetime and subsequently enhancing warming. It is therefore important to quantify fugitive hydrogen releases into the atmosphere from equipment over time. This can happen during the production, processing, storage and transportation of hydrogen and these will be considered where applicable. We will also consider impacts on any intentional hydrogen release.

To the extent that these emissions can be quantified and costed, they will be included in our economic assessment.

NOx emissions

NOx emissions arise from combustion processes and therefore could occur in numerous locations across the hydrogen value chain; for example, when compressors use hydrogen as the fuel, the higher combustion temperatures associated with hydrogen can result in increased NOx formation. The cost of these emissions can be estimated using an approach consistent with the CSNP gas methodology, whereby NOx emissions (kg per operating hour) are converted into monetary values using the National Air Quality Damage Cost figures (£/tonne). Annual changes in NOx emissions can be quantified based on compressor operating hours derived from the analysis. Noting the ongoing investment to reduce such emissions, we will estimate any significant impact an option may have on them and include the cost in the economic assessment.

4.2. Community impact - electricity constraint costs

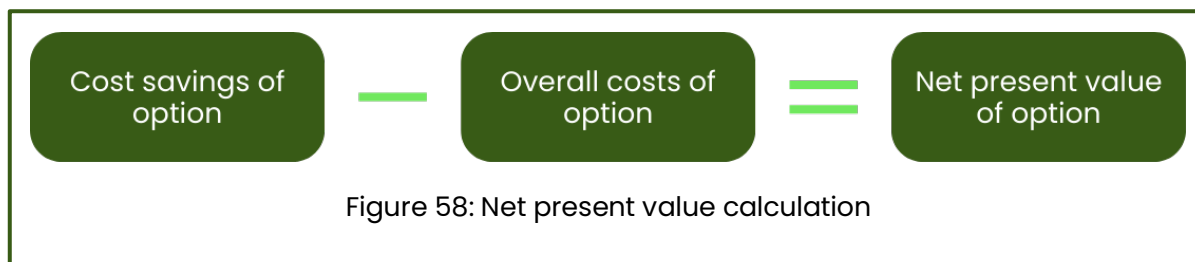
In contrast to hydrogen, the electricity network is likely to experience constraints in periods of high renewable output. Hydrogen assets (through their ability to absorb excess generation) have the capability of reducing these constraints, potentially reducing the need for electricity network investments in some scenarios. Hydrogen network solutions will be reviewed in their capacity to reduce or increase electricity network constraints. The method for monetising these benefits remains under development.



4.3. Other ECDO costs and benefits

Beyond the emission-related costs and benefits associated with managing electricity network constraints, additional costs or benefits linked to ECDO may be incorporated into the economic assessment if required.

5. Cost-benefit analysis - net present value (NPV)



We will calculate the NPV of each option to enable a consistent, like-for-like comparison across all scenarios based on the breakdown cost savings and option cost from above. The cost savings of options in Figure 58 differ from those typically seen in the electricity and gas methodology, where major savings arise from reduced constraints relative to the baseline. Instead, this option reflects broader whole-system benefits, such as improved electricity constraint management enabled by developing hydrogen network, along with environmental and community advantages. The direct benefits of a hydrogen network in reducing hydrogen network constraints are expected to be minimal and will only be included in the economic assessment if they materially influence the identification of the optimal network configuration.

Given the nature of the investment and the early-stage development context, the economic assessment is likely to produce negative NPV values across all options. Accordingly, the analysis will focus on comparing the relative NPVs of the available options to determine the most economically appropriate solution, which will be used together with the other four criteria (ECDO) to inform the overall assessment of hydrogen network options.

Environment and community

Any investment option that involves a change to the physical makeup of the hydrogen network could have local and wider environmental and community impacts. This includes impacts resulting from the construction itself, the longer-term effects of the installed assets and of changes to the operation of the network.

Environment and community impacts are assessed as distinct but related criteria, using a consistent methodological framework to allow comparative assessment while recognising their different policy and regulatory considerations. Existing work from electricity within NESO, together with external supplementary guidance such as HMT's



Green Book, can inform the approach to assessing environmental and community impacts.

NESO will identify and select optimal network projects and provide its best view of the relative merits of each proposed option, whilst minimising any detrimental effects on the environment. We are aligned with the UK Government's commitment to the protection and enhancement of the environment. The approach to appraising environment and community will follow the same methodology as outlined in the Electricity section.

This approach will consist of a qualitative and quantitative assessment. The quantitative assessment will use well defined environmental datasets and indicators to assess the impact of different options on environment and community. The outputs of the assessment would comprise a graded matrix, with a rating against each criterion to highlight the comparative potential risk of impact along with a qualitative narrative.

