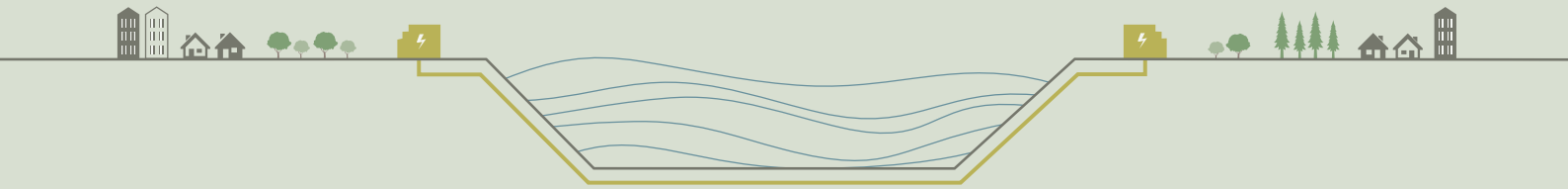
Greenlink

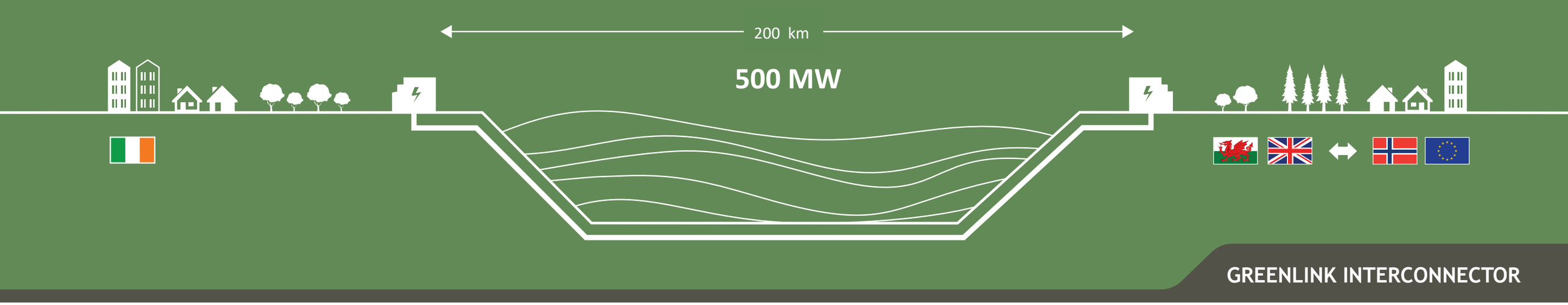
INTERCONNECTOR



TEN-E REGULATION INFORMATION BROCHURE

Issue 3 - June 2019

Connecting the power markets in Ireland and Great Britain for energy security, regional investment and value for money for consumers



This Greenlink brochure provides an update of the project information contained within the brochures published in May 2018 and November 2018 and forms part of the ongoing stakeholder consultation process.

Consents required to construct Greenlink are expected to include:

	Wales	Ireland
Converter station	**Major Development** - Pembrokeshire County Council	**Strategic Infrastructure Development** - An Bord Pleanála **Authorisation to construct** - Commission for the Regulation of Utilities
Onshore cable route	**Major Development** - Pembrokeshire County Council - Pembrokeshire Coast National Park Authority	**Strategic Infrastructure Development** - An Bord Pleanála **Consent to lay electricity lines across lands** - Commission for the Regulation of Utilities **Consent to lay electricity lines under the public road** - Commission for the Regulation of Utilities
Marine cable	**Marine Licence** - Natural Resources Wales **Marine Works Licence** - Milford Haven Port Authority	**Foreshore Licence** - Department of Housing, Planning and Local Government (Foreshore Unit)

IMPORTANT PLANNING UPDATE: MARINE APPLICATIONS

The Marine Licence application and the Foreshore Licence application are scheduled to be submitted to Natural Resources Wales (Wales) and the Foreshore Unit (Ireland) respectively in June/July 2019.

Co-financed by the Connecting Europe Facility of the European Union

Greenlink is a proposed subsea and underground electricity interconnector cable between the existing electricity grids in Ireland and Great Britain (GB), with a nominal capacity of 500 megawatts (MW). Greenlink will provide a new grid connection between EirGrid's Great Island substation in County Wexford (Ireland) and the National Grid's Pembroke substation in Pembrokeshire (Wales). The power will be able to flow in either direction, depending on supply and demand in each country.

Greenlink will have key strategic importance, as it will provide significant additional interconnection capacity between Ireland and GB with onward connections to continental Europe. The construction and development of Greenlink will deliver: increased energy security; regional investment and value for money to consumers; and enable the further integration of low carbon renewable energy sources.

Greenlink has been awarded Project of Common Interest (PCI) status, making it one of Europe's most important energy infrastructure projects and granting it the "highest national significance" possible.

Greenlink will consist of two converter stations - one located close to the Great Island substation in County Wexford and the other close to the Pembroke substation in Pembrokeshire - connected by two High Voltage Direct Current (HVDC) cables under the Irish Sea. A converter station converts electricity from Alternating Current (AC) to Direct Current (DC) and vice versa.

DC electricity is typically used for the transmission of electricity over long distances because it has lower losses, negligible heating effects and is therefore suitable to be buried underground. Accordingly, there will be no overhead lines between the two converter stations. Onshore, the cables will be buried underground and offshore the cables will be buried in the seabed or laid on the seabed with protection, if burial is not practicable.

Constructing and commissioning an interconnector requires the completion of a thorough programme of environmental and technical assessment to ensure that the final interconnector design fully considers the environment in which it is built.

Greenlink is planned for commissioning in 2023.

The project will require planning permission in Ireland and in Wales.

STATUS OF THE PROJECT: The project is in the pre-planning phase, with planning submissions anticipated during Q4 2019. The applications for the marine components are scheduled to be submitted in June 2019.

380,000
Potential to power 380,000 homes*

Investment
€400m/£350m of private capital investment for Ireland and Wales

Energy
Supports the growth and integration of low carbon energy

Security
Enhances the security of supply for electricity consumers

Value FOR Money
Downward pressure on electricity bills

Jobs
Jobs and knock-on economic benefits during construction

Regional investment and jobs
Greenlink represents around €400m/£350m of private capital investment in Ireland and Wales and will create jobs during construction and operation as well as knock-on economic benefits.

