September 2025

Electricity Transmission Design Principles

Consultation on Principles

NESO
National Energy System Operator

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Executive Summary

Executive Summary

In 2023 the Electricity Networks Commissioner proposed recommendations on how to accelerate the deployment of strategic electricity transmission infrastructure in Great Britain. The UK Government adopted these recommendations which now form the basis of the Transmission Acceleration Action Plan (TAAP). The TAAP sets out 43 recommendations, which collectively seek to reduce build time of electricity transmission network infrastructure from 14 to 7 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 infrastructure, which at the time of this consultation set out that developers of electricity transmission infrastructure should have regard to the Principles.

The Principles consider strategic, network planning and project development needs and will apply to new transmission infrastructure projects identified from January 2026. They have been developed by the National Energy System Operator (NESO) alongside other Working Group members and are now in public consultation. Further information on the Working Group is available in Section 3 of this document.

The Consultation

We invite all parties with experience of, and an interest in, electricity transmission projects to respond to this consultation with consideration to the following questions.

Key questions

1. Do you agree the Principles are written in a clear and accessible manner?
2. Given the context of the mission statement, are there any guidelines for transmission design that you think are missing?
3. Which of the Principles do you support, and which do you disagree with and why?
4. Do the Principles promote transparency in decision-making about new transmission projects?
5. Are the Principles realistic and actionable for designers and users?

1. Introduction

Purpose of this consultation

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Introduction

Purpose of this consultation

The National Energy System Operator (NESO) is responsible for coordinating the implementation of the strategic development plans for Great Britain's electricity transmission network. NESO and the three Transmission Owners (TOs)[1] have a statutory obligation to develop plans that consider network efficiency and consumer value for money whilst balancing the impact on the environment and local communities.

It is widely recognised within the UK Government and the electricity transmission industry of Great Britain, that to meet the Government's net zero targets and enable economic growth, the delivery of electricity transmission infrastructure needs to be significantly accelerated. Part of the acceleration strategy declared by the UK Government's Transmission Acceleration Action Plan (TAAP)[2] is to clearly communicate to potential transmission development stakeholders the type of transmission infrastructure they can expect to be installed in different types of terrain.

Of course, no single document can cover every eventuality for every infrastructure project, so these Principles do not represent 'policy' or 'rules'; rather, they aim to provide firm general (non-project specific) design guidance, with the expectation that justification will be provided for significant deviations. To achieve this, we were asked by the Department for Energy Security and Net Zero (DESNZ) to create, own and manage a set of 'Electricity Transmission Design Principles' (ETDP) that will be held in a publicly available living document, updated from time to time in a process of review and continuous improvement as described in Section 8, Next Steps.

Planning, consenting, and building new transmission infrastructure projects can take significant time, currently up to 14 years in some cases. The Electricity Transmission Design Principles aim to streamline the process by reviewing and agreeing some of the general principles associated with transmission design up front before specific projects come into development. This will allow discussions to focus on the unique aspects of project development and reduce the need for repeated discussions on design aspects.

We are keen to understand your views so that you can understand, comment, and inform the development of the final version that will guide transmission infrastructure design across

[1] The Great Britain Transmission Owners are National Grid Electricity Transmission, Scottish Hydro Electric Transmission Ltd, and SP Energy Networks.

[2] Transmission Acceleration Action Plan, Department for Energy Security and Net Zero, November 2023

Great Britain. Once the consultation and final redrafting is complete, the Principles are due to be given force in England and Wales by the UK Government's National Policy Statements (NPS) for the development of nationally significant infrastructure, in particular, NPS EN-5 – 'Electricity Networks Infrastructure'. The Scottish Government have also been a consultee, and the intention from the TAAP is that these Principles complement Scotland's National Planning Framework.

In addition, the Principles will become embedded into our strategic energy network planning processes through the Centralised Strategic Network Plan (CSNP)[3], which will use an evidence led approach to identify, develop, appraise options and recommend reinforcements both offshore and onshore. Specifically, the Strategic Principles and Network Planning Principles will apply to options submitted into the CSNP by the TOs and other parties. Meanwhile, the Project Development Principles will primarily be used following a CSNP recommendation, as projects go through detailed design and consenting.

We are pleased to invite your feedback on the proposed Principles based on the key questions raised in the Executive Summary and included here for ease of reference. The following pages detail the Principles and the ways in which you can comment on them.

Consultation objectives

This consultation aims to:

1. Gather comprehensive stakeholder perspectives on whether the proposed Principles effectively address the mission statement presented at the end of Section 2 of this consultation document.
2. Validate, and improve the clarity and applicability of the drafted Principles to ensure they provide practical, implementable guidance for all parties involved in transmission infrastructure development.
3. Identify and address potential gaps in the Principles that may not have been fully considered during the initial development phase.

Use of Artificial Intelligence

This consultation seeks to engage a broad range of stakeholders to ensure that a diversity of views and opinions are considered during its development. Artificial Intelligence (AI) will be employed to support summarising of the data and transforming it into actionable insights, facilitating a more efficient and comprehensive understanding of stakeholder perspectives across various sectors of society. All feedback received from

[3] Centralised Strategic Network Plan Draft Methodology
neso.energy/document/363521/download

stakeholders on the Principles will be read and reviewed by a human 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. AI can process large volumes of feedback quickly and accurately, ensuring that no valuable insights are overlooked. Additionally, AI can identify patterns and trends within the feedback that might not be immediately apparent to human reviewers alone.

AI will not be used to make decisions autonomously, but to 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 more effectively and proactively. This comprehensive approach ensures that stakeholder input into the Principles 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 attribute 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 activities; AI-related activities included. 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.

2. Concept of the Electricity Transmission Design Principles

Background and Approach

Problem Statement

Projects in scope

Scope interaction

Technologies in scope

Mission Statement

Concept of the ETDP

Background and Approach

Recommendation 'RD1' of the UK Government's Transmission Acceleration Action Plan (TAAP) states that:

"Electricity Transmission Design Principles should be created to provide greater clarity on the type of asset to be used in different environments."

To achieve RD1, we intend that the Principles draw together design considerations from key policy, industry guidance and professional experience, recording, clarifying and updating these in the process to ensure they are fit for purpose. In particular, the draft that we present in this consultation has been strongly guided by:

- The legislative framework for transmission developers, in particular their Transmission Licence conditions and the National Policy Statement EN-5 – 'Electricity Networks National Policy Statement' as well as the National Planning Framework 4 in Scotland.
- The Holford and Horlock Rules, which have provided designers with guidance for many years on overhead lines and substations, respectively, and which form part of current EN-5 Policy.
- Practical professional experience of transmission design provided by The National Energy System Operator (NESO) and the three Transmission Owners (TOs).

The first issue of the Principles is intended to operate alongside the Holford and Horlock Rules –two longstanding sets of rules that are well known in transmission design. As the Principles mature and increasingly take effect, consideration will be given as to whether the Holford and Horlock Rules will be subsumed by the Principles. Equally, as the Principles gain traction more broadly, national policy makers may wish to move some of the transmission design details to the Principles and reference the Principles as the single source for those details.

To support the development of the Principles, we convened a Working Group to ensure alignment between project developers and policy makers. We have been working with the Transmission Owners, the Department for Energy Security and Net Zero (DESNZ), The Office of Gas and Electricity Markets (Ofgem), the Welsh and Scottish governments as well as the Planning Inspectorate, since June 2024 to scope and develop the Principles. This consultation document represents a refined draft of the NESO-led Working Group.

During the development process, we also sought input from external stakeholders including the Landscape Institute, the National Infrastructure and Service Transformation Authority (NISTA, formerly the National Infrastructure Commission), RenewableUK, the Energy Systems Catapult, and the Electricity Networks Commissioner himself. By engaging in this way, we have endeavoured to ensure that, while the Principles address the design points in question, they also reflect a broad range of perspectives from across the energy sector, affected communities and environmental interests.

To test the practical application of the Principles, TOs undertook a testing exercise. This involved applying the Principles to recently consented projects and assessing what impact they would have if applied from project inception. The feedback from this exercise usefully informed Principle development, particularly with respect to the use of terminology or descriptions that unnecessarily and unintentionally limited the scope of a Principle's application.

Problem Statement

Early in the drafting process we developed the following Problem Statement, with input from the Working Group, to capture the key challenges that the Principles are intended to address:

- Articulate unambiguous guidelines on transmission technology choices.
- Are sensitive to and strive to mitigate the impact of transmission infrastructure on the environment, landscape, and communities.
- The National Policy Statements (England and Wales) and National Planning Framework 4 (Scotland) set out rules and guidance relevant to the design of transmission infrastructure which, along with the Holford and Horlock Rules, can be open to interpretation by different parties.
- There is lack of clarity among stakeholders on which aspects of a proposed design can be changed and what impact mitigations can be included to improve community acceptance.
- During the regulatory approval process, measures taken to gain community acceptance can be challenged. As a result, redesign of the route and reapplication for planning approval may be required, or additional funding sourced in a timely manner to avoid further delay.
- Public enquiries relating to proposed transmission investments encounter repeat questions on the need for a particular type of transmission technology employed for a given route or site.
- Many transmission design decisions that impact communities are made ahead of any community consultation, and TOs find that, where justification for these is not effectively communicated to impacted stakeholders, additional queries can be triggered at later stages of the planning process.

Projects and Technologies in scope

Following publication of the Principles, all new electricity transmission projects in Great Britain, identified from January 2026, will be expected to have regard to the Principles. This will include, but is not limited to, network reinforcement options entering network planning processes from the first iteration of the Centralised Strategic Network Plan (CSNP)[4]. Designers will not be expected to apply the Principles retrospectively to projects currently in development.

