



Awel y Môr Offshore Wind Farm

Category 7: Additional Information

Grid Connection and Cable Details Statement

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A	April 2022	ES	Burges Salmon	RWE	RWE

www.awelymor.cymru

RWE Renewables UK Swindon Limited

Windmill Hill Business Park

Whitehill Way

Swindon

Wiltshire SN5 6PB

T +44 (0)8456 720 090

www.rwe.com

Registered office:

RWE Renewables UK Swindon Limited

Windmill Hill Business Park

Whitehill Way

Swindon

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Glossary of terms

TERM	DEFINITION
The array area	The area where the wind turbines will be located.
AyM	The Awel y Môr Offshore Wind Farm project.
Environmental Statement (ES)	A document reporting the findings of the Environmental Impact Assessment (EIA) in accordance with the EIA Regulations.
Export Cable Corridor (ECC)	The area(s) where the export cables will be located.
Development Consent Order (DCO)	An order made under the Planning Act 2008 granting development consent for a Nationally Significant Infrastructure Project (NSIP) from the Secretary of State (SoS).
PEIR	Preliminary Environmental Information Report. The PEIR was written in the style of a draft Environmental Statement (ES) and formed the basis of statutory consultation. Following that consultation, the PEIR documentation was updated into the final ES that accompanies the applications for the Development Consent Order (DCO) and Marine Licence.
Order Limits	The extent of development including all offshore and onshore works areas.

Abbreviations and acronyms

TERM	DEFINITION
AC	Alternating Current
AfL	Agreement for Lease

TERM	DEFINITION
AyM	Awel y Môr Offshore Wind Farm
BEIS	Department for Business, Energy, and Industrial Strategy
CION	Connections Infrastructure Options Note
DC	Direct Current
DCO	Development Consent Order
ECCs	Export cable corridors
ES	Environmental Statement
GyM	Gwynt y Môr offshore wind farm
HDD	Horizontal directional drilling
HRA	Habitat Regulations Assessment
HVAC	High voltage alternating current
MHWS	Mean High Water Spring
NPS	National Policy Statement
OSPs	Offshore Substation Platforms
OnSS	Onshore Substation
OTNR	Offshore Transmission Network Review
PEIR	Preliminary Environmental Information Report
SABP	St Asaph Business Park
TCE	The Crown Estate
TJBs	Transition joint bays
WTGs	Wind turbine generators