An integrated European grid
Interconnection has a vital role to play in connecting energy generation between countries to provide reliable and affordable power for all. Greenlink will have strategic importance, by doubling the interconnection capacity between Ireland and GB and contribute to each country's interconnection targets.

Security of supply
The construction of Greenlink will deliver increased security of supply for electricity consumers, by diversifying energy sources and providing additional import and export capacity in both countries.

Integration of renewable energy
Greenlink improves the integration of renewable technologies in Ireland and GB supporting the growth of the green energy sector, which offers significant economic and environmental benefits to both countries.

Better energy price competition
Greenlink will deliver greater market integration and competition in the provision of electricity, ultimately providing significant benefits to consumers in Ireland, GB and continental Europe.

*Figure for number of homes is based on typical annual Irish household use of 4,200 kWh (CER, Review of Typical Consumption Figures - Decision Paper 12 March 2017 (CER17042) and estimated total flows from UK to SEM of 1,600,000 MWh/yr.

Great Britain
National Grid is the Electricity System Operator for the whole of GB and operates the electricity transmission network in Wales and England including the 400kV network and substation at Pembroke. In its role as System Operator for GB, National Grid publishes plans and assessments for the economic and efficient development of the GB electricity transmission networks:

- In Future Energy Scenarios (FES), National Grid considers different potential future impacts on the electricity system. In the 2017 FES the amount of interconnection capacity could reach 19GW by 2030 compared to 4GW today.
- In the Network Options Assessment (NOA), National Grid carries out economic analyses to determine which transmission investments are efficient. The 2018/19 NOA recommends additional interconnection from GB to Ireland, beyond the 1.5GW capacity provided by Greenlink and the existing interconnectors (East West Interconnector (EWIC) and Moyle).
- The Electricity Ten Year Statement (ETYS) includes data on the existing and planned transmission networks in GB and the ETYS 2017 references Greenlink as one of the planned interconnectors that has a connection agreement with National Grid.

Ireland
EirGrid is the Electricity System Operator for Ireland and with its subsidiary, SONI, operates the island of Ireland's electricity system. In its role as System Operator for Ireland, EirGrid publishes a ten year transmission development plan:

- Greenlink is part of Transmission Development Plan 2016-2026, is referenced as part of the European Ten Year Network Development Plan 2018 (ENTSO-E TYNDP 2018) and as a PCI. The documents note that interconnection assists in increasing security of supply and competition.
- The Irish regulator determined, in October 2018, that Greenlink passed the test to be part of the Irish transmission system paving the way for Greenlink to move to the permitting phase.

Offshore studies
The subsea cable route was expected to be up to 170km long. Following the completion of subsea surveys and consultation with key stakeholders the proposed cable route is circa 160km long.

Initial cable route selection centred on desk-based work and the assessment of known data and constraints. This work identified several route corridor options which required further assessment.

Subsea surveys commenced in September 2018 in order to identify and confirm the presence of any constraints facing the subsea cable routes. The environmental and technical constraints were assessed in conjunction with the Irish and Welsh foreshore authorities. **The route that offered the best solution to challenges identified while maintaining the shortest route solution was chosen as the preferred route.**

The results of the subsea surveys not only supported the selection of the preferred cable route but also the appropriate installation and protection methods to be adopted.

Technical and environmental assessment
As part of the project development, a series of technical and environmental assessment studies are being carried out to establish the viability of the proposed converter station sites and cable routes and to consider any potential impacts and opportunities arising from the project development. Greenlink is a cross-border project and no adverse cross-border impacts are expected.

Onshore studies and assessments

Biodiversity

Surveys are currently being carried out and the data assessed to ensure that the final onshore elements of Greenlink are designed sympathetically to the local environment and wildlife. Where possible, enhancement measures will be employed.

Surveys cover the landfall sites, the cable routes under consideration and the possible converter station locations.

As well as birds, wildlife being considered includes badgers, bats, otters, water voles, reptiles, great crested newts and dormice. Consideration is also being given to local vegetation, including hedgerows, trees and important habitats.

Our surveys and assessments will be verified and consulted on by Natural Resources Wales and the National Parks and Wildlife Service in Ireland.

Historic environment

The potential effects of Greenlink on local archaeology and cultural heritage are being assessed by identifying, predicting and evaluating the significance of potential effects on designated and non-designated heritage assets.

To mitigate any potential impacts we will consider the predicted impacts of the proposed scheme and will aim to avoid adverse effects. Wherever possible, mitigation will be designed to deliver benefits, such as maintaining the visual setting of historic assets. We will aim to avoid undisturbed archaeological remains and preserve them in situ. Where this is not possible, preservation by record will be proposed as mitigation.

Landscape & visual impact

This assessment relates to changes in the physical landscape, brought about by the proposed development, which may alter its character and how this is experienced.

We will produce visualisations of the converter stations from viewpoints that will be selected to represent the character of the area and particularly important landscape and heritage sites. Suitable mitigation, such as landscaping, building finishes and design layout, will be proposed.

Flooding and hydrology

This assessment considers the existing surface and ground water resources in proximity to Greenlink. It will assess potential impacts to water bodies, surface water drainage and flood risk due to the proposed scheme during the construction and operational phases. The results of this assessment will be incorporated into the final design.

Geology & hydrogeology

This assessment considers the existing ground conditions present in the vicinity of the various scheme components and addresses the potential effects that the construction and operation of the project may have on the geological and hydrogeological characteristics of the study area.

The assessment will include consideration of possible effects on the superficial geology (soils), solid geology and geomorphology, including mineral resources beneath the proposed route of the scheme. The groundwater beneath the site and surrounding area will be considered. The results of this assessment will be incorporated into the final design and delivery of the proposal to mitigate any potential impact.

ILLUSTRATION: WSP

Noise & vibration

This assessment will address potential noise and vibration impacts from the construction and operational phases of the project, and specifically construction noise, construction vibration and operational noise from the converter station.

The baseline conditions (i.e. existing background noise levels) at noise-sensitive receptors will be determined via noise surveys.

Noise sensitive receptors include residential properties, sensitive commercial and community uses (including educational premises, medical facilities, places of worship, etc) and open public spaces (including public footpaths).

The results of this assessment will be incorporated into the final design.

Traffic & transport

The traffic impact assessment will address the traffic impacts on the local road network from the construction and operation of Greenlink.