The Principles apply, as appropriate, to all transmission projects where new infrastructure is to be installed, whether new-build or system upgrade, and whether or not the project is expecting to utilise or extend existing transmission corridors or substation sites. The aim is to ensure that a series of relatively minor system upgrades, if left outside the scope of the Principles', does not undermine their effectiveness in supporting efficient and economical transmission infrastructure that also considers community and environmental impacts.

The Principles will apply to onshore and offshore transmission infrastructure operating at voltages of 275 kV and above (132 kV and above in Scotland).

Technology infrastructure considered in the Principles

- Overhead lines (OHL)
- Underground cables (UGC) originating onshore, including those whose routes are partly offshore
- Cables originating offshore, including Offshore Transmission Owners and international interconnectors

Scope interactions

In Summer 2025, NESO published the draft methodology for the CSNP which will holistically plan wider reinforcements on the onshore transmission network alongside the offshore network. The CSNP follows a three-year cycle, with the first cycle anticipated to be published in 2027. The process, as drafted, is described in five stages; *Drive*, *Identify*, *Develop*, *Appraise*, and *Deliver*. ETDP will be a key resource used within the CSNP to develop reinforcement options to meet future network requirements.

The first stages; *Drive* and *Identify,* led by NESO, in collaboration with TOs, defines and evaluates the needs of the energy networks, considering future energy demand, supply and flexibility. They identify the technical needs of the onshore and offshore electricity networks, such as the requirement for additional capacity, security of supply, stability and voltage management services.

[4] Centralised Strategic Network Plan Draft Methodology neso.energy/document/363521/download

The Strategic Principles of ETDP promote these steps and support a firm basis upon which new electricity infrastructure planning proposals shall be formed.

The *Develop* and *Appraise* stages start to consider in more detail the potential reinforcement options including network management options, upgrades to the existing network, new circuits and whether these be onshore or offshore. The *Develop* and *Appraise* stages will primarily interact with the Strategic and Network Planning Principles as this is where the majority of options will be designed and appraised. The details of the options developed in the CSNP will consider Reinforcement Options including network upgrades and new circuits.

The options development in the *Develop* stage is predominantly undertaken by the three TOs and NESO, although third parties may also submit options to the process. This is where clear yet comprehensive guidance by the Principle's cascading structure described in Section 3 will benefit. The *Appraise* stage in CSNP process will ultimately decide what technology will be implemented including whether they are installed offshore or onshore. Whilst the CSNP sets out an appraisal methodology for each criterion, the Strategic and Network Planning Principles form overarching guidance for each option and aid in NESO's assessment.

Finally, the *Deliver* stage confirms options to progress to the delivery pipeline. This step includes the identification and handover to a delivery body who will be responsible for the detailed design and delivery of the infrastructure where the Project Development Principles will apply.

Mission Statement

To address the challenges identified in the TAAP and deliver on Recommendation RD1, the Principles:

- Articulate unambiguous guidelines on transmission technology choices.
- Are sensitive to, and strive to mitigate the impact of transmission infrastructure on the environment, landscape, and communities.
- Set out clearly any route design flexibilities to be expected in any application of the principles.
- Encourage innovation, especially where that reduces transmission impacts effectively.
- Are compatible with Great Britain's regulatory principles, such that these principles promote economy and efficiency, as well as the Transmission Owners' licence obligations (from the Electricity Act 1989) to develop and maintain an efficient, coordinated, and economical system of electricity transmission.
- May be accepted and applied equally in England, Scotland and Wales, whilst recognising that landscapes differ across, and between, each of these nations and that by so doing, robustly support the swift planning decisions.

3. Overview of the Principles

ETDP Cascading Structure

Strategic Principles

Network Planning and Project Development

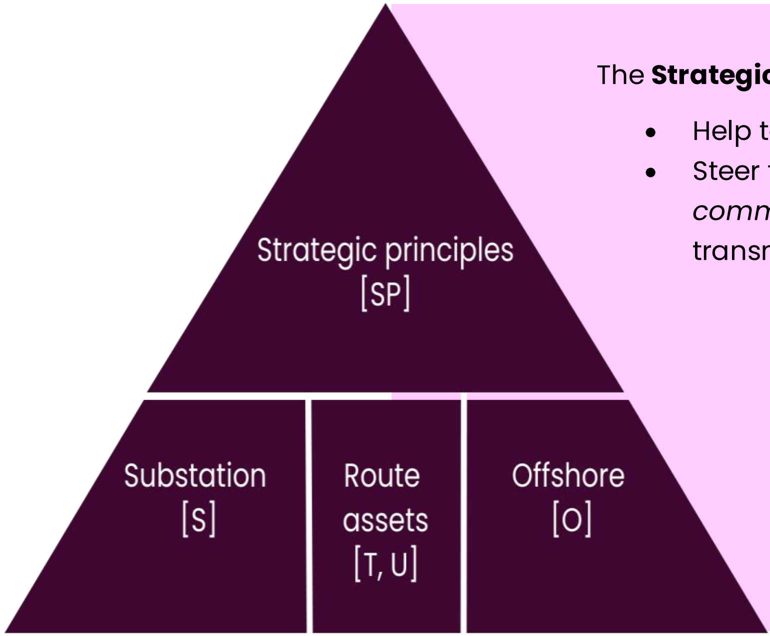
Overview of the Principles

The section is intended as a short introduction in how to read the Principles and to explain how and why the structure of the Principles was developed.

ETDP Cascading Structure

The ETDP document adopts a cascading structure, with Strategic Principles providing context and direction for the more specific Principles. The Principles apply to the Network Planning and Project Development stages of any transmission infrastructure project. The cascade structure is depicted below.

Figure 1: Cascading Structure of the Principles



The **Strategic** Principles will:

- Help to **facilitate engagement** for energy infrastructure
- Steer the **detailed design principles** by providing guidance on key themes: *community, environment, technical needs, futureproofing, cost & efficiencies* of transmission design*, mitigation considerations, innovation & future design*

The **Network Planning** Principles will guide the definition of high-level characteristics of future transmission infrastructure.

The **Project Development** Principles will guide the design of transmission assets, and where relevant provide mitigation considerations.

Strategic Principles

There are three Strategic Principles which comprise of headline text, a brief introduction, and a set of bullets stating the premise. The Strategic Principles aim to:

- Provide coherent strategic direction for transmission developers and project designers.
- Promote discussion on the critical factors that influence design decisions.
- Steer the overall direction of downstream principles providing guidance on key themes: community, environment, technical needs, futureproofing, cost & efficiencies of transmission design, mitigation considerations, innovation & future design flexibility.

Network Planning and Project Development Principles

The Network Planning and Project Development Principles work within the provisions of the overarching Strategic Principles providing technology and asset specific guidance and design considerations to be applied at the relevant stage of a project's lifecycle.

Network Planning Principles focus on matters relevant to the early stages of project design, focussing on the high-level requirements and characteristics of the project such as those identified in Strategic Energy Planning processes such as the Centralised Strategic Network Plan.

Project Development Principles focus more so on detailed project considerations and design choices as well as potential impact mitigation opportunities.

Each Network Planning and Project Development Principle comprises:

- A headline text, providing design guidance, with the intention that deviations from this guidance may still be developed so long as they are justified within the design.
- A rationale for the headline, explaining the principle's necessity and benefits using clear, accessible language and a non-exhaustive set of leading design considerations.

Design Considerations may emphasise the complexity or breadth of factors that designers must consider, may mention possible impact mitigations, or may raise circumstances that could justify deviation.

4. Strategic Principles

SP1: Technical Needs

SP2: Environment, Community and Sustainability

SP3: Economics and Regulation

Strategic Principles

The Strategic Principles provide a clear and practical framework for good design, aligned with planning and regulatory requirements.

They will provide strategic direction to key stakeholders and translate high-level ambitions into strong design guidance that is accessible to both professionals and the wider public.

SP1 | Technical Needs

Good transmission design seeks to ensure that proposals for new infrastructure meet the current technical requirements and anticipate future technical need and developments, as identified by Great Britain's transmission development processes:

- Meet reliability and security targets.
- Deliver required connections or additional capacity cognisant of future needs to minimise the demand for recurring updates within recognised planning horizons.
- Protect the network's operability by ensuring its maintainability, flexibility, and resilience, to minimise the impact of current and future physical, cyber and climate related security risks.
- Use innovative technology and approaches, where appropriate, to safely unlock further technical value.

SP2 | Environment, Community and Sustainability

Good transmission design understands, assesses, and improves environmental and social outcomes wherever feasible, embedding sustainability considerations at every stage:

- Protect or seek to avoid landscapes, environments and amenities of cultural and community importance, and actively reflect the views of communities and stakeholders wherever practicable.
- Use innovative technology and approaches, where appropriate, to further avoid or minimise environmental and social impacts and to offset residual effects.

SP3 | Economics and regulation

Good transmission design delivers value for existing and future consumers by supporting regulatory targets:

- Promote economic, efficient and co-ordinated infrastructure designs and technologies, and support effective project delivery, improving lifetime efficiencies wherever feasible.
- Use innovative technology and approaches, where appropriate, to further efficiency and co-ordination, and to hasten the achievement of the Government’s decarbonisation targets.

5. Network Planning Principles

Route Assets

Substations

Offshore

Network Planning Principles

The Network Planning Principles serve as design guidance to be applied at the relevant stage of a project's lifecycle.