Units

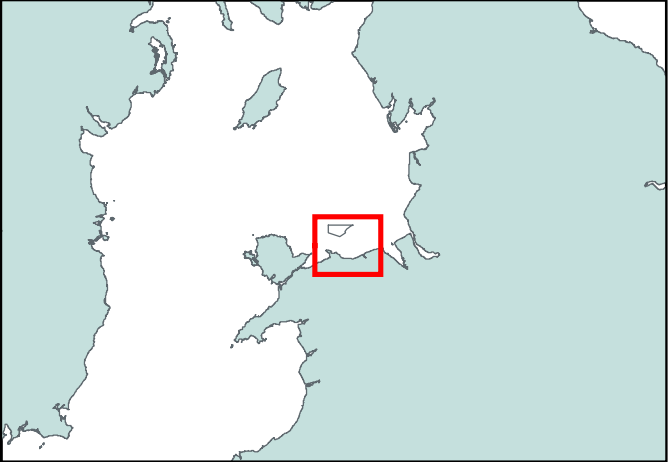
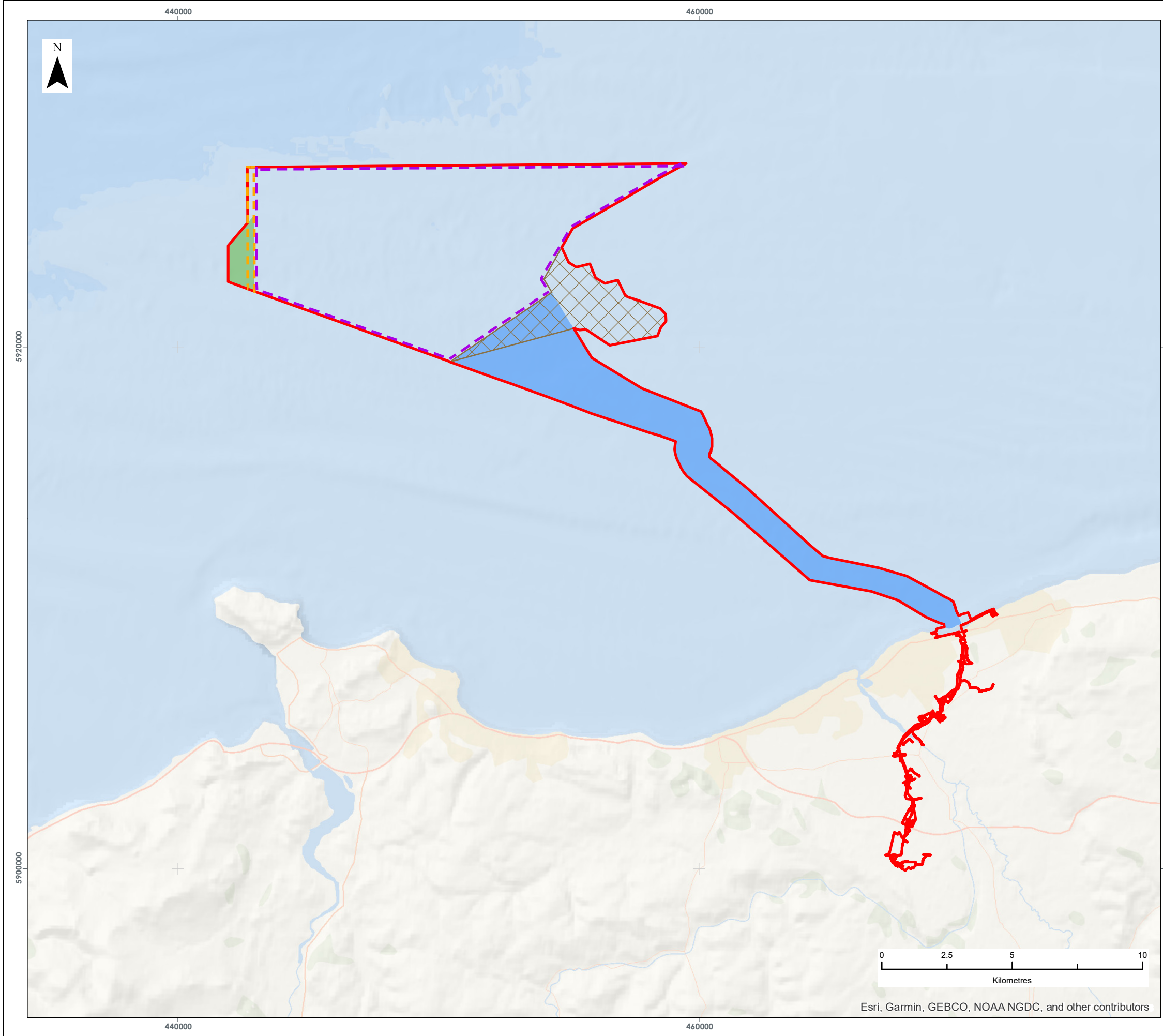
UNIT	DEFINITION
km	Kilometer
Km ²	Kilometer squared
m	meter
kV	Kilovolt
m ²	Meters squared
MW	Megawatt