The assessment will include the supply of materials, plant and equipment, the cable laying operations and the various components of the converter station. Traffic arising from the construction and operations workforce will also be addressed.

A transport assessment will be carried out in accordance with best practice.

An outline Traffic Management Plan (TMP) will be put together that will detail measures for managing and mitigating the construction traffic caused by Greenlink. We will consult the local community on the outline TMP to ensure that all considerations of local amenity have been incorporated and that members of the local communities are satisfied with the mitigation measures being proposed.

Electromagnetic fields (EMFs)

The Greenlink electrical infrastructure (converter stations and underground cables) will be designed to comply with the EC Directive relating to Occupational Exposure to Public Health and the EU 1999 recommendation on Public Exposure.

Use of agricultural land

Construction of the converter stations will result in the permanent loss of land from agricultural use. Land disturbed during the construction of the landfall and cable will be reinstated and therefore there will be no permanent loss of agricultural land associated with the landfall or cable route.

Socio-economics & human health

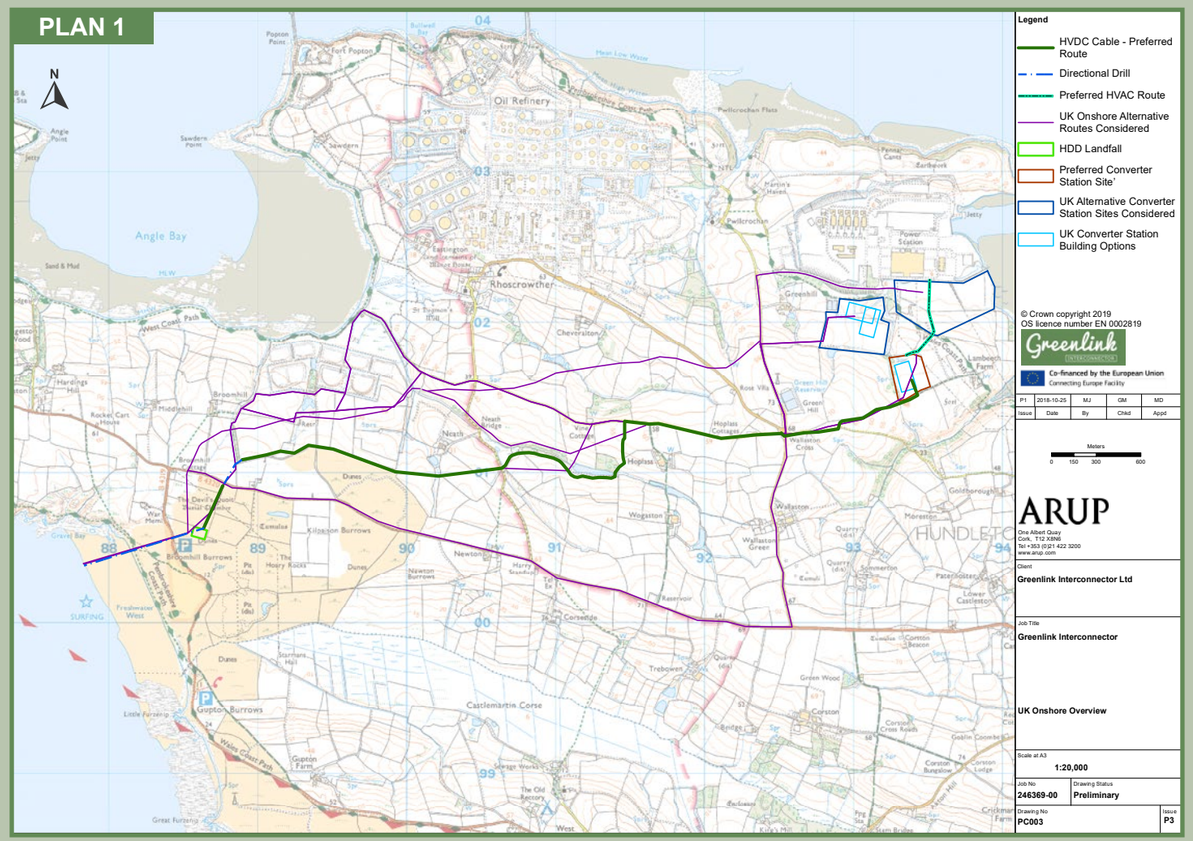
This study will provide an overview of the socio-economic conditions in the area of the proposed development and an assessment of potential effects on the population and human health derived from the implementation of the project. This will encompass consideration of population and demographic data, employment data and the volume and value of tourism to the local economy. The results of this assessment will be incorporated into the final design and delivery of the proposal to mitigate any potential impact and maximise benefits.

Air quality

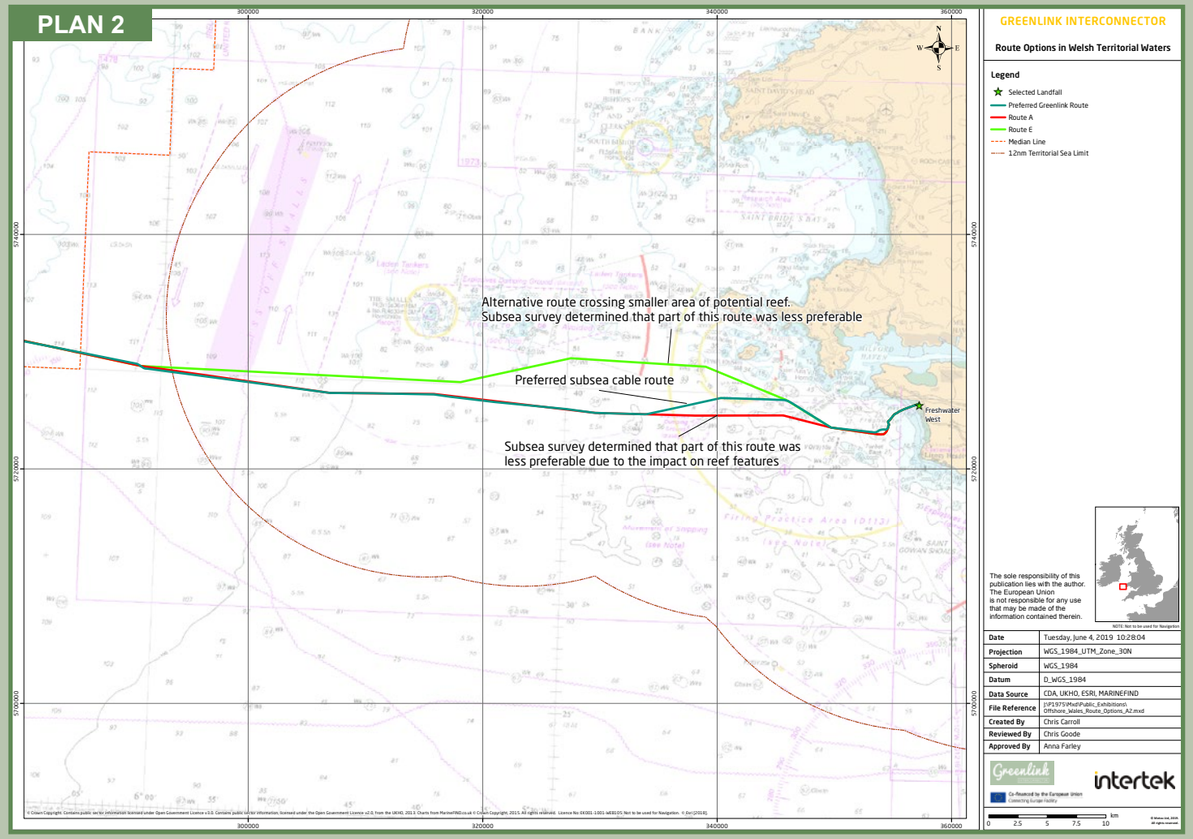
This assessment considers the potential impacts on air quality during construction, including dust emissions, on-site machinery and construction traffic travelling to and from the site. The potential impacts on air quality during the operational phase will also be considered.

