2. Project Need and Alternatives

2.1. Introduction

Options appraisal is an integral part of the Project development. The requirements to consider reasonable alternatives in the design of a project is set out in Schedule 3 paragraph 2 of the Marine Works (Environmental Impact Assessment) Regulations 2007 (as amended). Although the Project will not require a statutory EIA, the Applicants, have elected in this case, having regard to Schedule 9 of the Electricity Act 1989 (which places an obligation to preservation of amenity), and requirements of the English and Scottish Habitats Regulations and Offshore Habitats Regulations[3], to undertake suitable MEAs .In line with best practice the Applicant intends to provide a description of the reasonable alternatives (in terms of project design, technology, location, size and scale), which are relevant to the proposed project, the regulated activity and their specific characteristics, and an indication of the main reasons for selecting the chosen option, including a comparison of the environmental effects. Under the Habitats and Offshore Habitats Regulations, if the Appropriate Assessment process concludes that a project will have an adverse effect on the integrity of a European site (i.e., Special Areas of Conservation and Special Protection Areas), the Applicant must be able to demonstrate that all reasonable feasible alternatives have been assessed and that the least potentially damaging option has been selected.

Options appraisal is used by the Applicants to consider the implications of the selection of certain options when developing infrastructure projects. This chapter seeks to demonstrate that reasonable feasible alternatives have been, and will continue to be, considered during the design and development of the Project. The overall aim of the process is to ensure that the final Project design has assessed and adequately mitigated all potential environmental effects from a physical, biological and socio-economic perspective whilst ensuring that it delivers on the project's objectives of providing essential additional electricity transmission capability between Scotland and England.

The structure of this section (as outlined in Table 2-1) sequentially follows the decision-making process that has led to the design presented in the Scoping Report. It should be noted that all information in this section is based on the best available information at the time of writing. Engagement with stakeholders on offshore cable routeing is ongoing and will continue to influence the consideration of alternatives.

Table 2-1: Structure of Chapter 2

Section		Description
2.2	Need for the Project	This sub-section outlines the national policy driving the need for the Project and the public benefits addressed by its development.
2.3	Objectives of the Project	This sub-section defines the core and secondary objectives which must be fulfilled by any feasible solution.
2.4	Alternative solutions that can be discounted immediately	This sub-section identifies the alternative solutions that have been discounted immediately because they do not meet the core project objectives. It includes: • Do nothing • Alternative transmission options • Reduce electricity demand
2.5	Alternative solutions that are feasible alternatives	This sub-section identifies all feasible alternative solutions and justifies why the selected solution has been selected. It has been split into the following sub-sections: • Alternative technology • Alternative national connection points • Alternative landfall sites • Alternative offshore cable routes • Alternative construction techniques

2.2. Need for the Project

This section explains the importance of energy infrastructure, enhancing security of supply and maintaining a properly functioning energy market.

[3] Conservation of Habitats and Species Regulations 2017 (as amended) (England) and Conservation (Natural Habitats, &c.) Regulations 1994 (as amended) (Scotland) and the Conservation of Offshore Marine Habitats and Species Regulations 2017 (as amended)

The UK is a world leader in offshore wind energy and its target of becoming net-zero in all greenhouse gases by 2050 for England and Wales and 2045 for Scotland is enshrined in law. The Energy White Paper (2020) (BEIS, 2020) sets out government targets of increasing offshore wind capacity to 40 GW by 2030 to accelerate the transition to Net Zero. This target has since been increased to 50 GW by 2030, as detailed in the Energy Security Strategy (2022) (BEIS, 2022). In addition, the Scottish Government, in its Draft Energy Strategy and Just Transition Plan (2023), has set a new target for an additional 20GW of new low carbon renewable electricity generation by 2030, including 12GW of new onshore wind and potentially increasing its current offshore wind target of 11GW by 2030 on which is has consulted, with its final Energy Strategy and Just Transition expected by summer 2024.
North Sea developments, including offshore wind, interconnectors and transmission system reinforcements will be essential in meeting these climate change targets and driving economic growth across the UK. This Project will form an integral part of the UK transmission network and is not an interconnector.