Environmental assessments enable us to evaluate the potential impact that investment proposals could have on the environment and to compare options based on their relative impact. We will undertake environmental assessments on a consistent basis across gas, electricity and hydrogen where possible, including an SEA and HRA. Due to the scope of hydrogen being limited to onshore infrastructure, the requirement for consideration of an MCZ or MPA assessment for hydrogen is likely to be minimal; however, there may be a need to include offshore hydrogen storage proposals within the scope of marine assessments.

Security of supply and resilience

The future hydrogen networks should provide a benefit to consumers by providing a resilient and secure energy supply. Current NESO guidance highlights the need to assess resilience and capacity of system-level factors, such as hydrogen storage, ensuring their value to hydrogen transmission.

Currently, NESO incorporates hydrogen storage and its subsequent system benefits into the CSNP. However, no security of supply standard or assessment exists for hydrogen. Therefore, the framework for assessing the resilience of the network in relation to this is limited. In the event such a needs case is identified, NESO will seek to develop a methodology (for example, by establishing a minimum hydrogen supply standard, assessing the impact of potential hydrogen storage constraints on meeting hydrogen system need) for incorporating this accordingly.

Deliverability

To carry out the deliverability assessment, we apply a similar framework against each option consistently with electricity and gas, considering a range of factors:

- **Design Complexity** – This refers to the complexity of the options that could lead to constraints against system needs and delivery dates.
- **Technology readiness** – This is the assessment of the maturity of the technology being presented that could lead to a need for further justification for safety reasons or standards compliance.



- **Supply chain** – It is the assessment of the readiness, availability of components and supplier contracts that could lead to constraints against the delivery timeline.

We will score these factors using the deliverability qualitative matrix assessment. However, the matrix provides only indicative information regarding different levels of risk. For example, limited or low technology readiness may still indicate that the underlying technology has been mature and deployed for more than ten years. As the hydrogen network does not yet exist, including building a new hydrogen network or re-purposing the existing gas network to transport hydrogen, we do not expect any proposals or options to fall into the low-score categories.

Design complexity assessment

The design complexity framework ranking¹⁵⁶ in Table 31 provides an overview of the qualitative approach used when considering the feasibility of each proposal or option.

Table 31: Design Complexity framework

Complexity scoring	Design complexity
Lowest	<p>The design components:</p> <ul style="list-style-type: none"> • means the design of new assets or re-purposed existing gas assets that have minimal complexity and disruption to implement • result in no or very low emissions increase when maintaining assets • bear no or minimal risk of delays to programme delivery
Very low	<p>The design components:</p> <ul style="list-style-type: none"> • means re-purposed existing gas assets or new build hydrogen assets with designs that have very low complexity and disruption to implement • result in very low emissions increase when maintaining assets • bear very low risk of delays to programme delivery
Low	<p>The design components:</p> <ul style="list-style-type: none"> • means re-purposed existing gas assets or new build hydrogen assets with designs that have low complexity and disruption to implement • result in low emissions increase when maintaining assets • bear low risk of delays to programme delivery
Moderate	<p>The design components:</p> <ul style="list-style-type: none"> • means re-purposed existing gas assets or new build hydrogen assets with designs that have moderate complexity and disruption to implement • result in moderate emissions increase when maintaining assets • bear moderate risk of delays to programme delivery

¹⁵⁶ The design complexity scale will be scored from 0-5, where lowest complexity is 0 and very high complexity is 5.



High	<p>The design components:</p> <ul style="list-style-type: none"> means the design of new assets or re-purposed existing gas assets that have very complex that can lead to disruptions result in high emissions increase when maintaining assets means new projects on the hydrogen network that have only been through a design and test phase bear high risk of delays to programme delivery
Very high	<p>The design components:</p> <ul style="list-style-type: none"> means re-purposed existing gas assets or new build hydrogen assets with designs that are very complex that can lead to disruptions result in very high emissions increase when maintaining assets means new project that has only been in design phase bear high risk of delays to programme delivery

Technology readiness assessment

The technology readiness risk framework¹⁵⁷ in Table 32 provides an overview of the qualitative approach used when considering the feasibility of each proposal or option.

Table 32: Technology readiness risk framework

Risk scoring	Technology readiness
No or lowest	<p>The design components technology:</p> <ul style="list-style-type: none"> is mature technology that has been used over 10 years on new hydrogen assets or re-purposed gas assets bears no to low risk of operational testing sign-off delays is compliant with current safety legislation
Very low	<p>The design components technology:</p> <ul style="list-style-type: none"> is technology that has used for a five to ten-year period on new hydrogen assets or re-purposed gas assets bears very low risk of operational testing sign-off delays is compliant with current safety legislation
Low	<p>The design components technology:</p> <ul style="list-style-type: none"> is new technology that has only been used for less than five years on new hydrogen assets or re-purposed gas assets bears low risk of operational testing sign-off delays is compliant with current safety legislation
Moderate	<p>The design components technology:</p> <ul style="list-style-type: none"> is technology that is used by equivalent gas transmission system operators, but not on the new hydrogen network bears moderate risk of operational testing sign-off delays is compliant with current safety legislation

¹⁵⁷ The technology readiness risk scale will be scored from 0-5, where no or low risk is 0 and very high risk is 5.