1 Summary

- 1 This document is submitted on behalf of Awel y Môr Offshore Wind Farm Limited (the Applicant) in support of its application to construct and operate the Awel y Môr Offshore Wind Farm (AyM).
- 2 The electrical connection works for AyM will comprise offshore and onshore export cables comprising up to two cable circuits, transition joint bays (TJBs) at landfall, an onshore substation and connection to the National Grid at Bodelwyddan (the transmission works). The identified export cable corridors (ECCs) are approximately 31.5 km offshore and 12 km onshore. The transmission network for AyM will use High Voltage Alternating Current (HVAC) technology. A link to the operational Gwynt y Môr (GyM) offshore wind farm is also included as part of the DCO application.
- 3 The generation works will consist of the construction of wind turbine generators (WTGs), array cabling, up to two offshore substation platforms, one met mast, and related works. The number of WTGs will be determined following detailed design and two indicative scenarios have been assessed:
 - ▲ Up to 34 larger WTGs with a rotor diameter of up to 306 m; and
 - ▲ Up to 50 smaller WTGs with a rotor diameter of up to 250 m.
- 4 The maximum system voltages for the cables will be as follows:
 - ▲ Array and GyM interlink cables: up to 132 kV
 - ▲ Offshore export cables: up to 400 kV
 - ▲ Onshore export cables: up to 400 kV

2 Introduction

- 5 This Grid Connection and Cable Details Statement (the Statement) is submitted on behalf of the Applicant and relates to its proposal to construct and operate AyM (Figure 1). AyM is a sister project to the operational GyM located within Welsh inshore waters approximately 10.5 km off the coast of North Wales. AyM will have an installed capacity of over 350 MW.



- LEGEND**
- Order Limits
 - Array Area
 - Offshore Export Cable Corridor
 - Other Wind Farm Infrastructure Zone
 - Subsea Infrastructure and Temporary Works Area
 - GyM Interlink Zone

Data Source:

PROJECT TITLE:
AWEL Y MÔR OFFSHORE WINDFARM

FIGURE TITLE:
The AyM Order Limits

VER	DATE	REMARKS	Drawn	Checked
1	15/09/2021	For Issue for PEIR	BPHB	RM
2	03/03/2022	For Issue For ES	BPHB	RM