As the UK moves away from using traditional fossil fuels to power vehicles and heat homes, there will be a greater need for renewable and low carbon energy. To be able to move to these renewable and low carbon forms of energy, the UK needs to increase the capability of the electricity transmission network to be able to accommodate it.

The British Energy Security Strategy set out the United Kingdom (UK) Government's ambition to connect up to 50 GW of offshore generation to the electricity network by 2030. This will require additional network capacity and greater power transfer capability across the Anglo-Scottish border. To assist in bringing Scotland's vast reserves of renewable energy to the rest of the UK, the National Grid ESO Network Options Assessment (NOA) (National Grid ESO, 2022), and the Pathway to 2030 Holistic Network Design recommended four new HVDC Links. These are: Eastern Green Link (EGL) 1 (EGL 1) which would run from Torness, near Edinburgh to Hawthorn Pit in County Durham; EGL 2 which would run from Peterhead in Aberdeenshire to Drax, North Yorkshire; EGL 3, (this Project), which would run between Peterhead in Aberdeenshire to Lincolnshire; and Eastern Green Link 4 (EGL 4) which would run between Fife in Scotland to Lincolnshire.

In 2022, Ofgem (the UK energy regulator) undertook consultation to determine how they could support the accelerated delivery of the strategic electricity transmission network upgrades need to meet the Governments 2030 targets. This led to the introduction of a new Accelerated Strategic Transmission Investment (ASTI) framework. The EGL 3 project has been listed as an ASTI project, which means it will benefit from an accelerated regulatory framework, recognising its importance in supporting the UK meet its Net Zero targets.

2.3. Objectives of the Project

When developing a new project, it is important to establish what the key objectives of the project are. These are then used to establish whether the alternative solutions proposed during the feasibility and development stages are viable solutions that fulfil the desired outcomes. The objectives for the Project have been derived from the UK Government Net Zero targets, the objectives of NOA and the UK Holistic Network Design (HND), the Marine Policy Statement (MPS) and the relevant inshore and offshore marine plans. Table 2-2 outlines these objectives.

Table 2-2: Objectives of the Project

Objective		Basis of Objective
Core Objectives		
1	Develop a reinforcement link between the Scottish and the English electricity transmission networks.	To meet the power transfer requirements of over 20 GW by 2030 and 30 GW by 2035 across the Anglo-Scottish border. (National Grid ESO, 2022).
2	Project commissioning by 2030/31.	To provide a recommended onshore and offshore network to meet the Government ambitions of connecting 50 GW of offshore wind in Great Britain (GB) by 2030. (National Grid ESO, 2022).
3	Seek to coordinate and co-locate infrastructure to minimise the impacts on the environment and communities as far as possible.	To facilitate the objectives set out in government policy, the Offshore Transmission Network Review (OTNR) and HND, and to mitigate negative impacts on local communities and landscape, in accordance with the joint statement dated 7 July 2022. (See paragraph 3.3.54 EN-1 (DESNZ (2023))
4	Project infrastructure should be realistic to consent and capable of delivery.	Proposals will consider all environmental and technical constraints to ensure that the Project can be delivered both economically and with a minimal environmental impact to allow it to be consented responsibly in line with key guidance and policy.
Secondary Objectives		
5	Deliver the most efficient offshore and onshore cable routes.	Develop the shortest and least constrained route, balancing length, environmental, technical and economic constraints. Route should be optimised to allow burial in seabed sediments and avoid features where burial is not possible. Avoid constraints