High	<p>The design components technology:</p> <ul style="list-style-type: none"> • is emerging technology that has not been used beyond its testing phase on new hydrogen assets or re-purposed gas asset, therefore is unproven in real operations • bears high risk of operational testing sign-off delays • would require further justification to ensure compliance with current safety legislation
Very high	<p>The design components technology:</p> <ul style="list-style-type: none"> • is new technology that has not been used beyond its design phase on new hydrogen assets or re-purposed gas assets, therefore is unproven in real operations • bears very high risk of operational testing sign-off delays • would require further justification to ensure compliance with current safety legislation

Supply chain assessment

The supply chain risk framework ranking¹⁵⁸ in Table 33 provides an overview of the qualitative approach used when considering the feasibility of each proposal or option.

Table 33: Supply chain risk framework

Risk scoring	Supply chain
No or lowest	<p>The design components:</p> <ul style="list-style-type: none"> • are current components readily available for production and procurement • have established supplier contracts in place for project start • bear no or low risk of project delivery delay
Very low	<p>The design components:</p> <ul style="list-style-type: none"> • are current components available for production and procurement • have established supplier contracts currently in procurement for project start • bear very low risk of project delivery delay
Low	<p>The design components:</p> <ul style="list-style-type: none"> • are current components with limited availability for production and procurement • have established supplier contracts that require procurement to be undertaken or clear strategy in place for project start • bear low risk of project delivery delay
Moderate	<p>The design components:</p> <ul style="list-style-type: none"> • are only standard components available for project start • have ad-hoc supplier contract required for procurement to be undertaken for project start

¹⁵⁸The supply chain risk scale will be scored from 0–5 where no or low risk is 0 and very high risk is 5.



- bear moderate risk of project delivery delay

High

The design components:

- are emerging technology that requires ad-hoc testing and production
- have ad-hoc supplier contract required for procurement to be undertaken for project start
- bear high risk of project delivery delay

Very high

The design components:

- are specialised new innovative technology that requires ad-hoc design, testing and production
- have ad-hoc supplier contract required for procurement to be undertaken for project start
- bear very high risk of project delivery delay

Operability

Due to the lack of an existing hydrogen network or market, quantifying the benefits and risks related to the operability of a future hydrogen network remains unclear. NESO will collaborate with Ofgem and DESNZ to determine how operability considerations should be incorporated into the CSNP. At that stage, we will assess whether any operability-related factors (such as costs associated with balancing the network) can appropriately be included within the appraisal framework.

For options involving the repurposing existing gas assets, NESO may assess operability risks through a standalone assessment and expect to work with the option proposer to understand operability impacts across both gas and hydrogen systems.

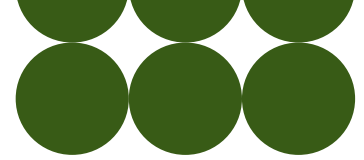
Review in combination

For each investment option proposed, all components of the assessment (environmental and community impacts, deliverability and operability where feasible, alongside economic considerations) will be used to inform the optimal network solution: Multi-Criteria Decision Analysis (MCDA), using swing weighting suggested by Green Book, can support the longlisting stage by enabling consideration of unmonetised trade-offs. However, because hydrogen network option development is a new process, it is not yet clear whether this is the most appropriate approach until assessment outcomes are reviewed. We will refine and confirm the approach during the CSNP as the analysis progresses.

Recognising the uncertainty of requirement for new hydrogen network development, it is essential to undertake a range of sensitivity analyses to provide decision-makers with confidence in approving the proposed network plans.

Sensitivity Analysis

Recognising the uncertainty inherent in early-stage hydrogen network development, economic appraisal outputs should be interpreted comparatively rather than as precise



measures of absolute value. Sensitivity analysis will play a key role in informing decision confidence.

Sensitivities may include, but are not limited to:

- alternative hydrogen supply and demand forecasts (for example, FES)
- variations in capital expenditure (CapEx)
- variations in hydrogen network option delivery timelines
- any further sensitivities identified or prioritised through the CSNP governance process

However, if there are unmitigable or significant environmental and community impacts associated with an option, we will consider the balance of impacts across the set of assessments. All relevant data, assumptions and calculations will be shared with DESNZ to demonstrate that NESO's recommendation is unbiased and transparent.

In future iterations we will review previous investment recommendations, updating the progress of these and, where relevant, the benefit of each option.