This section contains:

- Route Assets: Principles T1 & T2
- Substations: Principles S1 to S3
- Offshore: Principle O1

T1	Consider the technical feasibility, economic, environmental, community, deliverability, and operability characteristics of all options to deliver the required transmission capacity and address future development need, including both onshore and offshore solutions where appropriate.
Rationale Section 9(1) of the UK Electricity Act 1989 places upon any electricity transmission licence holder the duty to "develop and maintain an efficient, co-ordinated and economical system of electricity transmission". This obligation is reflected in Condition B.7 of the Electricity Transmission Standard Licence Conditions (19 10 2021), with which all UK transmission owners must comply. At the same time, Schedule 9 of the same Electricity Act places a duty on the licence holder to preserve amenity: to “have regard to the desirability of preserving natural beauty, of conserving flora, fauna and geological or physiographical features of special interest and of protecting sites, buildings and objects of architectural, historic or archaeological interest; and” … “shall do what he reasonably can to mitigate any effect which the proposals would have on the natural beauty of the countryside or on any such flora, fauna, features, sites, buildings or objects.” Alongside these factors, transmission asset designers must ensure that people and communities are also considered. Meeting this diverse set of requirements is a significant challenge for any transmission asset designer. The design of new transmission assets, such as overhead lines and underground cables, along with the selection of their preferred development options, involves many, sometimes conflicting, factors. In order to identify the most appropriate solution, designers should consider a broad range of feasible options, onshore and offshore, against the full range of requirements. These feasible options should explicitly include consideration of future development needs. Designing for the future may involve moderately higher upfront costs but can deliver long-term savings by avoiding the need for repeated interventions. It also enables faster deployment of	**Design considerations** • Transmission capacity need (the need for additional power transfer capability that justifies the new development in the first place). • Technical (such as the reliability and robustness of the proposed solution, ensuring compatibility with existing and future infrastructure and technology). • Operability (such as ease of operation and maintenance, flexibility and scalability for future upgrades, and resilience to adverse conditions e.g. wind, snow, pollution). • Deliverability (such as the feasibility of the site for construction, availability of materials and equipment, technology readiness level of the solution and system access impacts of any outages required). • Environmental (such as national landscape, ecological and heritage designations, hydrology and natural carbon stores). • Community (such as visual impact, cultural heritage, amenity, current land uses and settlement dispersion). • Economical (such as capital costs, operational costs and performance). • Holistic system needs (such as ensuring all factors are carefully balanced across all options to achieve the optimal overall solution, coordinate with other parts of the transmission network, and with other energy vectors). • Future development needs (such as those defined through network planning processes). • Opportunities to install higher voltage equipment and operating at a lower standard voltage in the interim.

T1	Consider the technical feasibility, economic, environmental, community, deliverability, and operability characteristics of all options to deliver the required transmission capacity and address future development need, including both onshore and offshore solutions where appropriate.
future infrastructure and reduces disruption to communities and the environment over time. The level of detail that goes into considering each option should be proportionate to its potential to meet the project's objectives and support a comprehensive and balanced evaluation to ensure the preferred option(s) is (are) robust and justifiable.	

References

- National Policy Statement for Electricity Networks EN-5, the Department for Energy Security and Net Zero (DESNZ), March 2023, Paragraph 1.1.7, Sections 2.7, 2.8
- UK Electricity Act 1989, Gov.uk, Section 9(1) and Schedule 9
- Electricity Transmission Standard Licence Conditions, Ofgem, June 2025, Condition B.7

T2	The design of onshore transmission circuits starts from the presumption that they will be continuous AC overhead lines.
Rationale Overhead line circuits are the preferred electricity transmission technology. This is because, despite their landscape and visual effects, compared to equivalent underground transmission cables they are usually: (i) quicker to construct, (ii) easier to access for maintenance and repair, (iii) have fewer environmental impacts along similar routes, (iv) more cost effective with a 4 to 5 times lower lifetime power transfer cost, (v) more future-proof, and (vi) easier to connect into existing or future circuits. In this context, a "continuous" overhead line refers foremost to a design with no underground sections. Great Britain's onshore supergrid employs double-circuit alternating current (AC[5]) overhead lines almost exclusively. This approach is typically the most cost-effective solution as it maximises the infrastructure's power transfer capacity and minimises materials consumption. At the same time, it enhances security of supply and minimises disruption to communities and the environment during construction and operation.	**Design considerations** • Differences in the national planning policies of the country in which the transmission circuits are proposed, noting that planning is a devolved matter and therefore subject to the frameworks of England, Wales, or Scotland. • In England and Wales, the starting presumption of overhead lines is reversed when proposed developments cross part of a nationally designated landscape (i.e. National Parks, The Broads, Areas of Outstanding Natural Beauty).
References • National Policy Statement for Electricity Networks EN-5, DESNZ, March 2023, Paragraph 2.9.20 • National Planning Framework 4 NPF4, Scottish Government, February 2023, Policy 11 • Approach to Routeing and Environmental Impact Assessment, SPEN, February 2020, Foreword from CEO • Comparison of Electricity Transmission Technologies: Costs and Characteristics, IET, April 2025 • HVDC Links in System Operations, ENTSO-E, Dec 2019. • Approach to Consenting, NGET, April 2022 • Planning Policy Wales Edition 12, Welsh Government, February 2024	

[5] High voltage direct current (HVDC) is an alternative transmission technology that, while more efficient over very long distances, particularly subsea, is less compatible with the interconnected, flexible, and distributed nature of the onshore Great Britain transmission system.

S1	Proposals for new substations, substation extensions and converter stations should meet the technical needs in a cost-effective way whilst considering environmental and community effects alongside deliverability and operability.

Rationale	Design considerations
Section 9(1) of the UK Electricity Act 1989 places upon any electricity transmission licence holder the duty to "develop and maintain an efficient, co-ordinated and economical system of electricity transmission". This obligation is reflected in Condition B.7 of the Electricity Transmission Standard Licence Conditions (19 10 2021), with which all UK transmission owners must comply. At the same time, however, Schedule 9 of the same Electricity Act places a duty on the licence holder to preserve amenity - to "have regard to the desirability of preserving natural beauty, of conserving flora, fauna and geological or physiographical features of special interest and of protecting sites, buildings and objects of architectural, historic or archaeological interest; and" … "shall do what he reasonably can to mitigate any effect which the proposals would have on the natural beauty of the countryside or on any such flora, fauna, features, sites, buildings or objects." Whilst people and communities are not mentioned in Schedule 9, transmission asset designers must ensure that these are also considered. Meeting this diverse set of requirements is a significant challenge for any transmission asset designer, and the design of a new substation, substation extension or converter station, along with the selection of a preferred site and layout, involves many, often conflicting, factors. The substation design process should evaluate environmental, community, and amenity effects and ensure designs demonstrate a commitment to sustainable and socially responsible infrastructure development whilst, at the same time, meeting technical, economic, deliverability and operability requirements and complying with relevant policies and licence obligations.	• Efficient (such as technical losses, operational complexity and deliverability). • Co-ordinated (with other parts of the transmission network, with the requirements of any directly connected Critical National Infrastructure (CNI), and with other energy vectors). • Economical (such as capital costs, operational costs, performance – particularly availability). • Environmental (such as national landscape, ecological and heritage designations, hydrology and natural carbon stores). • Community (such as visual impact, cultural heritage, amenity, current land uses and settlement dispersion). • Holistic system needs (such as ensuring all factors are carefully balanced across all options to achieve the optimal overall solution, coordinate with other parts of the transmission network, and with other energy vectors). • A preference for brownfield sites over greenfield, and a preference to avoid nationally important areas, such as Grade 1 agricultural land and sites of nationally scarce minerals. • Equipment specifications that allow operation at a higher voltage than initially required, to service future transmission system needs.

References

- Overarching National Policy Statement for Energy EN-1, DESNZ, March 2023, Section 2.6

S1	Proposals for new substations, substation extensions and converter stations should meet the technical needs in a cost-effective way whilst considering environmental and community effects alongside deliverability and operability.

- UK Electricity Act, Gov.uk, 1989, Section 9(1) and Schedule 9
- Electricity Transmission Standard Licence Conditions, Ofgem, June 2025, Condition B.7
- The Horlock Rules for the Siting and Design of Substations, National Grid Company, 2006 Rule#1: In the development of system options including new substations, consideration must be given to environmental issues from the earliest stage to balance the technical benefits and capital cost requirements for new developments against the consequential environmental effects in order to keep adverse effects to a reasonably practicable minimum.

S2	Operational flexibility during network outage should be considered in the electrical design and layout of all new substations, substation extensions, and converter stations.
Rationale Many substation design elements affect operational flexibility and network resilience, but two elements in particular – the substation electrical topology and the bay spacing - are totally dependent upon the space available. Since space is not easily increased after a site has been chosen, these two need to be considered very early in a substation's design. **Substation Topology** Every Main Interconnected Transmission System (MITS) substation has an impact on the transmission system's operational flexibility and resilience. One way a substation design can boost these two characteristics is by offering an alternative connecting point (busbar) to each of its transmission circuits so that, when any busbar needs to be maintained, network continuity can be sustained through another busbar. This is normally achieved by adopting a double busbar substation configuration[6] along with appropriate bus-section and coupler circuit breakers. However, for this to occur, the substation layout must include enough space, from the start, to accommodate the required double busbar, section and coupler topology. **Bay spacing** One way for substation design to improve the network's operational flexibility, and thus resilience, is by ensuring that, when one of the substation's circuit connection points (bays) needs to be maintained or repaired, this action can be safely achieved with a minimum (or no) need	**Design considerations** • Double busbar configurations are recommended for MITS supergrid substations. • Size and layout of substation footprint, particularly for strategically important substations. • Maintainability of both AIS and GIS substation bays with live neighbouring bays. • The differing requirements of MITS and customer only sites. Where a customer's site (not a MITS site) and the network can tolerate lower connection security, a single busbar or other configuration may be adequate.