Objective		Basis of Objective
		that cannot be physically moved in order to install the cables or will have severe/major financial and legal implications e.g., constrained navigation channels, wrecks, offshore oil and gas platforms, or physical implications on the route e.g., large expanses of rock or areas of sandwaves. Avoid areas of seabed used by others e.g., marine aggregate sites, disposal sites, renewable energy sites, ports and anchorage areas. Avoid or minimise the number of third-party asset crossings.
6	Ensure that the construction, operation and eventual decommissioning of the Project can be undertaken in a safe and efficient manner.	The safety and amenity of neighbours and workers is central to its design, delivery and decommissioning.
7	To minimise disruption to onshore communities.	The Applicants will endeavour to minimise long term disruption, either alone or in combination, with other developments in the region, through consultation with local authorities and communities and the design and management of the Project.
8	To avoid where possible, or otherwise minimise the distance through which the route crosses protected sites.	Minimise likely significant effects or adverse effects on protected sites and species, in accordance with conservation policy and legislation, and the conservation objectives of the protected site.
9	To minimise disruption to shipping	Through consultation with the local Port Authorities and other navigation stakeholders, the design and management of the Project seeks to not give rise to unsatisfactory risk to other sea users, particularly in areas of higher use and that it safeguards protected navigable depths within port authority waters.
10	To minimise disruption to commercial fishing.	Through consultation with appropriate Fisheries Associations, that the design and management of the Project does not give rise to long term displacement either alone or in combination with other developments in the region.

2.4. Alternative Solutions Discounted Immediately

Several alternative solutions were discounted immediately as being neither reasonable or feasible because they either were not supported by UK policy, or that they would not achieve the core project objectives. These were:

- **Do nothing** – This option necessitates that the transmission system must remain the same and constrains the transmittal of electricity when generation exceeds demand. It does not meet the UK policy objectives, nor does it meet the project need or deliver any of the core project objectives.
- **Alternative transmission options** – As part of the review for the connection of two new HVDC links in the Lincolnshire area (EGL 3 and EGL 4), the Applicants considered whether currently available alternative technology options, including High Voltage Alternating Current (HVAC) and HVDC based onshore options using overhead line technology solutions, should be further investigated. Findings from this review were that:
    - HVDC links over the proposed distance have comparable capital costs to the required HVAC solution, but much lower lifetime costs over this distance than the alternative onshore HVAC option. HVAC options are often the most economic when their distance is under multiple hundreds of kilometres, but in this case the proposed connections are in the order of 500 kms or greater where HVDC represents the economical and viable technology choice.
    - A fully onshore solution would consist of a substantially long route length, carrying a much higher delivery risk than the HVDC subsea cable reinforcement proposals (EGL 3 and EGL 4) that are currently being progressed, and this would not be possible to deliver by the 2030 timescale that is required by the system need.
    - Consequently, an option using overhead line (OHL) technology is not considered to be the right alternative in this case as the distances involved make subsea HVDC a more viable, economical, deliverable, and electrically controllable solution.
- **Reduce electricity demand** - This solution would not meet any of the core project objectives and is complementary (not an alternative) to the project need served by the Project. The National Energy and Climate Plan (NECP) (BEIS, 2021) states that "to meet the England and Wales 2050, and Scotland 2045 climate change targets, emissions from buildings will need to be near zero, coupled with action on industrial processes." To meet the drive for decarbonisation, sectors across the economy are switching to electricity, driving up electrical demand. Energy demand management will play an important role in the future energy balance but cannot on its own deliver the decarbonised energy system. Different pathways will need to be developed concurrently such as reduced use of high carbon fossil fuels, increased energy efficiency, investment in renewables, more decentralised energy and a greater level of interconnection and transmission. This solution is therefore akin to 'do nothing' as it does not meet the UK policy objectives for decarbonisation on its own, does not meet the project need and does not entirely deliver any of the core project objectives.

2.5. Alternative Solutions that are Feasible Alternatives

2.5.1. Alternative Technology

There are two viable options for transporting electricity: HVDC technology and HVAC technology.