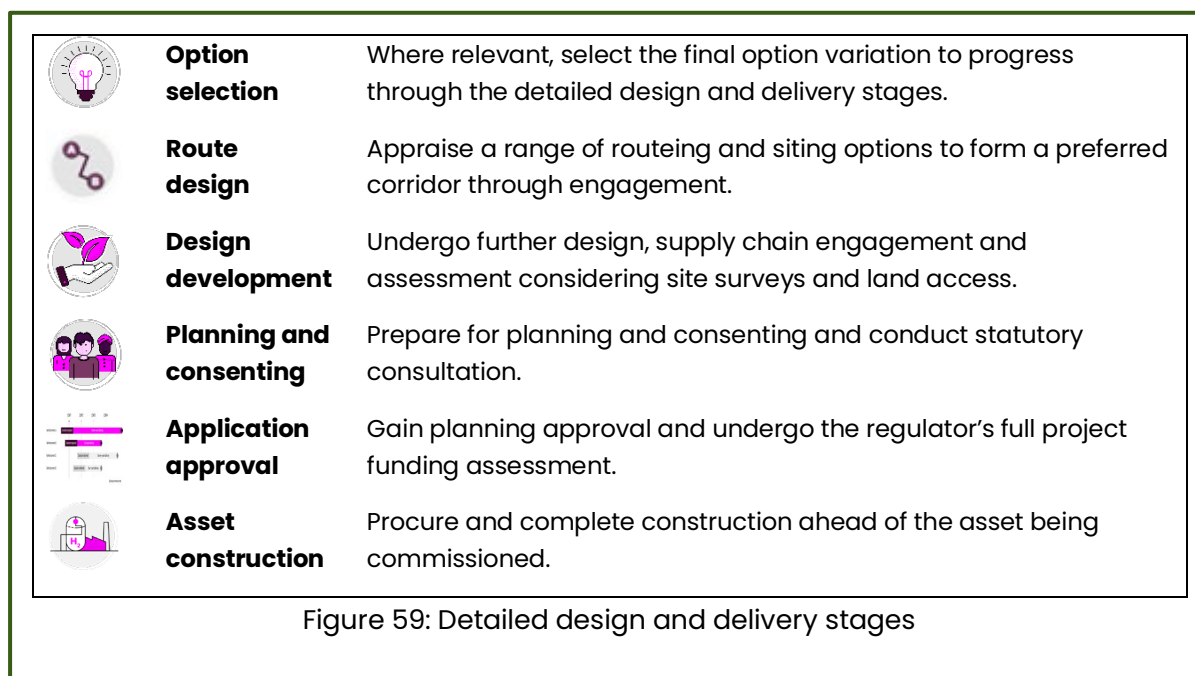
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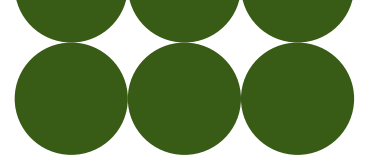
Our CSNP publication will set out our analysis of the submitted options to meet hydrogen network needs. While the CSNP sets out an indicative pathway from option selection to delivery, progression through these stages remains contingent on policy decisions, business model support and market development for hydrogen infrastructure.

For options that receive support from the DESNZ hydrogen business models, we will provide updates in subsequent iterations of the CSNP on the delivery schedule and progress of the hydrogen network proposals based on updates from the option developer, the regulator and DESNZ.

For hydrogen network proposals, both new-build and re-purposed, the CSNP will analyse the options which could meet the identified network needs.

NESO is not the decision maker on which options to take forward as they will be supported via hydrogen transport and storage business models designed by DESNZ and, as such, require a decision from the Secretary of State. We will therefore not be setting out a formal delivery pipeline, although our analysis of phasing of network development will give an indication. We expect developed options to follow a similar process to that followed for gas and electricity, as outlined in Figure 59.





Review of previous proposals

We will review all outcomes of previous hydrogen options assessment publications, updating on progress and status of each project to ensure that advice is still relevant. Where advice changes through each iteration, this will be communicated to the regulator and to DESNZ, who make the relevant funding decisions for hydrogen infrastructure subsidy through the business model support schemes.