[6] In accordance with NESO's Security and Quality of Supply Standard (SQSS), Appendix A

S2	Operational flexibility during network outage should be considered in the electrical design and layout of all new substations, substation extensions, and converter stations.
to also remove neighbouring bays from service. Again, for this to occur, Air Insulated Switchgear (AIS) substation layouts must include enough space and access around each bay, from the start, for them to be worked on safely with neighbouring bays live. For Gas Insulated Switchgear (GIS) substations, this same provision translates to incorporating sufficient space around the switchgear and Gas Insulated Busbar (GIB) equipment, in particular to facilitate lifting operations without impacting other circuits. It also translates to incorporating enough gas zones within the switchgear to allow interventions with single bay outages.	
References • National Electricity Transmission System (NETS) Security and Quality of Supply Standard (SQSS), NESO, April 2025	

<table>
<tr><th>S3</th><th>Consider current and anticipated future network needs in the location and layout of new substations including the availability of land to provide space for future connections.</th></tr>
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Rationale

Although designs for MITS substations cater for transmission connections known and planned for at the time of the original design, later on these same substations frequently need to accommodate further development triggered by new customer connection requests or wider system imperatives. However, these developments require additional physical space, which is acquired with much less time, cost, and disruption to neighbours and to the environment where the necessary land and planning provisions are negotiated at the time that the substation location is first established.

This future-proofing principle doesn't propose a specific planning horizon; rather, it encourages proactive review of the above triggers (potential customer connections and wider system imperatives) to anticipate and justify appropriate strategic investment in land to reduce both future connection delays and incremental local disruption. It advocates a holistic, do-it-once approach to substation design, with the starting presumption that the substation's ground footprint and planning consent will be sized for the connections anticipated by network planning processes, even if some equipment is installed later, as required.

Design considerations

- Land availability for the potential future expansion of the substation.
- Strategic investment to acquire options on land or buildings that would help future proof the substation's ability to satisfy demands on its accommodation.
- Coordination between network needs, customer needs, and future anticipated (not yet specifically identified) needs.
- The appropriate mix of fully equipped bays, skeleton bays (bays with minimal equipment) and future bay space provision (substation space that is initially undeveloped).
- Specification of switchgear capacity for futureproofing.
- Any restrictions on future connection types due to spare bay sizing.
- Space for anticipated (not yet specifically identified) transmission circuit entries, for circuit disposition between bus-sections, and for anticipated reactive compensation requirements.
- For DC multipurpose substations, whether they are designed multi-terminal ready[7].

References

- SSEN's Shetland multi-terminal link at 320 kV, Hitachi Energy, August 2020
- Tennet's approach for Germany and Netherlands, Tennet, April 2023
- CIGRE paper on Modular Offshore HVDC transmission planning principles, Cigre, 2024
- National Electricity Transmission System (NETS) Security and Quality of Supply Standard (SQSS), NESO, April 2025, Appendix A

</td></tr>
</table>

[7] Multi-terminal ready', as exampled by SSEN in Shetland, or Tennet for Germany and the Netherlands. Multi-terminal readiness considers the need to reserve offshore platform space for further bays and yet-to-be-refined HVDC circuit breakers as well as accommodating spare cable hang-offs and j-tubes in the platform design. Considerations are described by the referenced CIGRE paper on Modular Offshore HVDC transmission planning principles.

01	Strategic parameters, such as landfalls, routes, and technology for offshore cable corridors, should balance technical considerations with marine spatial constraints, considering potential impacts on the environment, community, and amenity, as well as deliverability and economic efficiency.

Rationale

Offshore cable corridor design at a strategic planning stage is foremost influenced by, and therefore must respect, the technical requirements of offshore cable technologies with marine spatial constraints. Key technical considerations at this stage include the required transmission capacity, number of circuits, and voltage level. Other factors, such as landfall location feasibility, route length, technology choice (High Voltage Alternating Current (HVAC) or High Voltage Direct Current (HVDC)), installation method feasibility and futureproofing, remain as design parameters to be balanced.

Design choices around these considerations interact differently with the marine spatial constraints and therefore impacts must be carefully balanced. Offshore corridors must navigate a complex marine environment shared with other users and protected areas such as shipping lanes, fishing grounds, military zones, historic environment assets, and environmentally sensitive habitats. Selection of suitable technology will inform the total project costs, delivery time, and spatial footprint. Alongside these considerations, the design process must also account for potential impacts on communities, environment, and economic efficiency. Offshore coordination (spatial and electrical) should be considered as a potential way of achieving further efficiencies, and where no material risks across the above-mentioned factors (technical, environmental, community, deliverability, economic) arise, or where risks can be reasonably managed, it should be taken forward.

Design considerations

- Technical needs for the provision of new transmission capacity and supporting SQSS requirements
- Potential for shared primary and auxiliary infrastructure onshore and offshore.
- Environmentally sensitive or protected areas, both on- and offshore (e.g. benthic marine protected areas), and the feasibility and cost of finding a proportionate environmental compensation for potential impacts thereon.

Offshore cable corridor considerations:

- Potential for shared cable corridors.
- Potential for shared marine survey campaigns.
- Marine constraints including (but not limited to) the marine ecology, marine physical environment, marine historic environment, seabed geology and topology, other marine infrastructure and sea users.
- Offshore areas that have restricted navigation i.e., moorings and shallow waters.
- Known wrecks and areas of archaeological/historical importance.
- Hazardous seabed terrain (e.g., bedrock outcrop, boulder fields, excess slopes, mobile sediments etc.).
- Third parties, including high intensity demersal and static gear fishing areas, local tourist trade, military practice zones and aggregate extraction areas/dredged channels.
- Anchorage areas, traffic separation schemes & high-density shipping lanes.
- Marine protected areas and sensitive nature conservation areas.

01	Strategic parameters, such as landfalls, routes, and technology for offshore cable corridors, should balance technical considerations with marine spatial constraints, considering potential impacts on the environment, community, and amenity, as well as deliverability and economic efficiency.

Landfall considerations:

- Physical characteristics of the coastline and area in the direct vicinity of landfalls.
- Availability of onshore space at the landfall location to host the required AC substations or DC converter stations and other auxiliary equipment.
- Availability of onshore transmission capacity in the vicinity of landfall locations.
- Presence of communities and/or sensitive environment in the vicinity of landfall locations who can be affected during construction and maintenance.
- Presence of other infrastructure.

References

- HND Follow Up Exercise Methodology, NESO, November 2022
- Export transmission cables for offshore renewable installations, Principles of Cable Routeing and Spacing, Crown Estate, 2012

6. Project Development Principles

Overhead Lines

Underground Cables

Substations

Offshore

Project Development Principles

The Project Development Principles serve as design guidance to be applied at the relevant stage of a project's lifecycle.

This section contains:

- Overhead Lines: Principles T3 to T7
- Underground Cables: Principle U1
- Substations: Principles S4 to S10
- Offshore: Principles O2 & O3

<table>
<tr><th>T3</th><th colspan="2">The starting presumption for support structures for double circuit overhead transmission lines is that they be of a steel lattice design.</th></tr>
<tr><td colspan="2">

Rationale

Where double circuit overhead transmission lines are selected, steel lattice towers offer several benefits over other forms of support structures (e.g. monopole constructions such as T-pylons). They have lower levels of embodied carbon (less concrete and steel, whilst still retaining excellent structural integrity), they are easier to construct and maintain (in general they do not require permanent access roads and they can be serviced using smaller site vehicles), and they are more cost-effective. In addition, the lengths of steel angle-section used in lattice towers can be more easily transported to, and assembled in, hard-to-access areas than the prefabricated sections of monopole designs causing less disruption to the environment and local ecology.

Alongside other benefits, the relatively open silhouette of lattice towers make them easier to see through, allowing them to be backdropped by local landscape features (especially in wooded or moorland areas). However, in certain highly situation-dependent settings, monopole constructions may offer an improved visual appearance.

Overhead lines form the backbone of the electricity supply to the national economy, so must continue to operate reliably through the very harshest British weather conditions. For this reason, whatever factors contribute to the selection of a transmission support design for a given project, be they technical, visual or both, only thoroughly tested, high-quality designs should be considered.

</td><td>

Design considerations

- Altitude, wind-speeds and ground conditions for the foundations.
- Where adverse effects of steel lattice towers on key receptors cannot be mitigated by careful routeing, consider whether alternative tower designs could be visually advantageous and economically justified.
- Differences in national planning policy frameworks degrees of protection between England, Wales, and Scotland.
- Locations of any transitions between different tower designs along a continuous route, considering technical requirements and visual impact.
- Wood poles as a proven alternative to single circuit steel lattice designs (132 kV in Scotland only), where future double circuit capacity is not envisaged.
- Opportunities to install structures capable of supporting higher voltages operation and operating at a lower standard voltage in the interim.

</td></tr>
<tr><td colspan="3">

References

- UK Electricity Act 1989, Gov.uk, Section 9(1) and Schedule 9
- Approach to Consenting, NGET April 2022

</td></tr>
</table>

T3	The starting presumption for support structures for double circuit overhead transmission lines is that they be of a steel lattice design.