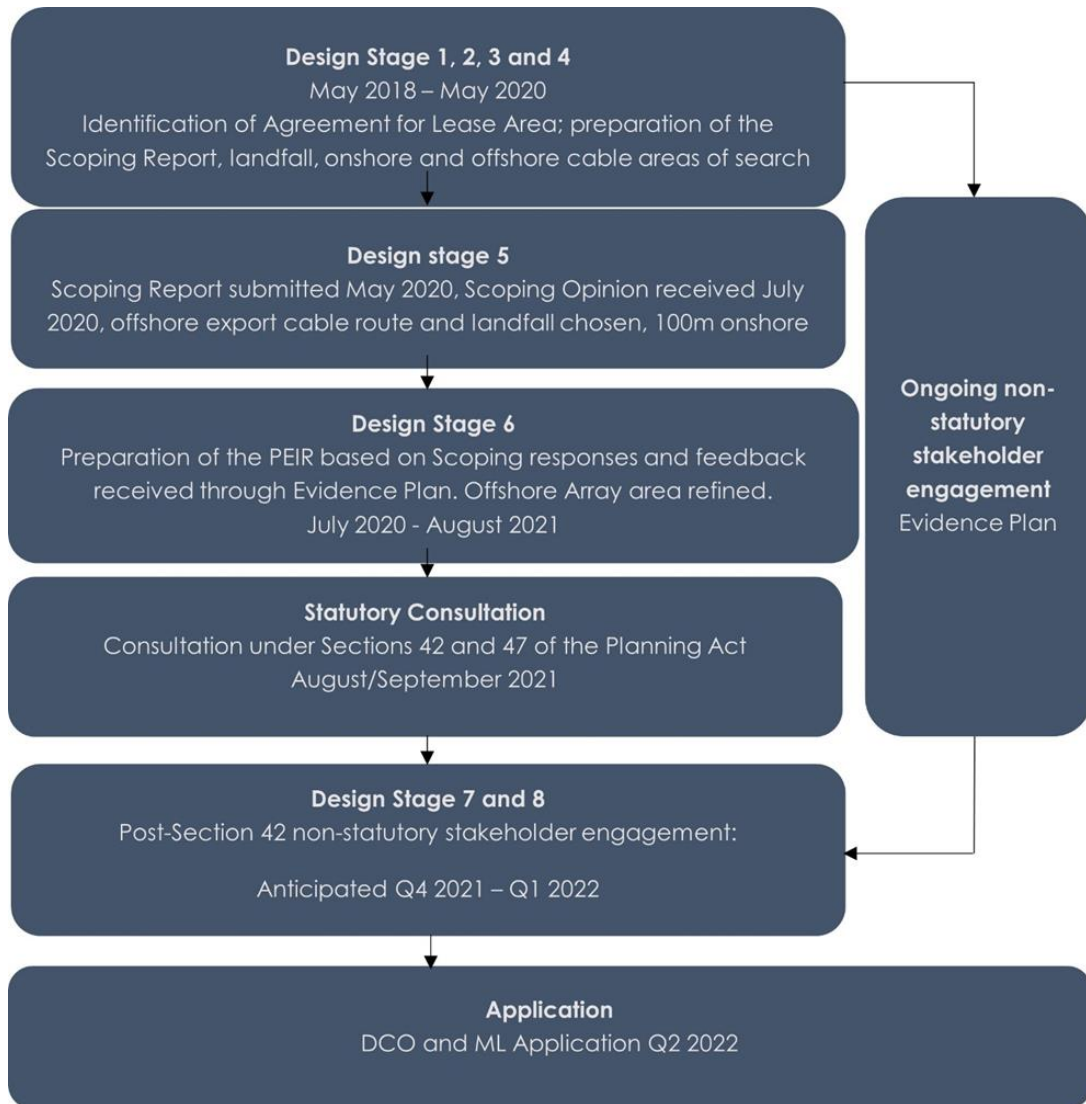
FIGURE NUMBER:
Figure 1

SCALE: 1:150,000	PLOT SIZE: A3	DATUM: WGS84	PROJECTION: UTM30N
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Fferm Wynt Alltraeth
AWEL Y MÔR
Offshore Wind Farm

- 6 This Statement has been prepared in accordance with Regulation 6(1)(b)(i) of the Infrastructure Planning (Applications: Prescribed Forms and Procedures) Regulations 2009 (the APFP Regulations) which requires the Applicant to provide '*details of the proposed route and method of installation for any cable*' as part of its application for a development consent order in respect of AyM.
- 7 This Statement provides a summary of the relevant information contained within the Environmental Statement (ES) (application ref 6.1.1 et seq) and, where appropriate, reference to the relevant chapters of the ES is provided.
- 8 The array area of AyM will cover approximately 78 km² with an offshore cable corridor running from the east of the array up to and including the intertidal zone (up to Mean High Water Springs or MHWS) at Ffrith beach in Denbighshire.
- 9 The offshore export cables will connect to the onshore cables in TJBs to the south of the landfall at Ffrith beach. From there the onshore cables will connect to the Onshore Substation (OnSS) located to the west of St Asaph Business Park (SABP) and from the OnSS to the existing National Grid substation at Bodelwyddan in Denbighshire. The onshore cable route will have a length of approximately 12 km and the onshore export cables will be buried between the landfall and the National Grid substation.
- 10 The AyM Development Consent Order (DCO) will, among other works, authorise the construction, operation, maintenance and decommissioning of the following infrastructure:
 - WTGs,
 - Offshore Substation Platforms;
 - Array cables;
 - Interlink cable to connect into GyM;
 - Export cables (onshore and offshore);
 - Cable crossings;
 - TJBs;

- ▲ Cable link boxes;
 - ▲ The OnSS;
 - ▲ Cables connecting into the National Grid substation; and
 - ▲ Installation of 400 kV switchgear at the National Grid substation to connect AyM
- 11 The development of AyM has been shaped by extensive engagement with a wide range of stakeholders, landowners and people with interests in the land, together with input from a range of technical disciplines, including electrical, engineering, heritage, human environment, ecological and socio-economic appraisal studies. Further detail is provided in the Consultation Report (application ref: 5.1)
- 12 The Site Selection Chapter of the ES (Application Ref 6.1.4) sets out the approach taken to identifying the most appropriate location for the AyM transmission works and refining the project design. A high-level summary is shown below and a detailed account of the process is set out in this chapter of the ES.