11. Section 6: Consult, Refine, Publish

Consult

Refine

Publish



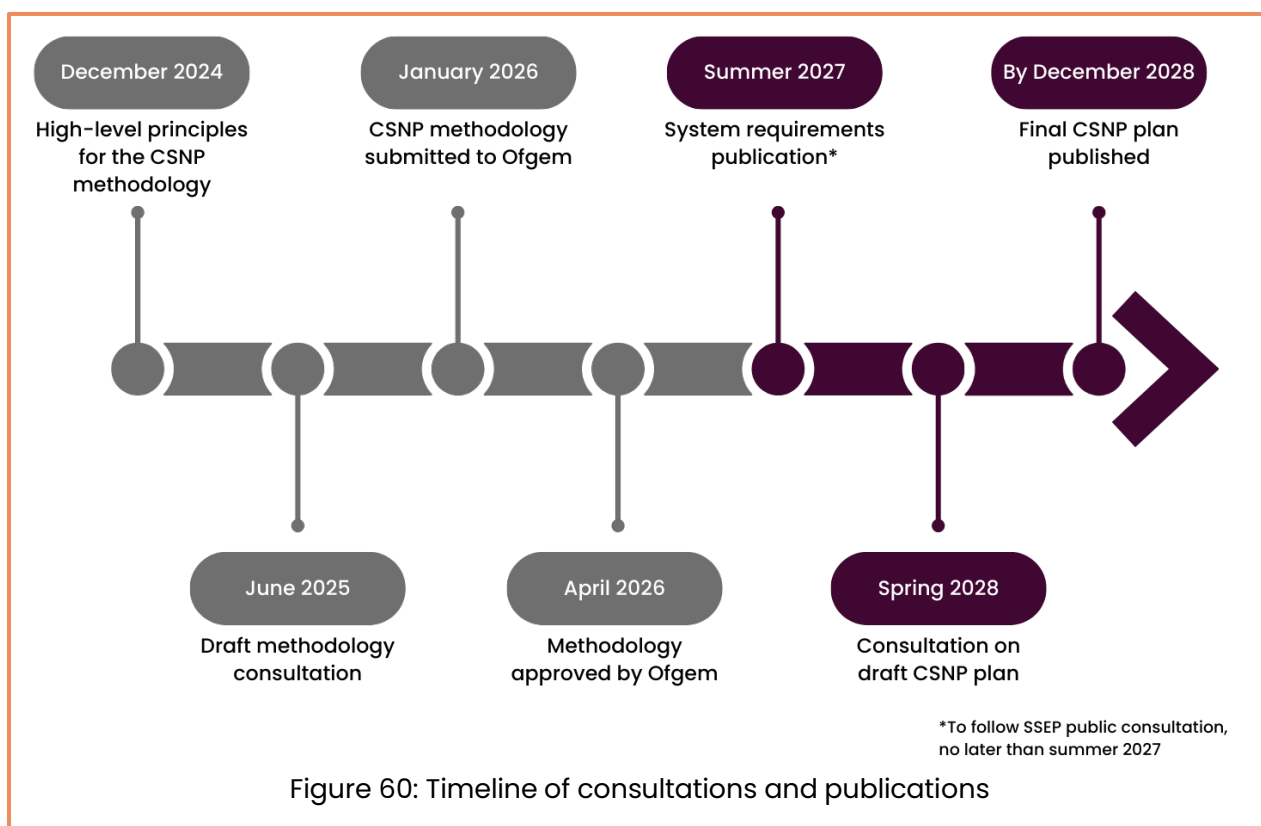


Consult

This chapter explains how we will carry out a formal consultation on the draft CSNP and use feedback to enhance the final plan as outlined in Figure 60¹⁵⁹.

It also covers the same process for the statutory environmental reports accompanying the CSNP, including:

- the Strategic Environmental Assessments (SEA)¹⁶⁰ environmental report
- report to inform Habitats Regulations Appraisal (HRA)
- Marine Conservation Zones (MCZ) assessment report



Our approach to stakeholder feedback

Our consultation process is designed to be open, inclusive and responsive to stakeholder needs. Building on engaging through bilateral meetings, working relationships and formal established SEP channels (such as the SEP working groups)

¹⁵⁹ These are the timings NESO expects, but it is possible that they may change, particularly if impacted by matters outside of NESO’s control.

¹⁶⁰ UK government, [gov.uk/guidance/strategic-environmental-assessment-and-sustainability-appraisal](https://www.gov.uk/guidance/strategic-environmental-assessment-and-sustainability-appraisal)



and societal forums, our consultations will enhance our engagement with a range of political, societal, industry and community stakeholders, gathering valuable perspectives.

Consultation feedback will be analysed using artificial intelligence (AI) to develop robust and accurate findings that in turn create clear actions for improving the final CSNP. We will also review feedback to ensure accuracy and depth of the responses. We will close the loop with stakeholders following any feedback opportunities so they can understand what has been done in response.

Stakeholder feedback is essential to help shape the CSNP. Insights, perspectives and recommendations from stakeholders will continue to inform the outputs of the plan and will be invaluable as we deliver on the aims of the CSNP. An important element of this will be the formal consultations we will undertake ahead of the final publications.

CSNP consultations

To give stakeholders the opportunity to help shape the CSNP's approach, we consulted on our draft methodology (published in June 2025). This was the second CSNP methodology consultation, following the first high-level principles window which closed on 20 January 2025. Using feedback from the first consultation, the draft methodology proposed a first-of-a-kind planning framework that considers the interactions between gas, hydrogen and electricity, paving the way for building a low-carbon, affordable and secure energy system for the future. Feedback can be found in [Appendix A](#) of this document.