- Approach to Routeing and Environmental Impact Assessment, SPEN, February 2020, p19
- The Holford Rules, Lord Holford, 1959, p5 – "In additional [sic] to adopting appropriate routeing, evaluate where appropriate the use of alternative tower designs now available where these would be advantageous visually, and where the extra cost can be justified."
- National Planning Framework 4 NPF4, Scottish Government, February 2023, Policy 11
- National Policy Statement for Electricity Networks EN-5, Department for Energy Security and Net Zero (DESNZ), March 2023
- Comparison of Electricity Transmission Technologies: Costs and Characteristics, IET, April 2025

T4	Route options for overhead lines should seek to avoid or minimise the impact on areas of amenity value which are afforded protection through national planning policies, acknowledging the hierarchy of protection designations.

Rationale	**Design considerations**
The most direct route between two substations is usually the most economic choice for new overhead lines, as it has the potential to minimises the length of infrastructure required and therefore reduces materials and construction costs. However, in developing route options for new overhead lines, designers may encounter areas of particular sensitivity. These may include settlement areas, designated landscapes, protected habitats, and Heritage Coasts. National Policy Statements (NPS) for England and Wales, and National Planning Framework 4 (NPF4) for Scotland, assign varying levels of protection of amenity to these areas that should be considered and addressed by all proposals for new developments. Design should endeavour to avoid or minimise, the impacts on the amenity value of sensitive areas. It is important to balance the hierarchy of designated protection in national planning policies against the costs of routeing an overhead line to avoid areas of amenity value.	• The type and extent of protection afforded to designated areas or buildings under relevant national planning policies[8] • Differences in policy frameworks and protection levels between England, Wales, and Scotland. • Trade-offs associated with lengthening routes to avoid protected areas, including the additional number, location and impact of the larger angle towers which are required. to change the direction of the new overhead line.

References

- National Policy Statement for Electricity Networks EN-5, DESNZ, March 2023
- National Planning Framework 4 NPF4, Scottish Government, February 2023
- UK Electricity Act 1989, Gov.uk, Section 9(1) and Schedule 9
- The Holford Rules, Lord Holford, 1959
- Rule#1 'Avoid altogether, if possible, the major areas of high amenity value, by so planning the general route of the line in the first place, even if the total mileage is somewhat increased in consequence.'

[8] For example, the NPS EN-5 [2.9.12] states for England and Wales that "*in nationally designated landscapes (for instance, National Parks, The Broads and Areas of Outstanding Natural Beauty) even residual impacts may well make an overhead line proposal unacceptable in planning terms*".

T4	**Route options for overhead lines should seek to avoid or minimise the impact on areas of amenity value which are afforded protection through national planning policies, acknowledging the hierarchy of protection designations.**

- Rule#2 'Avoid smaller areas of high amenity value, or scientific interest by deviation; provided that this can be done without using too many angle towers, i.e. the more massive structures that are used when lines change direction.'
- Rule#3: 'Other things being equal, choose the most direct line, with no sharp changes of direction and thus with few angle towers. '

T5	Route options for overhead lines should seek to balance the impacts on communities, landscape and visual amenity with other environmental and technical considerations.
Rationale Overhead line routes traverse areas of varying landform, topography, ecology, land use and population. The routeing and design of an overhead line must consider competing environmental, community and technical considerations, each of which require careful consideration to minimise the overall impact. This could involve, for example, balancing the benefits of avoiding prominent skylines or ridgelines and using natural screening (e.g. trees or hills) to break up views of the infrastructure and reduce perceived height of supports, against the potential drawback of routeing in lower-lying areas which may bring infrastructure closer to settlements and properties. Re-routeing part of the line is likely to affect adjacent sections of the line. Design should, therefore, demonstrate how often competing considerations, are balanced along the length of the overhead line route.	**Design considerations** • Proximity to settlements and land use categories, including residential, industrial, and mixed-use areas. • Topography and landform features that influence visibility and provide opportunities for screening. • Cumulative visual impacts from existing electricity infrastructure and other developments. • Opportunities to maintain visual consistency in tower design, height, and alignment. • Ecology, including wildlife areas such as woodlands, wetlands or bird migratory routes. • Deliverability and accessibility of the route for construction and ongoing maintenance.

References

- The Holford Rules, Lord Holford, 1959
- Rule#4: 'Choose tree and hill backgrounds in preference to sky backgrounds wherever possible; and when the line has to cross a ridge, secure this opaque background as long as possible and cross obliquely when a dip in the ridge provides an opportunity. Where it does not, cross directly, preferably between belts of trees.'
- Rule#5: 'Prefer moderately open valleys with woods where the apparent height of towers will be reduced, and views of the line will be broken by trees.'
- Rule#7: 'Approach urban areas through industrial zones, where they exist; and when pleasant residential and recreational land intervenes between the approach line and the substation, go carefully into the comparative costs of the undergrounding, for lines other than those of the highest voltage.'

T6	Where a continuous overhead line route cannot be identified, consider forms of mitigation for environmental, community and technical impacts.
Rationale Where a proposed new continuous overhead line route[9] passes through one or more protected areas and re-routeing is not feasible, a review of the likely adverse effects should be undertaken as part of the Environmental Impact Assessment (EIA) to determine whether there is an emerging case for considering other forms of mitigation. Mitigation options come with their own set of challenges and must be thoroughly justified in balancing economic viability, technical feasibility and the extent of the predicted effects on a receptor or grouping of receptors. Alternative tower designs, such as monopole and low-height steel lattice towers, can reduce landscape disruption and lessen visual impacts in certain situations. However, these designs are often more difficult to construct and maintain. They may also have higher levels of embodied carbon compared to traditional full-height steel lattice towers. Additionally, their increased costs must be weighed against their effectiveness. Where the effects on a particular sensitive receptor or group of receptors, in cognisance of stakeholder feedback, are assessed by the relevant professional as being over and above the thresholds of significance defined in relevant EIA legislation and guidance, or where the technical feasibility brings into question the continuity of an overhead line, and where these effects cannot be otherwise mitigated, undergrounding sections of the line may be the only viable alternative. The assessment of potential underground solutions must carefully consider the advantages and disadvantages of undergrounding, taking cognisance of costs and	**Design considerations** • Alternative tower designs, including lower height steel lattice towers and monopoles. • Where factors are identified that call into question the continuity of an overhead line route, carefully consider the advantages and disadvantages of undergrounding, without incurring excessive costs and the technical issues associated with undergrounding. • As a guiding example, undergrounding a section of a line should be carefully considered where it crosses a National Park, Area of Outstanding Natural Beauty or a National Scenic Area, provided no suitable overhead line route can be identified. • Ground conditions preventing certain cable ratings, complex crossings with other infrastructure, other designations and limited access areas. • Availability of space for cable sealing end compounds and their impacts on the visual amenity. • Holistic impact of the proposed mitigation measures on the project – the balance between the benefits achieved through the mitigation and the costs and risks involved therein.

[9] In this context, a “continuous” overhead line refers to a design with no underground sections and consistent support structures used throughout the route.

T6	Where a continuous overhead line route cannot be identified, consider forms of mitigation for environmental, community and technical impacts.
effects of associated technical issues within the context of relevant license obligations.	

References

- National Policy Statement for Electricity Networks EN-5, DESNZ, March 2023, Paragraphs 2.9.20, 2.9.23 to 2.9.25
- National Planning Framework 4 NPF4, Scottish Government, February 2023, Policy 11(e)
- Comparison of Electricity Transmission Technologies: Costs and Characteristics, IET, April 2025
- Approach to Routeing and Environmental Impact Assessment, SPEN, February 2020, p9

T7	Consider overhead line transmission routes and designs that minimise susceptibility to high-impact physical and climate-related events.
Rationale Intense flooding, coastal erosion, and the increasing frequency of extreme weather events are all effects of climate change which threaten the resilience of Great Britain's transmission networks. Whilst overhead lines are designed to be exposed to sustained periods of wind and rain, temperature fluctuations and ice loading, this infrastructure remains susceptible to more severe external influences, for example very high temperatures and airborne debris. Environmental hazards such as flooding and wildfires can compromise the mechanical integrity of conductors and tower structures, posing a risk to the safety of the equipment and its surroundings. Disruptions can be temporary, for example, owing to an electrical flashover across the insulation, or more permanent, such as a compromised tower structure. The resulting failure of an overhead transmission line becomes not only a safety hazard, but can undermine the system's operational flexibility, heightening the risk to security of supply. In addition to environmental risks, transmission routes may also be exposed to malicious threats, such as sabotage or coordinated attacks. Once constructed and in operation, transmission infrastructure is rarely relocated due to its scale and its integral role to the operation of the transmission system at any given time. Moreover, overhead lines constructed using steel lattice towers are generally designed to operate for up to 80 years, so it is vitally important to account for physical and climate related risks in their routeing and design.	**Design considerations** • Risk zones, including areas prone to natural hazards such as flooding, land slip, high winds, icing, and wildfires, can restrict access for maintenance or repair. Risks can be mitigated with strategies such as designing for flood resilient infrastructure, crossing at a risk zone's narrowest point, as directly as possible, spanning the lowest flood levels by choosing tower locations above normal flood levels.
References • ETR 138 Resilience to flooding of Grid and Primary substations, ENA, 2018	

T7	**Consider overhead line transmission routes and designs that minimise susceptibility to high-impact physical and climate-related events.**

- CCAR4 ENA Fourth Round Climate Change Adaptation Report, ENA, December 2024
- Approach to Routeing and Environmental Impact Assessment, SPEN, February 2020, p12
- National Policy Statement for Electricity Networks EN-5, DESNZ, March 2023, Section2.3 "…ensure that electricity networks infrastructure is resilient to the effects of climate change."
- Electricity Safety, Quality and Continuity Regulations, Gov.uk, 2002