The UK onshore electricity transmission networks operate as HVAC systems in which the direction of the current changes on average fifty times a second. The capacity of HVAC subsea cables reduces significantly with distance, with long lengths of HVAC cable requiring electrical compensation to be installed, typically every 50 km. Electrical compensation requires a large shunt reactor which needs to be installed on a small, fixed platform (like that used by the oil and gas industry). HVDC does not require electrical compensation (reducing the footprint of the Project) and operates over much longer distances more efficiently. As a result of this higher efficiency of power transmission in HVDC cables, fewer materials (e.g. copper or aluminium) are required for cable manufacture, ultimately leading to fewer cables being required. Through previous project experience this translates into cost savings for the Project (which are passed on to consumers) and a lower environmental impact as fewer resources are required in comparison to a HVAC system.

The Marine Scheme proposes the use of HVDC technology because it is more effective at transmitting high electricity capacity over longer distances with lower energy losses than an equivalent High Voltage Alternating Current (HVAC) system. Additionally, a HVDC technology system provides a greater degree of control over the magnitude and the direction of power flow, eliminating the requirement for synchronisation between the electricity systems at either end of the link

2.5.2. Alternative National Connection Points

The first stage of the project development process is to identify where the reinforcement cables will connect to the transmission network in Scotland and England. The TOs identified Aberdeenshire, Scotland and Lincolnshire, England as the optimal connection points for the Project.

Lincolnshire was initially identified as the National Grid connection point, whereby a connection node for the Project and for other National Grid customers would be constructed. However, after understanding the number of schemes that were looking to connect terrestrially to this same area, it was deemed that there needed to be a scope change to avoid a delay in delivery of EGL 3, as the construction of this connection point was reliant on the completion of another project.

For the Project to meet system capability needs, NGET made the decision to reduce the level of interaction and improve scheme deliverability by relocating the connection point of EGL 3 to a new substation in the Walpole area. This in-turn, reduces the power infeed to Lincolnshire.

A HVDC converter station is proposed as the cable connection point in Scotland, located in Aberdeenshire, approximately 7.5 km to the west of Peterhead and 1 km to the south-east of Longside. This site is proposed to be the central hub (The Netherton Hub) for a number of new transmission links feeding into the northeast Scotland area. The aim of the collective development of these projects is to avoid a dispersed pattern of development, minimise the landscape impact, and impact to the local community.

The site in Aberdeenshire was identified as the preferred location of the proposed Netherton Hub through a site selection process whereby 13 initial feasible site options were identified. However, an assessment of technical and environmental impact considerations ruled out the other 9 sites to take forward for further evaluation. From the 4 options progressed into Stage 2 consultation, the proposed Netherton site emerged as the preferred option when assessing environmental and technical factors.

2.5.3. Alternative Landfall Sites

2.5.3.1. Approach

Landfall locations were initially identified though a review of publicly available and purchased mapped data. Data was classified according to whether it was a potential planning, physical, environmental, or human constraint on the development of the Project. Landfalls were identified based on the following criteria, (in no particular order of importance):

- Access to an onshore grid connection;
- Ground condition suitability;
- Site access both onshore and offshore;
- Alternative access available for landowners;
- Avoidance of existing infrastructure where possible;
- Potential environmental or socio-economic constraints (e.g., designated sites, populated areas or archaeological restrictions);
- Topography;
- Coastal sediments;

- Geomorphology of the shoreline including evidence of erosion/accretion;
- Potential to support either open cut or trenchless options at the landfall;
- Coastal defence or flood features; and
- Fishing activity.

Each landfall was assessed based on its own merits, technically and environmentally, taking into consideration any information available from other major developments in the region. They were also assessed in combination with the merits of the associated onshore and offshore cable route(s), to prove that the end-to-end solution meets the Project objectives.