Ahead of the final CSNP, we will consult on the draft plan seeking feedback on the proposals.

In parallel, consultations will be conducted for:

- the SEA environmental report
- the report to inform HRA
- the MCZ assessment report

Responses will be duly considered, implications evaluated and updates published via addendums. This will provide all stakeholders with the opportunity to understand and comment on the environmental impacts of the draft plan.

Our consultations are nationwide, inclusive and guided by the Gunning Principles, which are designed to make consultation fair, accessible and worthwhile. The Gunning Principles state that:

- Consultation must take place when the proposal is still at a formative stage.
- Sufficient reasons must be put forward for the proposal to allow for intelligent consideration and response.
- Adequate time must be given for consideration and response.



- The product of consultation must be conscientiously taken into account.

In addition to formal consultations, we will continue engaging with stakeholders where relevant throughout the CSNP cycle as explained in the stakeholder engagement section of this document. These methods balance broad and meaningful engagement with stakeholders and experts, creating a robust plan and encouraging advocacy for its direction.

SEA Environmental Report, HRA Report to Inform and MCZ Assessment Report consultation

Public and statutory consultation are legislative requirements for the SEA Environmental Report. This will form the key consultation document in the SEA process, providing an explanation of the environmental effects of the draft plan and reasonable alternatives, along with an opportunity to comment.

For the HRA and MCZ Assessment Report, we are only required to consult statutory bodies. However, to maintain transparency, these reports will be included as part of the public consultation.

The statutory and public consultation for the SEA Environmental Report, HRA Report to Inform and MCZ Assessment Report will take place alongside the CSNP draft plan consultation.

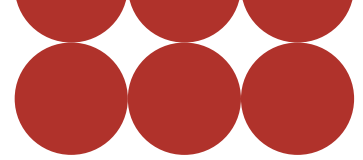
Use of artificial intelligence (AI)

AI will be employed to support summarising of the data and transforming it into actionable insights, facilitating a more efficient and comprehensive understanding of a range of stakeholder perspectives.

All feedback received from stakeholders on the CSNP will be read and reviewed by a human being in both its raw and summarised form. AI's ability to handle diverse data sources and formats enhances our capacity to engage with a wide range of stakeholders.

Whether the feedback comes from surveys, meetings, forums, emails or other channels, AI can integrate and analyse this information cohesively.

AI can process large volumes of feedback quickly and accurately, ensuring that no valuable insights are overlooked. It can identify patterns and trends within the feedback that might not be immediately apparent to human reviewers alone. When we make decisions on the CSNP, AI will help ensure that the voices of all stakeholders are heard and considered. AI will not be used to make decisions autonomously, but serve as a tool to enhance, rather than replace, human judgement and support decision-making.



AI will help to highlight important issues and common themes, allowing us to include stakeholder feedback in the CSNP more effectively and proactively. This comprehensive approach ensures that stakeholder input into the CSNP is informed by a broad spectrum of perspectives, allowing us to respond in a timely and appropriate manner.

We will regularly review our use of AI in interpreting stakeholder responses, and we will be able to track any stakeholder insight identified by AI to its original source. We acknowledge the potential for biases in AI platforms. We will incorporate bias mitigation strategies into our AI planning processes.

This proactive approach will help us ensure that the actionable insights our AI systems provide are fair, unbiased and reflective of the diverse range of stakeholders' views. Additionally, we recognise our responsibility to maintain transparency and due diligence in all our AI-related activities. Our AI use will strictly adhere to NESO's relevant policies, including AI, data management, data privacy, data classification and data sharing. These policies ensure that our AI practices are aligned with our commitment to ethical standards and regulatory compliance.



Refine

The refinement phase is an opportunity to enhance the final CSNP before publication using stakeholder feedback and insights, guided by the following principles:

- engagement
- coherence and consistency
- continuous learning and improvement
- transparency
- collaboration
- proactive refinement

Details on refinement

Engagement

We will continue to prioritise meaningful engagement with stakeholders, valuing the input and perspectives collected in consultation throughout this phase. We will strive to strike a balance between different stakeholder perspectives, considering the weight of feedback based on its representativeness, significance and alignment with project and national planning objectives.

Coherence and consistency

While refining the CSNP, we will strive to maintain overall coherence and consistency. Changes made during the refinement process will be carefully balanced to ensure that the plan remains robust and aligned with its objectives. Changes will be evaluated for their feasibility and practicality, considering technical, economic, environmental and societal aspects to mitigate adverse effects because of changes made.

Continuous learning and improvement

Alongside the process of incorporating stakeholder feedback, we will use this period to reflect on lessons learned and actively seek opportunities to refine the CSNP and processes based on emerging best practices and new information. Lessons learned will be incorporated in the process of refining the CSNP should this benefit the overall quality and effectiveness outputs. Feedback received from the consultation exercises will also inform future versions of the CSNP.