Following the assessment of air quality effects during the construction phase, mitigation measures will be recommended to minimise the impact from dust. These measures, including dust suppressant measures, will be considered for both human and ecological receptors.

PLAN 1



PLAN 2



Greenlink in Wales

In Wales, Greenlink will connect to the Pembroke 400kV substation in Pembrokeshire. The Pembroke substation was identified as the connection point for Greenlink following the completion of assessments and consultation with National Grid. AC cables will connect the HVDC converter station to the substation. Three sites, in close proximity to the substation, were assessed as potential locations to locate the HVDC converter station.

A preferred cable route and converter station site have been selected following consultation with stakeholders and analysis of the results of environmental and technical work.

The preferred cable route and converter station site are shown in Plan 1 along with alternatives that were considered.

To minimise environmental impact, it is proposed that the cables between the landfall and the sea will be installed using a Horizontal Directional Drill (HDD) underneath the dunes and beach at Freshwater West.

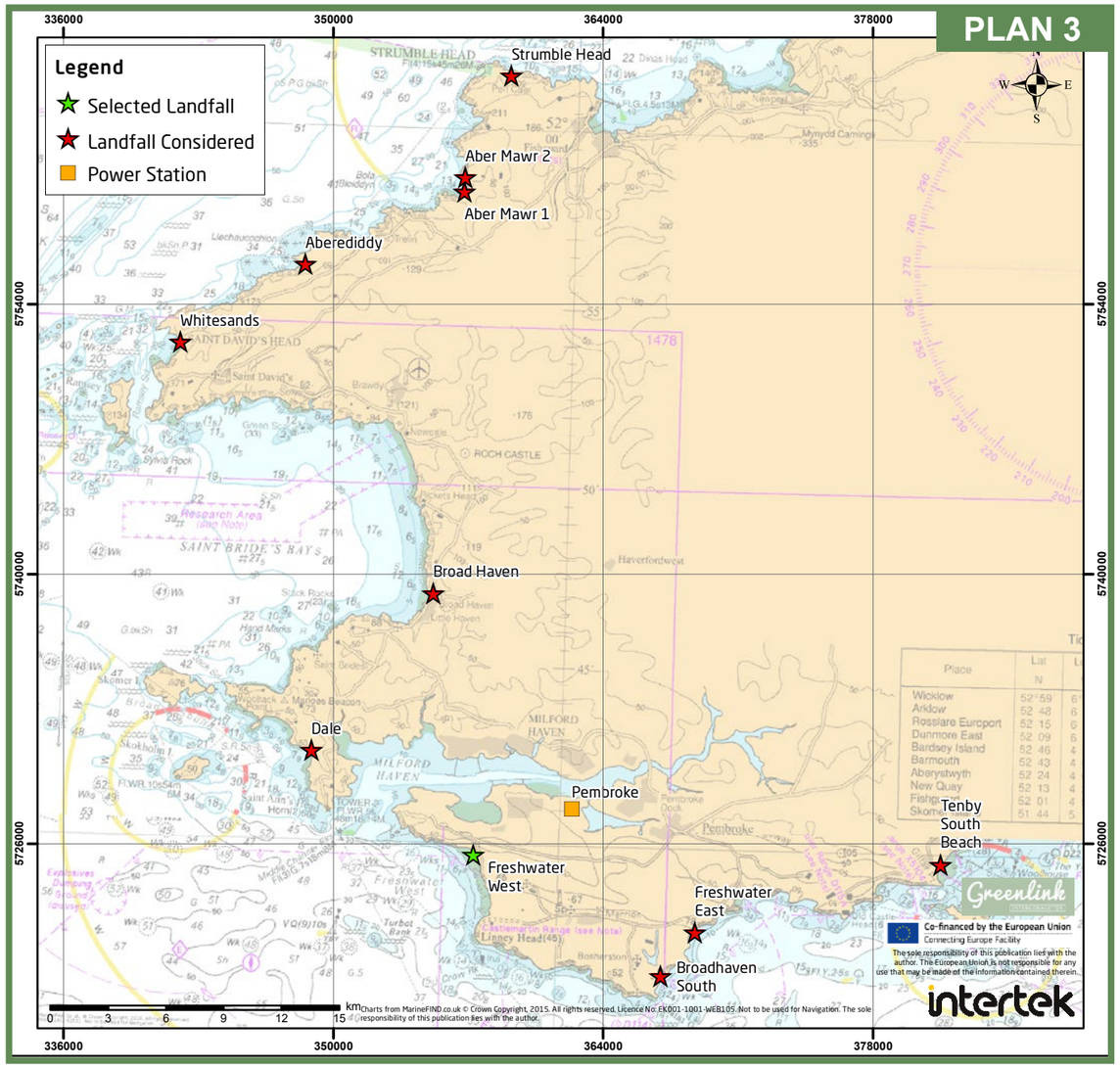
HDD is a trenchless method of installing underground cables, as detailed on page 13.