2.5.3.2. England

In England, NGET have identified the Walpole substation as the connection point for the Project. Following analysis of constraints and consultation with Natural England, strategic options appraisal discounted The Wash and North Norfolk coastline as landfall search areas for this project, primarily on nature conservation grounds.

A preliminary landfall search area was identified between the southern coast of the Humber Estuary and north-west corner of The Wash. An initial comparative red, amber, green (RAG) assessment was conducted based on the constructability of the landfall (due to technical and environmental constraints). This study identified three landfall locations on the Lincolnshire coastline; Horseshoe Point, Theddlethorpe Beach and Anderby Creek; noting that the location at Anderby Creek had multiple landfall options.

Horseshoe Point was discounted as a landfall option after consultation with stakeholders identified that the area is part of a pilot project for the re-introduction of seagrass and oysters. In addition, due to the presence of the Hornsea 1 and 2 offshore wind farm export cables the landfall would have a likely significant effect on saltmarsh habitat and the nearshore approach would be extremely constrained, with likely significant effects on access to Port facilities, safeguarding navigation depth and shipping and navigation on the Humber Approaches Channel. The proximity to the Donna Nook firing range and seal haul out site were also a consideration.

Theddlethorpe Beach and Anderby Creek are both being considered as landfall options in this Scoping Report. Theddlethorpe Beach lies within the Saltfleetby-Theddlethorpe Dunes & Gibraltar Point SAC, Saltfleetby-Theddlethorpe Dunes SSSI and Humber Estuary SPA. Both landfalls lie within the Greater Wash SPA. The marine approach to both landfalls share several constraints. Whilst both avoid the River Humber Approaches Traffic Separation Scheme (TSS) they would require a crossing of the Hornsea 1 & 2 offshore wind farm export cables within an area of high-frequency shipping in relatively shallow water. In addition, the marine routes to Anderby Creek would require the crossing of four pipelines in shallow water. Engineering and environmental studies and stakeholder consultation is ongoing to understand the constraints and potential mitigation for both landfalls and a preferred option has not yet been selected.

2.5.3.3. Scotland

In Scotland, SHE-T have identified Northeast Scotland as a location for one of several strategic hubs within its licence area. The Project is expected to connect into SHE-T's existing network through this proposed new strategic hub, The Netherton Hub. Consequently, a landfall location was required to allow appropriate onward onshore connection to the Netherton Hub. A preliminary landfall search area was identified covering the broad extent of coastline north of Aberdeen, between Aberdeen and Fraserburgh. This area was chosen as a broad, reasonable area within which the landfall could connect directly to the Netherton Hub and was subdivided into four zones. A long list of 12 possible landfalls were identified in this search area following review of constraints by the terrestrial and marine technical and environmental teams.

An initial comparative RAG assessment was conducted based on the constructability of the landfall (due to technical and environmental constraints). The assessment excluded eight of the long list of landfalls from further consideration, identifying a short-list of four landfalls, namely Sandford Bay, Cruden Bay and two landfalls at Scotstown Beach.

Of the four short-listed landfall options, Sandford Bay emerged as the preferred option. The marine approach to the landfall avoids direct interaction with the Buchan Ness to Collieston Coast Special Protection Area (SPA). Further offshore it is also feasible that the marine route can avoid the Southern Trench Marine Protected Area ((MPA)[4]. The landfall has been consented by the Applicant for the Eastern Green Link 2 project. Other constraints identified can be managed through best practice and industry standard measures.

The marine approaches to Cruden Bay and Scotstown Beach, whilst technically feasible, could not avoid interaction with protected sites, namely the Buchan Ness to Collieston Coast SPA, Ythan Estuary, Sands of Forvie and Meikle Loch SPA and Southern Trench MPA. Several other major developments are known to be targeting the coastline north of Peterhead and analysis of Scoping boundaries indicated that the installation of EGL 3 through the Southern Trench MPA to Scotstown Beach would likely result in infrastructure crossings with one or more of these developments in the future, with the resultant permanent loss of habitat in the MPA due to cumulative effects.