Transparency

We will be transparent on the modifications made. Explanations will be provided for how consultation feedback has been considered and incorporated, ensuring that stakeholders are informed about the outcomes and the reasons behind them.



Collaboration

We will utilise the relevant CSNP governance group, technical experts and relevant stakeholders across gas, hydrogen and electricity to evaluate proposed changes and ensure their effective implementation. This collaborative approach allows us to consider various perspectives and expertise in assessing the feasibility, costs and timelines associated with any refinement that is proposed. This will help ensure proposals made are considered from a whole-system perspective.

Proactive refinement

As we develop the final plan, we will encourage stakeholder engagement and refinement via stakeholder engagement channels. This approach ensures that development and outputs are consistently aligned with stakeholder interests, address concerns and maintain a balanced and informed approach from the outset. By involving stakeholders early in the CSNP's creation, potential issues can be proactively addressed, input can be gathered and adjustments can be made along the way.

This proactive involvement strives to reduce the need for significant changes during the public consultation phase and allows for the incorporation of key feedback and perspectives from the beginning.

Analysing stakeholder feedback

We value input from our stakeholders as it plays a vital role in creating a comprehensive and robust CSNP. We are committed to transparency and will clearly communicate which suggestions have been incorporated and the reasons why certain views cannot be implemented. We will explain to stakeholders how they can inform, influence and improve the plan prior to the consultation window in a timely manner. We will analyse the feedback from our consultations alongside views from our SEP stakeholder groups and our governance groups while adhering to the confidential nature of the work where appropriate.

After all feedback is digested, it will be grouped into themes and presented back as part of the final publication.

The CSNP will show optimal areas across GB where network reinforcements are required to deliver clean, affordable and safe networks for the next 25 years. A consultation on the draft CSNP will provide stakeholders with the opportunity to feed back on the outputs before the final plan before it is sent to Ofgem. Given the proposals are optimal designs, this is not an opportunity for option developers to alter their submitted reinforcement options.

SEA environmental report addendum

Once the consultation on the draft CSNP and accompanying SEA environmental report has been completed, the responses received will be considered and their implications for the SEA process evaluated. Where appropriate, assessments in the SEA



environmental report will be updated to reflect significant changes to the CSNP considering responses received and new or updated evidence.

The updates to the assessments will be presented in the environmental report addendum, which will be made available alongside the updated plan. If no updates are required, this will be highlighted in the subsequent SEA adoption statement.

Report to inform HRA and MCZ assessment report addendum

After the completion of consultation on the draft CSNP and accompanying report to inform HRA and MCZ assessment report, responses received will be considered and their implications in relation to the HRA and MCZ assessment processes evaluated. Where appropriate at this stage, the report to inform HRA and MCZ assessment report will be updated to reflect any significant changes to the CSNP made because of the responses received and any new or updated evidence.

Prior to approval by Ofgem, the Competent Authority will then use the report to inform for their own formal HRA, which will be consulted upon with statutory stakeholders including Natural England, Joint Nature Conservation Committee, Natural Resources Wales, NatureScot and the Department of Agriculture, Environment and Rural Affairs in Northern Ireland.



Publish

We will submit the first CSNP to Ofgem for their approval before the end of 2028.

Once approved, the CSNP will be published on our website and an update with a link to the content will be posted on all our social media channels. This will be supported by wider stakeholder communication in the form of formal channels (such as working groups), webinars and more targeted engagement to ensure the outputs of CSNP are understood.

NESO is developing a Welsh language policy in collaboration with the office of the Welsh Language Commissioner. The final output of the CSNP and its wider engagement will be compliant with the policy. To ensure the document is accessible for stakeholders, the CSNP will be published in two formats: the first will be a digital publication in PDF format with interactive navigation, while the second will be designed for downloading and printing. The content will be the same in both formats, with the digital version including navigation tools to aid readability.

The CSNP will adhere to NESO's brand guidelines, which are designed to ensure how we communicate with our audiences is clear and accessible.

The CSNP is technical by nature, and we work in a complex environment where accuracy and clarity are essential.

Throughout the document, we will use graphs, charts, maps and tables to illustrate and expand on important data and insights.

The digital version will contain links to:

- the SEA and HRA
- in-depth supporting information as required
- the previously published CSNP final methodology (relevant for the second CSNP cycle)

We will also include references in the print version to signpost stakeholders to this additional information.

The final plan will include a glossary of terms which is necessary to ensure consistency across all the supporting documents, reduce ambiguity and enhance readability for new audiences unfamiliar with the technical terminology it uses.

We endeavour to adhere to the principles included in this document. However, given the evolving environment in developing the CSNP, we may have to adapt approaches due to unforeseen circumstances if required. Where this is the case, we will inform stakeholders.