The final subsea route was selected following the conclusion of subsea surveys and consultation with stakeholders.

Two initial routes were subject to subsea surveys. Following the results of surveys confirming the presence of reef habitats a third route was identified and assessed in partnership with Natural Resources Wales. The third route assessed has been confirmed as the preferred subsea cable route. The final subsea route and the two other routes assessed are shown in Plan 2.

The landfall at Freshwater West was selected following a review of potential landfall sites in the region. The landfalls assessed are shown in Plan 3.

PLAN 3



Greenlink in Ireland

In Ireland, Greenlink will connect into the Great Island 220kV substation in County Wexford. The substation at Great Island was identified as the connection point for Greenlink following the completion of assessments and consultation with EirGrid.

AC cables will connect the HVDC converter station to the substation. A site adjacent to the substation has been identified as the most suitable location to construct the HVDC converter station.

The proposed converter station site is shown in Plan 4 along with potential onshore underground cable routes linking the landfall at Baginbun Beach.

The preferred converter station site and cable route options were identified following environmental and technical assessments and consultation with key stakeholders.

The length of the underground onshore cable route could be circa 22km.

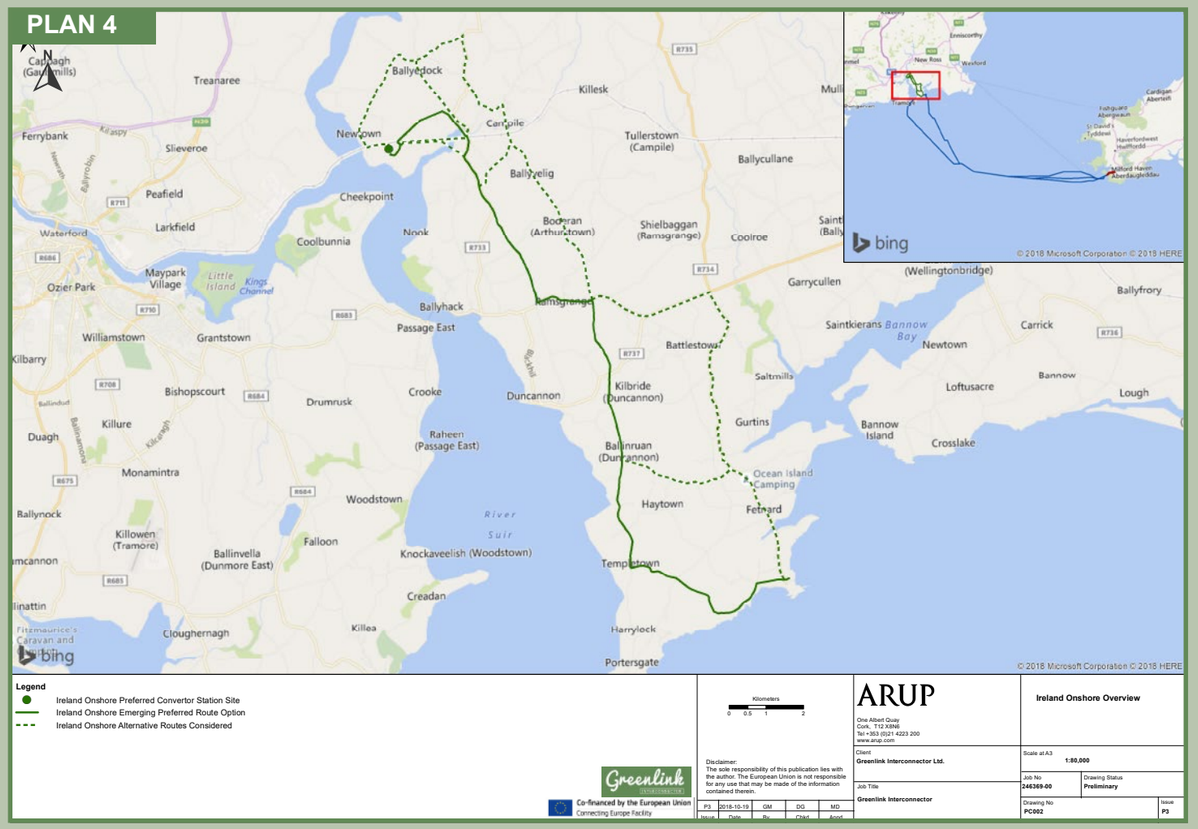
To minimise environmental impact, it is proposed that the cables between the landfall and the sea will be installed using a Horizontal Directional Drill (HDD) underneath the cliff edge and sand at Baginbun Beach.

HDD is a trenchless method of installing underground cables, as detailed on page 13.