U1	Where underground transmission cables are proposed, respect the constraints of underground technology, including ground conditions, land use and access considerations in the design of the route, balancing impacts on the community, landscape and visual amenity and environmental considerations.
Rationale Underground transmission cable routeing differs fundamentally from the landscape-led approach used for overhead lines. While overhead line design prioritises minimising visual and landscape impacts, underground cable routeing is primarily engineering-led. This means routes are determined by technical feasibility, constructability, safety, and cost. High-capacity underground circuits require wide construction swathes (typically 35–70 metres) to allow for heat dissipation, with trenches buried around 1.2 metres deep. These physical requirements, combined with the need to avoid challenging ground conditions, flood zones, and sensitive habitats, and the greater motivation for routes to be shorter due to the increased cost of underground cables, often result in routes that diverge significantly from those of an equivalent overhead line. Although, with the exception of the cable sealing ends, they are less visually intrusive post-construction, underground cables cause substantial ground disturbance and have the potential to increase landowner impacts during installation, compared to an equivalent overhead line. The success of reinstatement varies by land type, being quicker in agricultural land and most visible in uplands or semi-natural areas. Unlike overhead lines, which can span certain obstacles such as rivers and railways, underground cables typically avoid them or use specialist and expensive methods, such as horizontal directional drilling (HDD) or tunnelling, to install the cables safely under the obstacle. This can significantly increase project costs and in some locations may not be technically feasible. As such, careful route selection, habitat reinstatement, and long-term access planning are essential to minimise both temporary and permanent environmental effects.	**Design considerations** • Technical constraints including bending radius, heat dissipation of cables, access for maintenance and additional equipment to provide reactive power compensation, where relevant, for underground cables. • Disturbances during construction and repair (noise, visual, air quality, environmental, soil, drainage, archaeology). • Opportunities to route along existing disturbed corridors such as roads or existing infrastructure to reduce new impacts, being mindful of physical resilience implications and access requirements during construction and operation. • Ground conditions including risk of contamination and ground stability. • Longer construction and repair times than overhead lines. • The requirement to build additional above ground infrastructure such as cable sealing end compounds and link pillars together with the need for reactive compensation equipment at nearby substations (physical limitations of distancing for reactive compensation stations). • Safety and land use requirements in areas directly above the buried cables. • The cost and availability of underground cables for a given application, which may vary on a case-by-case basis. • Susceptibility to high-impact physical and climate related events, including flooding.

U1	**Where underground transmission cables are proposed, respect the constraints of underground technology, including ground conditions, land use and access considerations in the design of the route, balancing impacts on the community, landscape and visual amenity and environmental considerations.**

References

- Approach to Routeing and Environmental Impact Assessment, SPEN, February 2020
- Undergrounding high voltage electricity transmission lines - The Technical Issues, NGET, January 2015

S4	Where possible, locate new substations or converter stations near to the infrastructure to which it will connect.
Rationale During the Project Development stage, when locational flexibility is more limited than at the Network Planning stage, siting decisions should be optimised to reduce infrastructure requirements and their associated impacts. For new substations or converter stations that connect to existing infrastructure, locating them in close proximity to these existing assets typically reduces the extent of new connection infrastructure required, including any necessary diversions of existing circuits, reducing both cost and associated impacts.	**Design considerations** • Distance to existing transmission infrastructure requiring connection or diversion. • Number and configuration of circuit entries and exits and the length and routeing complexity of new transmission connections required • Land availability and ground conditions. • Access requirements for construction and maintenance.
References • Informed by discussions and engagement with transmission project developers.	

S5	Choose locations for new substations and converter stations that minimise susceptibility to high-impact physical and climate related events, where possible.
Rationale Extreme climate related events, such as floods, land slip, wildfires and heatwaves, present an enduring threat to the resilience of Great Britain's transmission networks. These events are increasing in frequency and intensity due to climate change, which poses new challenges for designers of transmission substations. Substations are also susceptible to malicious threats, such as sabotage or coordinated attacks. With effective siting and design these risks can often be minimised to ensure infrastructure security and operational continuity. Once constructed and in operation, transmission infrastructure is rarely relocated due to its scale and its integral role to the operation of the transmission system at any given time. Moreover, substations are generally designed to operate for 40 years, or longer, so it is vitally important to account for physical and climate related risks in the positioning and design of new transmission infrastructure.	**Design considerations** • Areas prone to natural hazards such as flooding, land slip, high winds, icing, and wildfires. • Electrical redundancy and diversity of substation auxiliary supply. • Single points of failure for incoming and outgoing circuits of Main Interconnected Transmission System (MITS) substations. • Materials and equipment that operate efficiently under foreseeable environmental conditions. • Mitigation measures, for example, flood prevention measures including water barriers, raising equipment within a substation or converter station, and land management-based measures. • Ease of operational and maintenance access. • Measures to deter non-authorised entry onto substations.
References • Flood defence framework for National Grid substations in United Kingdom, Climate Adapt, 2019 • Enhancing Resilience in UK Energy Networks, DESNZ, April 2024 • Electricity Safety, Quality and Continuity Regulations, Gov.uk, 2002	

S6 Substation or converter station design choices related to indoor or outdoor, and to air insulated or gas insulated switchgear, should be based on site-specific factors including environmental and community impacts, spatial constraints and whole-life cost.

Rationale (general)

Buildings: A substation may be installed either outdoors or indoors in a protective building.

Technology: A substation's switchgear is based upon one of two technologies: either the connections and busbars are insulated from ground and from each other by air - Air Insulated Switchgear (AIS), or they are placed in tubular metal enclosures and insulated from ground by an insulating gas - Gas Insulated Switchgear (GIS).

Both installation types and both technologies have their advantages, as outlined next.

Rationale (indoor or outdoor?)

Transmission substations may be installed outdoors or enclosed in protective buildings. Whilst it is less costly to install substations outdoors, there are a few reasons why some substations are installed indoors, key amongst them being:

- For GIS: The UK climate tends to degrade the external parts of GIS, impacting its long-term reliability and, in particular, compromising its ability to effectively retain the insulating gas, so GIS equipment is normally, though not always, enclosed indoors. An exception to this is Gas Insulated Busbar (GIB), which is frequently installed outdoors to facilitate connections to incoming transmission circuits.
- For AIS: Pollution, such as salt from blown sea spray, or industrial pollution, would degrade the performance of AIS substation steelwork, insulators and other components. Therefore, AIS substations exposed to these risks may well be installed indoors to mitigate these risks. The physical scale and associated costs of the required building become increasingly significant at higher transmission voltages.
- For AIS: Extreme weather risk (for example, heavy icing, severe snow, high winds) in some locations may lead to the judgement that, for substations in these areas, network operability and resilience are enhanced by enclosing them, or part of them, indoors.

Rationale (AIS or GIS technology?)

- Technically, AIS substations are simpler to repair than GIS. On the other hand, healthy GIS equipment is simpler to maintain and can be maintained less frequently than AIS. Another technical factor is the substation building; AIS can be installed indoors or outdoors depending upon the severity of the weather and pollution levels, however, at least in the UK, GIS is normally installed indoors to preserve its operational reliability , and an indoor GIS solution is generally more cost effective than an indoor AIS solution due to the prohibitive cost of an AIS substation building. The expected lifetime of indoor GIS equipment is greater than outdoor equipment as the equipment is protected from the environment.

S6	Substation or converter station design choices related to indoor or outdoor, and to air insulated or gas insulated switchgear, should be based on site-specific factors including environmental and community impacts, spatial constraints and whole-life cost.

- Should a substation extension be required in the future, and assuming the extra space is available, AIS is easier to extend and has lower reliance on the original equipment manufacturer than GIS, though a full replacement of an AIS substation can be more challenging than a GIS replacement.
- For AIS substations, individual asset replacement or refurbishment can be used to target specific assets; however, should a full site replacement be required, this can be challenging due to the space required for an offline replacement or the operational complexities associated with an in-situ replacement.
- Environmentally, the size of the substation footprint will proportionally affect the volume of earthworks and quantities of concrete and steel required during construction, with some biodiversity impacts also scaling proportionally. Conversely, GIS involves greater use of metal in its insulating enclosures compared to AIS. A site-specific assessment should consider the balance of these factors. Meanwhile operationally, AIS substations almost invariably use much smaller amounts of insulating and interrupting gas and have less gas seals to manage per bay than equivalent GIS substations. Historically, the IIG used in both AIS and GIS has been sulphur hexafluoride (SF6), which has a very powerful global warming potential (GWP). From around 2025, GIS installations will use SF6-free F-gases, and AIS installations are expected to follow this practice within the next 1-2 years. SF6-free F-gases still have high GWP, but a leakage of SF6-free F-gas will have an environmental impact only 1-2% of that of the same mass of SF6 so this is anticipated to become less of an environmental issue in future.
- Community- wise, the comparative effects of the two technologies depend upon the local landscape, the extent of the land take and upon the degree of visual impact mitigation applied to the site. Regarding the space requirement, the headline benefit of GIS is that it needs a smaller ground footprint than AIS. However, this only relates to the switchgear itself, not to the other substation components, such as transformers, reactive compensation, and overhead line entries. For this reason, the space-saving benefit of GIS is usually less pronounced for substations with a greater number of circuits, where the other substation components increasingly affect the land area requirement. Regarding visual impact, where AIS is installed outdoors, the relatively open silhouette of AIS and its smaller ancillary buildings, compares with the larger GIS building that is taller, wider and longer than the equipment it contains. Except in built-up areas, screening by trees and earthworks can equally be applied to both substation technologies to reduce the visual impacts.
- Cost-wise, the purchase cost for GIS equipment is normally higher than for the AIS equivalent , although the overall lifetime cost comparison for the full solution between the two technologies will depend upon many factors including the location, land-take and planning conditions, the cost of land, the need for a substation building, the extent of earthworks, carbon costing, and projected maintenance and repair costs.