3 Proposed offshore works

- 13 Identification of the AyM array area was the first of multiple stages in the site selection and alternatives process. The initial boundary for AyM was identified by reference to The Crown Estate's Extensions leasing criteria and informed by an analysis of engineering, environmental, economic and consenting factors and subject to further feasibility analysis for key issues such as shipping routes, conservation areas and other offshore industry. The array area was further refined through the EIA scoping process.
- 14 Following initial identification of the array area and National Grid's offer for AyM to connect to its existing Bodelwyddan substation in Denbighshire (see section 5 below), the process of selecting the offshore cable route commenced. This involved an assessment of a long list of identified options against the 2017 Crown Estate 'Cable Route Protocol' and design principles set by the Applicant. These design principles had regard to environmental constraints and sought to minimise environmental effects balanced with costs and deliverability. The long list was analysed for constraints and engineering feasibility to identify a shortlist of suitable options. The shortlist was then consulted on and further refined before the final offshore cable route was selected. The selected offshore cable route was subject to statutory consultation as part of the overall AyM proposal. Further detail on this process is provided in section 3 of the Site Selection Chapter of the ES (Application Ref 6.1.4).
- 15 The offshore infrastructure for AyM includes:
- ▲ up to 50 wind turbine generators (WTGs);
 - ▲ up to two Offshore Substation Platforms (OSPs);
 - ▲ array cables with total length of up to 124 km;
 - ▲ up to two export cables each approximately 31.5km with a total length of up to 69.4 km; and
 - ▲ up to 10 km of interlink cable between AyM and GyM.

Array Cables

- 16 Cables carrying the electrical current generated by WTGs will link WTGs together and on to an OSP. A small number of turbines are typically grouped together on a cable 'string' that connects those turbines to an OSP. The wind farm array will contain several of these strings.
- 17 The inter-array cables will consist of a number of conductor cores, usually made from copper or aluminium. These will be surrounded by layers of insulating material as well as material to armour the cable from external damage and to keep the cable watertight.

Export cables

- 18 The offshore export cables are typically larger in diameter than the inter-array cables as they contain larger cores to transmit greater power. Like the inter-array cables, the offshore export cables will consist of a number of cores, usually made from copper or aluminium, surrounded by layers of insulation material and armour to protect the cable from external damage.
- 19 There will be up to two offshore cable circuits installed comprising one offshore export cable for each circuit.
- 20 A single interlink cable may be installed to connect one of the AyM WTGs or an OSP to the western GyM OSP. The cable will be bi-directional and will be held in open standby as a contingency measure should the AyM export cables go offline.

Installation

- 21 Prior to installation of the offshore cables, works will be undertaken to prepare the seabed. This is likely to include unexploded ordnance clearance and sandwave clearance.
- 22 Possible installation methods for the inter-array cables include:
 - Simultaneous lay and burial via ploughing, cutting or jetting;
 - Post-lay burial via cutting, jetting, ploughing, mass flow excavation or dredging; and

- ▲ Installation following pre-installation ploughing, cutting or trenching.
- 23 It is also possible that ducts are laid and the cables subsequently installed.

Cable protection

- 24 In some cases where the minimum cable burial depth cannot be achieved, it will be necessary to use alternative methods to protect the cable from external damage. This could involve rock placement, concrete mattresses or other solutions such as cable protection systems or protective aprons. Cable burial is the preferred method of installation, and additional cable protection will only be used as a contingency where cable burial is not appropriate or achievable.