SEA adoption statement

To accompany the published CSNP, an SEA adoption statement will be prepared as required under Part 4 of the English and Welsh SEA Regulations and Part 3 of the Environmental Assessment (Scotland) Act 2005. Reflecting the requirements of the SEA Regulations Act, the SEA adoption statement will include:

- an overview of the process which has been undertaken for the SEA to date
- how the SEA has informed and influenced the development of the CSNP (including the consideration of reasonable alternatives)
- the consultation that has been undertaken as part of the SEA process and how the feedback has been considered
- a summary of proposed monitoring processes (expanded on through the preparation of a subsequent SEA monitoring and implementation plan)

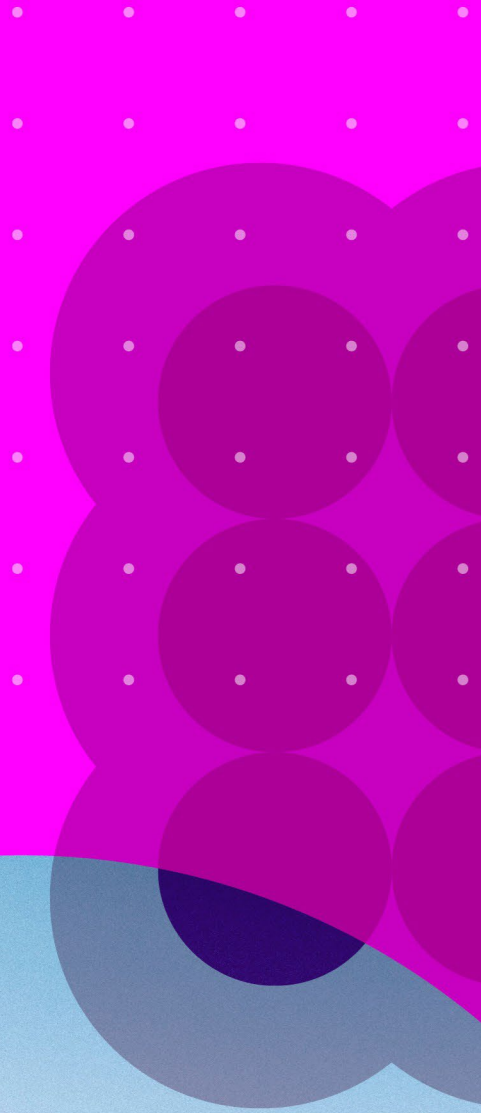
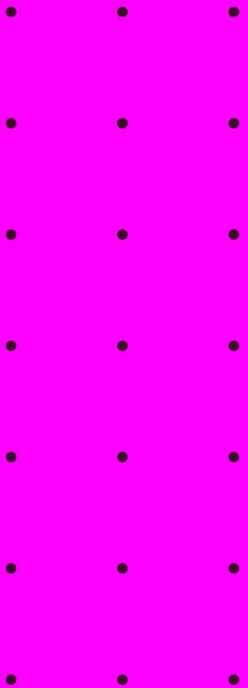
SEA monitoring and implementation plan

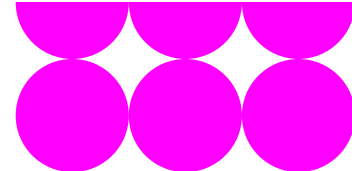
Regulation 17 of the English and Welsh SEA Regulations and Section 19 of the Environmental Assessment (Scotland) Act 2005 require the responsible authority to monitor the significant environmental effects of the implementation of the plan. The purpose of this is to identify unforeseen adverse effects at an early stage so remedial action can be taken.

SEA monitoring evaluates the sustainability performance of the plan and its compliance through its implementation. It also checks whether the effects predicted in the SEA occur as envisaged or whether unforeseen issues arise. Monitoring can help evaluate whether the CSNP is fulfilling its core objectives of delivering sustainable development and providing a high level of protection of the environment.

The information gathered through monitoring will inform the review and preparation of subsequent iterations of the CSNP and the plans and projects that sit within them, thus better influencing future planning decisions. In response to this, an SEA monitoring and implementation plan will be prepared on the adoption of the CSNP.

12. Legal notice





Legal notice

For the purposes of this report, the terms “NESO” , “we” , “our” , “us” etc. are used to refer to National Energy System Operator Limited (company number 11014226).

NESO has prepared this report pursuant to its statutory duties in good faith and has endeavoured to prepare the report in a manner which is, as far as reasonably possible, objective, using information collected and compiled from users of the gas and electricity systems in Great Britain, together with its own forecasts of the future development of those systems.

While NESO has not sought to mislead any person as to the contents of this report and whilst such contents represent its best view as at the time of publication, readers of this document should not place any reliance in law on the contents of this report.

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