Given the above factors, outdoor AIS can often be the economic choice for new substation designs. However, the key benefit of GIS, namely that it requires a significantly reduced ground footprint compared to that of AIS, means it can offer economic and efficient solutions in space-constrained circumstances for which AIS cannot be considered or in less constrained areas can provide greater opportunities for future expansion. GIS is thus a valuable option in the transmission designer's toolbox.

S6	Substation or converter station design choices related to indoor or outdoor, and to air insulated or gas insulated switchgear, should be based on site-specific factors including environmental and community impacts, spatial constraints and whole-life cost.

Design considerations

Substation design is complex and affected by many variables:

- Where space is unconstrained and there is a low risk from pollution or extreme weather, outdoor AIS can often be the most economic and efficient solution, whereas indoor GIS is generally more suitable where space is constrained or there is risk from pollution or extreme weather.
- Visual impact from key viewpoints considering the smaller footprint of a GIS building versus the larger footprint and openness of AIS.
- Expected pollution levels (salt spray or other airborne pollution).
- Severity of anticipated weather conditions such as heavy icing or high winds.
- The availability of consentable land areas.
- The GWP of the composition of gases that comprise the insulating medium. (Whilst distinctly less potent than legacy SF6, an insulating medium that contains a mixture of the F-gas Fluoronitrile (C4-FN) is still a powerful greenhouse gas.)
- Ecological and resources effects such as disturbance of peat and mineral-rich soils

References

- The Horlock Rules for the Siting and Design of Substations, National Grid Company, 2006, Rule#7 Note 8 'Where there are particular technical or environmental constraints, it may be appropriate to consider the use of GIS equipment which occupies less space and is usually enclosed within a building'
- Evaluation of Different Switchgear Technologies (AIS, MTS, GIS) For Rated Voltages of 52 kV an Above (390), Cigre, August 2009

<table>
<tr><th>S7</th><th colspan="2">Optimise, with respect to its surroundings, the space to be occupied by any new substation or converter station, its line entries, and potential future extensions.</th></tr>
<tr><td colspan="2">Rationale

Whilst Substation Design Principle S3 urges the designer to set aside enough space for current and future substation needs, this complementary Principle focuses upon using that space efficiently, balancing technical requirements with careful regard to the community and the uses of land into which it is placed, to minimise disruption to the lives, businesses and environment that its arrival effects.

Early consultation with stakeholders allows understanding of the local issues, as a first step to optimising the location and layout of the substation and its transmission line entries. Consideration should be given to mitigating any changes of access to roads, buildings, footpaths and fields and to the useability of land parcels that are left surrounding the station. Consideration should also be given to mitigating visual and acoustic noise effects. In rural locations this could be through tree planting or earthworks, for which additional ground space would most likely be required whilst, in urban environments, suitable perimeter walls or buildings might offer the most appropriate impact mitigation of visual effects.</td><td>Design considerations

• Access and egress for abnormal indivisible loads.
• Access and accommodation for Construction.
• Access, egress, and control point facilities for emergency services (fire, police and ambulance).
• Utility diversions.
• Detour lengths and routes for established rights of way.
• Drainage considerations, minimising environmental impacts and maintaining established field boundaries.</td></tr>
<tr><td colspan="3">References
• The Horlock Rules for the Siting and Design of Substations, National Grid Company, 2006
• Rule#4: ‘The siting of substations, extensions and associated proposals should take advantage of the screening provided by landform and existing features and the potential use of site layout and levels to keep intrusion into surrounding areas to a reasonably practicable minimum. ’
• Rule#6 ‘The land use effects of the proposal should be considered when planning the siting of substations or extensions.’
• Rule#8: ‘Space should be used effectively to limit the area required for development consistent with appropriate mitigation measures and to minimise the adverse effects on existing land use and rights of way, whilst also having regard to future extension of the substation.’</td></tr>
</table>

S8	Consider the implications of overhead line and underground cable connections in the siting and design of substations or converter stations, and any mitigation or enhancement required.
Rationale Where overhead lines converge and enter a substation or converter station, the visual effect of the lines and their terminal towers, or 'wirescape' must be carefully considered. The design of these assets should endeavour to mitigate cumulative wirescape issues by siting line entries and using visual screening in this way helping to ensure that landscape and environmental factors are considered alongside technical requirements.	**Design considerations** • Existing and planned overhead line entries, potential conglomerations of structures and wires, as seen from key viewpoints. • Cumulative visual impacts at key viewpoints due to anticipated substation or converter station extensions or new line entries. • Visual impact mitigation such using landscaping as screening. • Environmental impacts. • Planned customer connections to sites via either overhead line or underground cables.

References

- The Horlock Rules for the Siting and Design of Substations, National Grid Company, 2006
- Rule#6: 'In country which is flat and sparsely planted, keep the high voltage lines as far as possible independent of smaller lines, converging routes, distribution poles and other masts, wires and cables, to avoid a concatenation or 'wirescape.'
- Rule#7: 'In the design of new substations or line entries, early consideration should be given to the options available for terminal towers, equipment, buildings and ancillary development appropriate to individual locations, seeking to keep effects to a reasonably practicable minimum.'
- Rule #10: 'In open landscape especially, high voltage line entries should be kept, as far as possible, visually separate from low voltage lines and other overhead lines so as to avoid a confusing appearance.'

S9	Where possible, the design of substations, converter stations, access roads and other ancillary developments should consider the local environment in the vicinity of the new infrastructure.

Rationale

A new substation or converter station, with its access road and other ancillary developments can have a considerable impact upon the ecology, hydrology and visual amenity of the locality. However, with careful consideration during the project development stage, most effects can at least be mitigated, if not avoided.

Substation and converter station design should ensure that, whilst any new substation achieves its functional purpose, its impacts on its surroundings are studied during design so that impacts can be mitigated to the extent practicable. For visual impact mitigation this could take the form of careful siting and layout of the infrastructure, consideration of the design, colour and form of buildings, or partial visual screening with vegetation or earthworks. For ecological impacts, substation design should endeavour to minimise negative effects.

Design considerations

- Ecological effects on the surrounding area, including potential impacts on habitats and species.
- Hydrological conditions, such as flood risk and water flow patterns, which influence both siting and design of infrastructure and access roads.
- Visual impact from key viewpoints, with opportunities for mitigation through siting, layout, building form, colour, and screening measures.

References

- The Horlock Rules for the Siting and Design of Substations, National Grid Company, 2006
- Rule#1: 'In the development of system options including new substations, consideration must be given to environmental issues from the earliest stage to balance the technical benefits and capital cost requirements for new developments against the consequential environmental effects in order to keep adverse effects to a reasonably practicable minimum.'
- Rule#3: 'Areas of local amenity value, important existing habitats and landscape features including ancient woodland, historic hedgerows, surface and ground water sources and nature conservation areas should be protected as far as reasonably practicable.'
- Rule#5: 'The proposals should keep the visual, noise and other environmental effects to a reasonably practicable minimum'
- Rule#9: 'The design of access roads, perimeter fencing, earth shaping, planting and ancillary development should form an integral part of the site layout and design to fit in with the surroundings.'
- Rule#11: 'The inter-relationship between towers and substation structures and background and foreground features should be studied to reduce the prominence of structures from main viewpoints. Where practicable the exposure of terminal towers on prominent ridges should be minimised by siting towers against a background of trees rather than open skylines.'

S10	When designing substations, substation extensions, and converter stations, seek to minimise carbon impact in construction and operations
Rationale As with all major infrastructure projects, the construction of substations and extensions depends on materials such as concrete and steel, which are often manufactured using relatively carbon-intensive processes. Designers should seek to minimise the lifetime carbon impact from these sources whilst also considering other sustainable construction and operational solutions that may arise from time to time.	**Design considerations** • Extent of disturbance to natural carbon sequestration (e.g. trees, peat, wetlands, ponds and, offshore, seaweed). • The degree to which the substation's layout follows land contours, to minimise energy-consuming earth-moving. • Type(s) of concrete used, and associated water consumption. • Potential for natural air and oil flow cooling systems to reduce operational emission, supported by appropriate equipment and thermal design, and noting the trade-off with this leading to larger equipment sizing. • Balance between lifetime operational emissions from technical losses and cooling, and the embodied carbon from equipment manufacture.
References • Informed by discussions and engagement with transmission project developers.	

O2 In the design of offshore cable routes, and their respective points of landfall, consider opportunities and risks arising from coordination with other existing and planned offshore infrastructure in the region

Rationale

Developers of offshore electrical infrastructure should look for ways to coordinate with other projects. This could include, at the earlier stages of a project's development, consideration of shared cable corridors, common infrastructure, and coordinating development timelines. Aligning cable paths and landfall sites can help reduce environmental impacts, especially in protected coastal and marine areas. Coordination can bring several benefits:

- More efficient use of space by routeing multiple cables along parallel corridors and towards common landing points.
- Less disruption to the seabed and onshore areas.
- Minimising interactions with existing infrastructure and avoiding overlapping routes.
- Lower cost by sharing surveys, equipment, and construction efforts (e.g. installation vessels and trenching operations).
- Easier compliance with environmental and other regulations.

However, coordination also comes with risks:

- Possible delays or additional costs if projects are interdependent.
- Increased vulnerability to damage or failure resulting in security risks if assets are too close to each other.
- Challenges in accessing and repairing shared infrastructure.
- Potential risks due to interface management between multiple developers – delays, dependencies, commercial, regulatory and liability difficulties, etc – that would prevent the transmission developers from meeting their license obligations.