[4] Note, the Scoping Boundary currently overlaps with the protected site. This provides optionality for micro-routeing around an area of sandwaves directly to the south of the protected site.

2.5.4. Alternative Offshore Cable Routes

Following the identification of potential landfall sites, it was possible to start identifying potential marine cable route options. The aim was to create the shortest marine cable route possible which will optimise the route to ensure the cable can be buried along its extent, minimise the length of cable needed, reduce the manufacturing and installation costs, and minimise the environmental footprint of the Project. It was also designed to:

- Avoid environmentally sensitive areas, where possible.
- Avoid areas which would represent restrictions to vessel movement e.g., anchorages, restricted navigation channels.
- Avoid areas of archaeological importance and wrecks.
- Avoid existing offshore infrastructure e.g., offshore wind farms, oil and gas infrastructure, marine aggregate extraction areas, aquaculture sites.
- Minimise the crossing of in-service cables and pipelines. Where it is not possible to avoid a crossing altogether, then to seek to optimise the crossing angle and to ensure that navigational safety or water depth is not adversely affected.
- Avoid hazardous seabed e.g., mobile sediments or bedrock outcrops and sub crops.
- Minimise any impact on third party considerations a such as seasonal fishing activities or local tourism.

Marine route alignments were developed in three distinct areas: England landfalls, an offshore section, and Scotland landfalls. The marine route options started at the English landfalls and merged to a common point approximately 100 km offshore. From the first common point in English waters, the offshore routes extended to another common point in Scottish waters before splitting into further options leading to the landfalls in Scotland. This led to two offshore marine route alignments being developed (Offshore Route A and Offshore Route B), and six marine route alignments to English landfalls and seven to Scottish landfalls from each offshore route.

Each marine route alignment was assessed based on its own merits, technically and environmentally, taking into consideration any information available from other major developments in the region. They were also assessed in combination with the merits of the associated landfall and co-joining marine cable route alignments, to prove that the end-to-end solution meets the Project objectives.

An iterative, phased process was used to assess these marine route alignments which consisted of workshops (including input from technical and environmental disciplines from both the marine and terrestrial teams), key marine statutory stakeholders and industries consultation followed by either a second set of workshops or refinement of marine route alignments with further targeted stakeholder engagement and follow-up decision-making workshop. This process resulted in two phases of marine route alignment before the emerging preferred marine cable route option was selected, which is presented in this Scoping Report.

Within English waters, two options are presented in the Scoping Boundary; an option that avoids the Holderness Offshore Marine Conservation Zone (MCZ) but crosses the northern tip of the Silver Pit glacial tunnel valley feature outside of the site; and an option that crosses through the protected sites broadscale habitat features but avoids interaction with the Silver Pit glacial tunnel valley feature. A marine survey will be conducted on both route options to collect as much data on the site as possible in order to make an informed decision. The Joint Nature Conservation Committee (JNCC) and Natural England will be consulted, to inform the decision-making process and selection of the preferred option.

2.5.5. Alternative Construction Techniques

There are a variety of alternative construction techniques for the installation of subsea power cables. The decision as to which combination of techniques to choose influences how the Project will affect the environment. Typically, the selection of alternatives will depend on the individual constraints and environmental conditions at any point along the cable route, meaning that different techniques may be appropriate at different locations. For example, surface cable lay with external cable protection may be necessary where ground conditions (e.g., outcropping bedrock) will not allow burial in the seabed, however burial in the seabed may be the most feasible solution for the remainder of the cable route.

Site-specific surveys would be carried out to inform engineering decisions and the selection of installation solutions. In the absence of detailed engineering, for the purposes of scoping it has been assumed that any installation technique could be used. The design parameters considered by this Scoping Report are presented in Section 3.

2.6. References

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