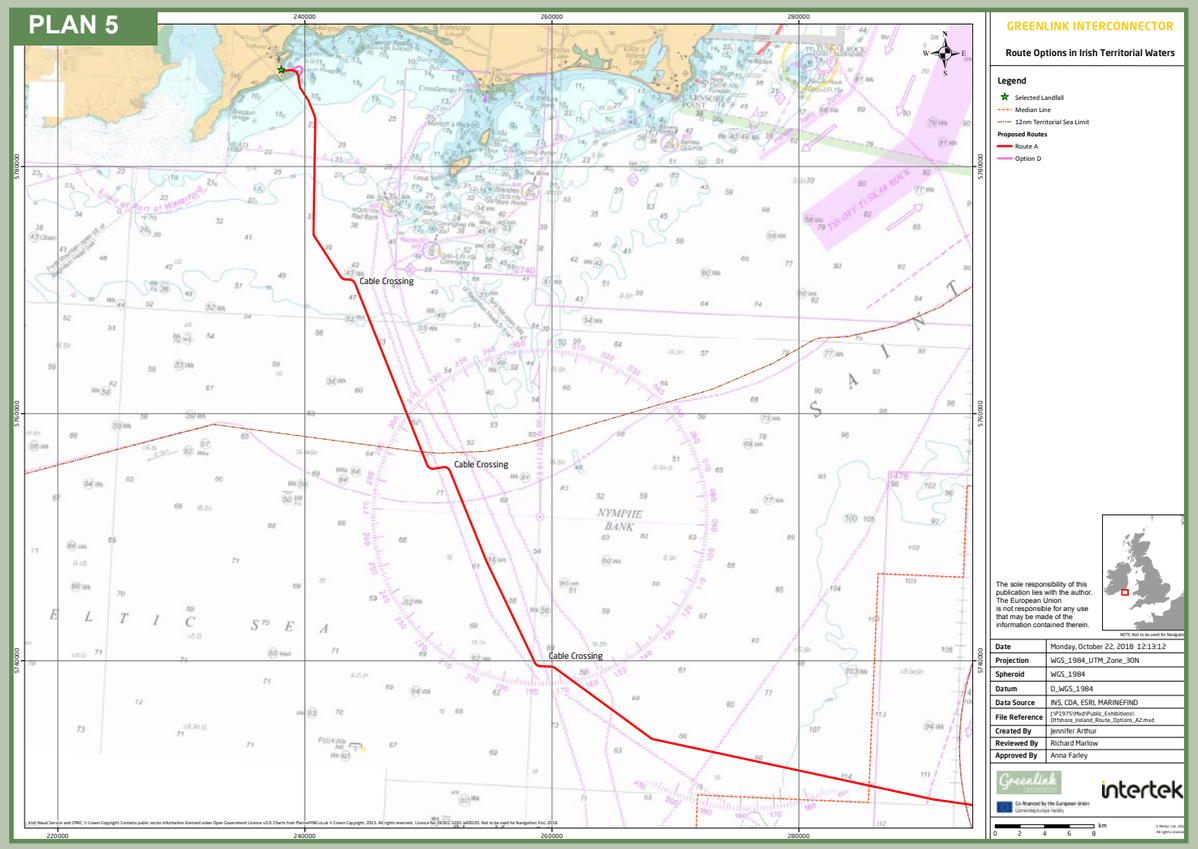
A preferred subsea route has been identified following desk-based assessments supported by the results of subsea surveys. The preferred route is shown in Plan 5.

The landfall at Baginbun Beach was selected as the landfall site following a review of potential landfalls in the region. The landfalls assessed are shown in Plan 6.

PLAN 4



PLAN 5



PLAN 6

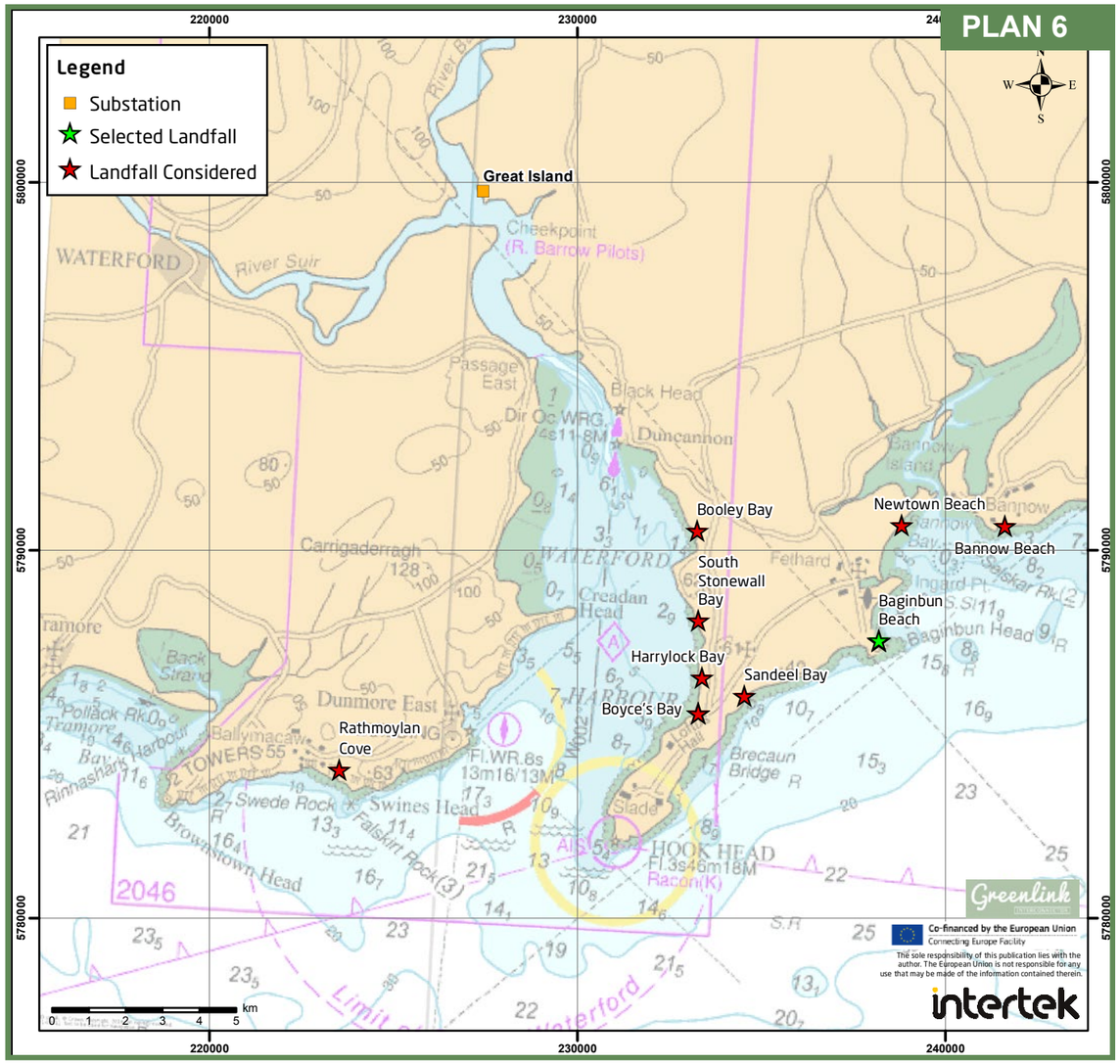


PHOTO COURTESY OF MMT

Technical viability

Marine surveys which commenced in September 2018 and included geophysical and geotechnical surveys, have now all been completed.

Geophysical

The geophysical survey mapped the seabed and sub-surface geology along the survey route corridors to identify marine habitats, optimise cable routing within the survey corridor and enable the assessment of cable target burial depth. It also provided the geophysical data from which a marine archaeological assessment was undertaken as part of the consenting process.

Geotechnical

The geotechnical surveys evaluated the nature and mechanical properties of the seabed and intertidal sediments along the survey corridor. This was done using a number of techniques, including drilling boreholes and taking shallow core samples.