Once a cable route is chosen, considering other projects, the developer does not need to change it later to accommodate new third-party plans.

Design considerations

At the earlier stages of a project's development:

- Potential for shared marine survey campaigns.
- Potential for shared primary and auxiliary infrastructure onshore and offshore.
- Potential for shared cable corridors.

In the subsequent stages of a project's development:

- Restricted marine areas which limit space for cables or impose constraints on subsea routeing.
- Requirements for cable spacing for the projects under consideration and the availability of required seabed and landfall area.
- Relative timing and location of developments in the vicinity.
- Potential to minimise cable crossing.
- Potential for shared impact mitigation measures, subject to each project's consents obligations.
- Potential security and safety risks due to physical proximity of coordinated assets – risks of common failure modes (internal failures and external damages).
- Ease of access for repair and servicing.

References

- Proximity Study, The Crown Estate, 2012

03	Landfall area locations should meet the technical requirements of the overall project, while respecting both marine and terrestrial constraints, considering potential impacts on environment, community, as well as deliverability and economic efficiency.
Rationale Offshore infrastructure makes landfall at various locations along the coastline of Great Britain. For electricity infrastructure, the general location of landfall is in the first place influenced by the technical need to provide transmission capacity. At the same time, other considerations, namely detailed technical design, environmental constraints, impacts on community, economic efficiency, deliverability and security of supply, are important in determining the landfall location. Moreover, the coastline surrounding Great Britain is home to a diverse array of terrestrial and marine habitats and ecosystems, protected landscapes, archaeological sites, conservation areas, geological and physical features, alongside settlements, recreational amenities, as well as infrastructure and technology, such as coastal defences oil and gas pipelines and telecommunications cables.	**Design considerations** • The primary technical need justifying the new development, and thus determining the wider region for the location of the landfall • Location of feasible onshore landfall locations with reference to multiple marine and terrestrial spatial constraints, including local communities and tourism; environmental designations and features of conversation importance, historic environment designates sites and features of interest; suitable geology and topography as well as other existing or planned infrastructure. Consideration should also be given to availability of access roads and other enabling infrastructure and facilities. • Availability of sufficient onshore space at the landfall location to host the required High Voltage Alternating Current (HVAC) or High Voltage Direct Current (HVDC) cables and other auxiliary equipment. • Location of point of connection with available capacity for feed-in • The offshore and onshore cable and their impacts on sensitive areas, local communities and the environment. • Potential for applying mitigation measures as appropriate.
References • Proximity Study, The Crown Estate, 2012	

7. How to respond

How to respond to this consultation

How to respond to this Consultation

The National Energy System Operator (NESO) has published this consultation document to seek feedback on the content of this, the first iteration of the Principles.

The consultation is open to all individuals and organisations and will close at 11:59pm BST on Sunday, 26 October 2025.

Please submit your response using our online form: etdp-consultation response

We have included specific questions where we would particularly welcome your feedback. However, we would welcome other comments on the proposed Principles, and would request that they be provided with due consideration to the mission statement and purpose of the Principles.

Consultation Questions

1. Do you agree that the Principles are written in a clear and accessible manner?
2. Given the context of the mission statement, are there any guidelines for transmission design that you think are missing?
3. Which Principles are you supportive of and which do you disagree with and why?
4. Do the Principles promote transparency in decision-making about new transmission projects?
5. Are the Principles realistic and actionable for designers and users of the Principles?

8. Next steps

Next Steps

Following the close of this consultation, The National Energy System Operator (NESO) will review and analyse all responses received. The ETDP Working Group will then reconvene to consider this feedback before publication of a final version of the Principles in early 2026.

Once published, the Principles will undergo an initial review within the first year of implementation to assess their effectiveness and identify any necessary refinements.

It is anticipated that, subject to review by relevant policymakers, the Principles would be referenced in the National Policy Statement EN-5 – 'Electricity Networks National Policy Statement' in England and Wales, and compliment the National Planning Framework 4 in Scotland.

Subsequent reviews and revisions of the Principles will be undertaken in alignment with updates to the National Policy Statements and/or National Planning Framework, ensuring the Principles remain current and fit for purpose. These reviews will be overseen by a Working Group with similar representation to the current ETDP Working Group.

9. 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.

The contents of this report must be considered as illustrative only and no warranty can be or is made as to the accuracy and completeness of such contents, nor shall anything within this report constitute an offer capable of acceptance or form the basis of any contract.

Other than in the event of fraudulent misstatement or fraudulent misrepresentation, NESO does not accept any responsibility for any use which is made of the information contained within this report.

10. Glossary

Acronym	Description
Air Insulated Switchgear (AIS)	Switchgear that uses air as an insulating medium to dissipate fault currents.
Centralised Strategic Network Plan (CSNP)	A longer-term strategic assessment of transmission network needs, primarily for the transfer of energy across electricity transmission, gas transmission, and hydrogen, initially to 2050 but with a rolling 25-year time horizon. It will assess options for achieving the net zero target and select optimal projects for a shorter term delivery, and a longer term range of potential projects for future delivery.
Department for Energy Security and Net Zero (DESNZ)	UK Government department focused on the energy portfolio, formerly part of the Department for Business, Energy and Industrial Strategy (BEIS). DESNZ is responsible for delivering security of energy supply, ensuring properly functioning energy markets, encouraging greater energy efficiency and seizing the opportunities of net zero to lead the world in new green industries.
Electricity Transmission Design Principles (ETDP)	The ETDP are a key recommendation outlined by the Electricity Network Commissioner Nick Winser, and discharged by the Transmission Acceleration Action Plan. These principles seek to provide greater clarity on the type of asset to be considered in different environments and to set out the core rationale and design considerations that shape the development of the electricity transmission system.
Environmental Impact Assessment (EIA)	A process that evaluates the potential environmental consequences of a project or development before it is approved.
Gas Insulated Switchgear (GIS)	Switchgear that uses gas (typically F-gas) as an insulating medium to dissipate fault currents. Can also be used for a Gas Insulated Busbar (GIB).
Global Warming Potential (GWP)	A measure of how much heat a greenhouse gas traps in the atmosphere over a specific time period, relative to carbon dioxide (CO_2).
Horizontal Directional Drilling (HDD)	A method of undergrounding cable for short sections to mitigate against challenging topography or other infrastructure obstacles.

Acronym	Description
High Voltage Alternating Current (HVAC)	Transmission voltages of 400 kV and 275 kV in England and Wales, and 400 kV, 275 kV and 132 kV in Scotland.
High Voltage Direct Current (HVDC)	Transmission voltage typically at ±320 kV or ±525 kV using direct current to transmit power over significant distances minimising transmission losses. An offshore High Voltage Direct Current (HVDC) transmission link comprises two onshore DC converter stations connected to separate nodes on the transmission network, along with two or three HVDC offshore cables connecting the two converters. Each of these converter stations is expected to occupy between 4- 5 Ha, which is approximately 8 times larger than a football pitch. It is important to note that not all offshore cables use HVDC technology; routes of a few tens of kilometers can use High-Voltage Alternating Current.
Main Interconnected Transmission System (MITS)	High-voltage electricity transmission network in Great Britain, specifically the 400 kV and 275 kV supergrid elements and, in Scotland, the 132 kV systems connected to them.
National Energy System Operator (NESO)	NESO is the independent energy system operator in Great Britain. Taking a whole system approach, NESO plan the electricity and gas systems and operate the electricity system to drive the transition to net zero.
National Planning Framework (NPF)	NPF sets out spatial principles, regional priorities, developments and planning policy for Scotland.
National Policy Statements (NPS)	Statutory documents published in accordance with the Planning Act 2008.
Offshore Transmission	Offshore transmission projects including bootstraps, OFTO connections, and interconnectors are all within the scope of ETDP.
Overhead Line (OHL)	A high voltage transmission circuit carried by lattice towers or wooden poles at 132 kV for Scotland.

Acronym	Description
The Office of Gas and Electricity Markets (Ofgem)	Ofgem is the government regulator for the electricity and downstream natural gas markets in Great Britain. Their principal objective is to protect the interests of existing and future electricity and gas consumers.
Security and Quality of Supply Standard (SQSS)	It sets out the criteria and methodology for planning and operating the National Electricity Transmission System onshore and offshore.
Strategic Spatial Energy Plan (SSEP)	The SSEP will spatially map the optimal mix and location of clean generation and storage to meet forecast demand, net zero targets, and security of supply for all consumers.
Supergrid	The supergrid refers to the high-voltage transmission network, primarily operating at or above 275 kV, that facilitates the long-distance transfer of electricity across Great Britain.
Transmission Acceleration Action Plan (TAAP)	The government's response to the Electricity Network Commissioner's report on accelerating electricity transmission network build. The Action Plan seeks to halve the end-to-end build time of electricity transmission network infrastructure, from 14 to 7 years.
Transmission Owners (TOs)	A collective term used to describe the three transmission asset owners within Great Britain, namely National Grid Electricity Transmission (NGET), Scottish and Southern Electricity Networks – Transmission (SSEN-T) and SP Transmission Limited (SPT).
Underground Cable (UGC)	A high voltage transmission cable originating onshore, including those whose routes are partly offshore. UGC make up approximately 5% of the existing transmission system in England and Wales. Most underground cables are installed in urban areas, where it is less practical to use OHLs.
Working Group/ ETDP Working Group	The group convened by NESO to develop the Principles, consisting of subject matter experts from the Great Britain Transmission Owners, UK Government, Scottish Government, Welsh Government, and Ofgem. The Planning Inspectorate also joined the group during the development of the Principles.

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

Email: box.sep-engagement@neso.energy

www.neso.energy