Marine environmental assessments

Greenlink will cross a number of European Marine Protected Sites: Special Areas of Conservation designated for the protection of habitats and species, and Special Protection Areas designated for the protection of wild birds. To determine if the project is likely to have a significant effect on the conservation objectives of the sites, a Habitats Regulations Assessment is being carried out in Wales and a Natura Impact Statement is being carried out in Ireland. These processes identify any potential impacts Greenlink may have on designated sites and assesses whether it is likely that the feature of the site will be affected.

Where Greenlink is likely to undermine the conservation objectives of the site e.g. it is possible that condition, characteristics, or distribution of the feature cannot be maintained, then mitigation measures are proposed to manage or reduce the potential negative impacts identified.

We are undertaking an Environmental Impact Assessment for Greenlink. An Environmental Statement will be completed for the marine components of the project in Wales and an Environmental Impact Assessment Report will be completed for marine components in Ireland. The Habitats Regulations Assessment (Wales) and Natura Impact Statement (Ireland) will form part of this larger environmental appraisal.

Topics covered by the environmental assessment will include:

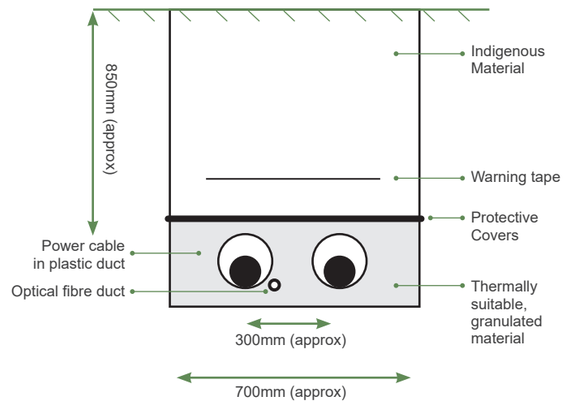
- Coastal processes
- Protected sites
- Benthic ecology
- Fish and shellfish
- Marine birds
- Marine mammals and reptiles
- Marine archaeology and unexploded ordnance
- Fisheries
- Shipping and navigation
- Recreation and other sea users
- Cumulative effects

Onshore cable technology and installation techniques

The onshore HVDC cables will be buried underground in a single trench with a typical depth of cover of 850mm. These will be installed in plastic ducts to simplify the construction process. It is usual for the two ducts to be positioned close together (approximately 300mm). A protective cover and warning tape will also be buried along with marker posts at regular intervals at ground level. This arrangement is shown in Figure 1.

It is usual to increase the depth of cover in agricultural land to around 1050mm (from 850mm). The width of the trench may also vary with depth of cover (the deeper the cables are buried the wider the trench may become).

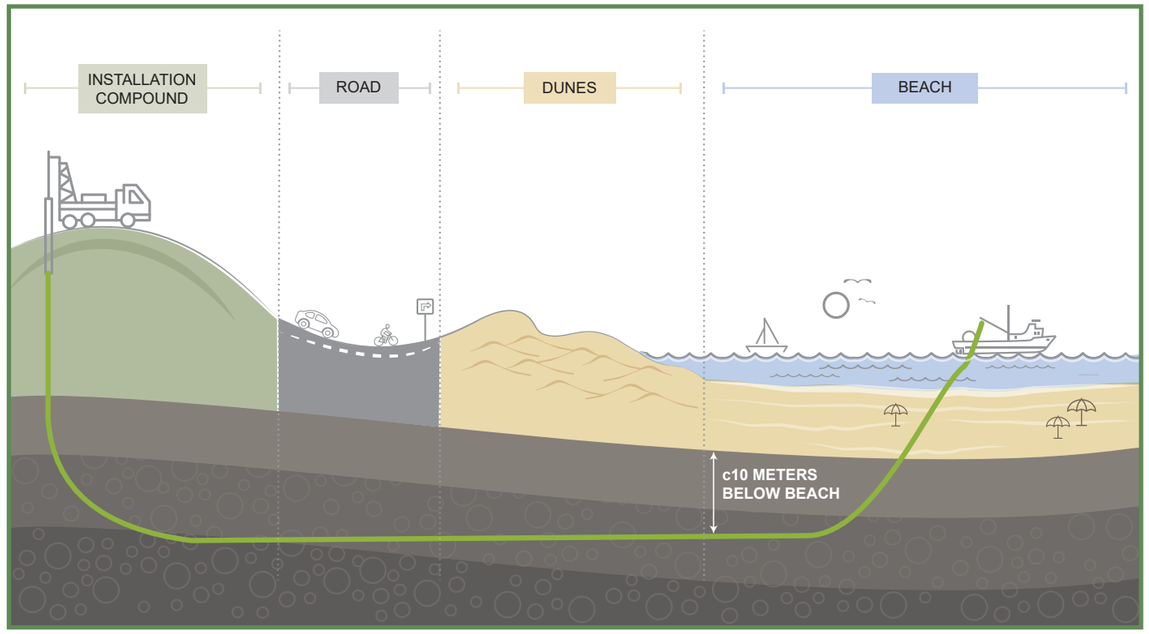
Figure 1 : Indicative underground cable arrangement



A specific design would need to be engineered for utility crossings, crossing watercourses or other areas where the ordinary depth of cover cannot be achieved.

Installation of Cables at Landfalls

We are proposing to use a Horizontal Directional Drill to install the cables at both Baginbun Beach (Ireland) and Freshwater West (Wales). Using this method of installation will ensure that cables can be installed without any impact on the beaches at both locations and will avoid any impact on the dune system at Freshwater West. The cable will emerge below the low water mark so no work will take place on either beach. While the construction programme for the full project is anticipated to take around three -years construction work around each landfall would last for approximately 3 months and be scheduled to avoid the most popular periods of use. Below is an illustration of how an HDD might work.



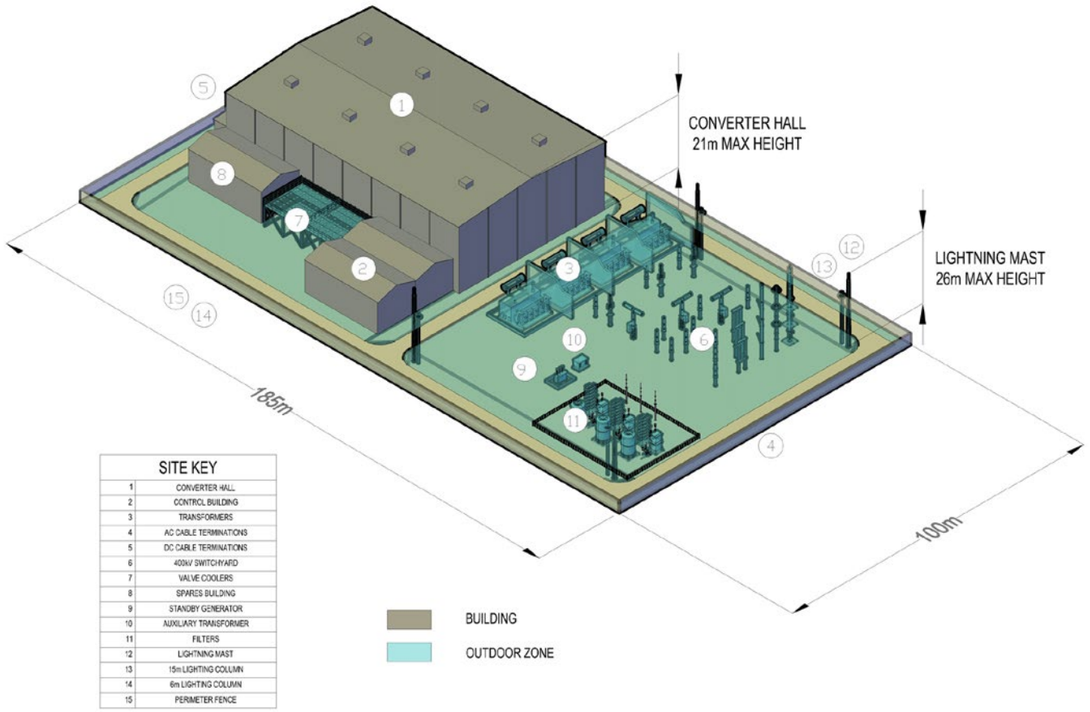
Greenlink will use High Voltage Direct Current Voltage Source Converter (HVDC VSC) technology to link the two power systems. In Ireland and GB, HVDC has been selected over an AC connection because AC is technically difficult over this distance. VSC technology has the benefit that it reduces the size of the converter stations (when compared to similar technologies).

The Greenlink Interconnector Converter Station

The indicative converter station site footprint would be circa 1.85 hectares (185m x 100m).

A converter station consists of various components. These include a converter hall, converter transformers, AC switchgear and busbars, harmonic filters (if required), lightning towers, ancillary plant such as cooling bank and stand-by back-up emergency generators, and a control building. Typically the tallest components are the lightning towers at circa 26 metres high and the converter hall, which could be up to 21 metres high at its apex. The converter hall and main building are usually one continuous building with height difference. The layout of the converter station and final dimensions will depend on the local terrain, physical constraints, the results of environmental surveys, consultations and the supplier's technical requirements.

A TYPICAL CONVERTER STATION LAYOUT



Tail Station

A tail station is a substation built adjacent to infrastructure such as a converter station and remote generation plant. Following consultation, EirGrid has confirmed that a tail station will need to be developed alongside the converter station in Ireland. We will now incorporate a tail station within the design to be assessed within the final planning application in Ireland.

We are using a 60m x 70m footprint for the potential tail station, however consultations are taking place with EirGrid to reduce the footprint of the tail station to minimise environmental and landscape impacts.

Project Timeline

A large infrastructure project such as Greenlink takes several years from concept to construction, including technical design, obtaining the relevant permits and consultation with a variety of stakeholders.

Technical and environmental constraints have to be identified and fully assessed to ensure that they are considered within the final design of an infrastructure project. Detailed environmental and technical assessment surveys commenced in 2018. This followed the completion of desk-based assessments and consultation with statutory consultees.

Once a detailed proposal and design are completed, permits and licences will need to be obtained from: Pembrokeshire County Council, Pembrokeshire Coast National Park Authority, Natural Resources Wales (NRW) and Milford Haven Port Authority, in Wales; and An Bord Pleanála and the Department of Housing, Planning and Local Government - Foreshore Unit and the Commission for the Regulation of Utilities, in Ireland.

Once the appropriate permits and licences have been obtained, the scheme will be constructed, which is expected to take approximately three years from start to finish.

The project is envisaged to commence on-site construction in 2020 and be fully operational in 2023.

An important energy infrastructure project

Greenlink has been given the status of a European Union Project of Common Interest (PCI), making it one of Europe's most important energy infrastructure projects.

The "Energy Union" launched by the European Commission on 25th February 2015 is driving a fundamental transition towards more innovative ways to produce, transport and consume energy, and to address different approaches to the design and implementation of energy policy.

Facilitating the Union requires a range of actions, chief amongst them being an increase in the physical interconnection of the EU and surrounding country energy grids (both gas and electricity) to meet a 10% interconnection target by 2020 and to reach 15% by 2030.

The EU, Irish and UK governments all agree that even after Brexit, an interconnected grid will help to ensure affordable, secure and sustainable energy, and also growth and jobs across Europe.

- For information regarding the infrastructure transparency platform referred to in Article 18 of the TEN-E Regulation, please visit: http://ec.europa. eu/energy/ infrastructure/ transparency_ platform/map- viewer/main.html
- For information regarding the manual of procedures for each of UK and Ireland https:// assets. publishing.service. gov.uk/ government/uploads/ system/ uploads/attachment_ data/ file/311184/uk_manual_ procedures_ten_e_regulation. pdf and www.pleanala.ie/ publications/2014/pocimanual. pdf

Greenlink

INTERCONNECTOR

Greenlink is being developed by Greenlink Interconnector Limited.

Greenlink Interconnector Limited is owned jointly by Element Power Holdings, part of Hudson Sustainable Investment, and Partners Group on behalf of its clients. Hudson Sustainable Investment is an independent investment management firm with a strong track record and expertise in investing in and developing sustainable energy infrastructure projects in Ireland, the UK and internationally. Partners Group is a global private markets investment management firm with €73 billion in investment programs under management in private equity, private real estate, private infrastructure and private debt.

Greenlink Interconnector Limited is bringing private capital to the project and will assume the majority of the project risks.

For more information on Greenlink, please visit our website: **www.greenlink.ie**

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