4 Landfall

- 25 Development of the chosen landfall location followed on from considerations around the proposed offshore cable route corridor and took into account a number of additional considerations including the location of designated conservation sites. Further refinement of the landfall location was undertaken following EIA scoping including by applying a constraints analysis to the identified options and considering consultation feedback before the final landfall location was identified.
- 26 The offshore cables will make landfall at Ffrith beach, east of Rhyl and adjacent to Rhyl Golf Club, with associated landfall infrastructure, including the TJBs, in an area to the south of the North Wales Coast Line railway.
- 27 The works at the landfall include the following:
- construction of TJBs;
 - trenchless techniques for installation of cable ducts;
 - installation of offshore export cables (cable pulling);
 - installation of and jointing to onshore export cables; and
 - backfilling and re-instatement works.
- 28 There will be up to three cable ducts (one per circuit plus one spare) at landfall which will be laid at an indicative maximum of 20 m depth.

TJBs

- 29 A maximum of two circuits will be required and each circuit will require a TJB, with an indicative footprint of 100 m² per TJB (typically 5 m width by 20 m length and 2.5 m depth).

Installation

- 30 The cable installation techniques used to carry out the landfall works within the intertidal area broadly fall into two categories:
- trenchless installation techniques (such as horizontal directional drilling or HDD), and
 - open-cut installation (such as trenching).

- 31 The likely trenchless installation process for HDD would be to drill from the works area located to the south of the surface feature (i.e. the railway), which will contain the HDD entry pits, in a northerly direction. The HDD exit pits may be located within the intertidal zone or the shallow subtidal area (within the area between MHWS and 1,000 m seaward of MHWS).
- 32 In the case of open-cut installation, cables will be installed in the intertidal zone using a backhoe or dredger.
- 33 Depending on the final methodology and location, it may be necessary to install cofferdams to reduce water intrusion and protect the landfall works.

5 Proposed onshore works

Selection of the connection point to the Main Interconnected Transmission System “MITS”, owned and operated by National Grid Electricity Transmission “NGET”.

- 34 In April 2019, the Applicant applied to National Grid Electricity System Operator (NGESO) for a grid connection. As part of the application process NGESO ran a Connections Infrastructure Options Note (CION) process to facilitate an appraisal of a variety of connection options, including an assessment of technical, environmental and cost considerations, in order to identify the preferred onshore connection point. The CION process concluded in April 2020 and identified the existing Bodelwyddan 400kV substation as the preferred connection point. The post -CION grid connection agreement for a connection at Bodelwyddan, was signed in May 2021.

The offshore transmission network review

- 35 In July 2020 BEIS launched the Offshore Transmission Network Review (OTNR) process, the stated aim being to review the existing offshore transmission regime to address the barriers it presents to further significant deployment of offshore wind with a view to achieving the government's Net Zero ambitions.
- 36 OTNR includes an 'Early Opportunities' workstream, which is focused on facilitating the coordination of 'in-flight' projects through the current regulatory framework. This workstream has sought to identify opportunities for the grid connections for proximate in-flight projects to be co-ordinated and where changes are therefore needed to their planned connections. The OTNR also includes the 'Pathway to 2030' workstream. This workstream is focused on less-advanced projects (projects which have secured seabed leases in 2021, or will do so by 2022). With a grid connection date of 2027, Awel y Môr falls within the scope of this the Early Opportunities workstream, which was set up on an 'opt-in' basis for project's participation. OTNR also includes workstreams focused on Multi-Purpose Interconnectors and 'The Enduring Regime'. AyM falls outside the scope of both of these workstreams.

- 37 AyM has had discussions with National Grid (a key party in the OTNR process) and has reviewed available options for coordination with other projects, both in the same geographical area as AyM and those within the timescales of AyM's development. This has included a review of existing offshore wind farms connections, future offshore wind farm connections and other technology connections, as set out in the OTNR Generation Map published by BEIS. In addition AyM has discussed potential coordination with NGENSO, and also has sought to understand which OTNR workstreams other projects in the Irish Sea are likely to fall within.
- 38 Within the vicinity of AyM there are a number of operational offshore wind projects. As each of those existing wind farms has transmission infrastructure designed specifically for the capacity of those projects there is no opportunity for coordination with AyM. However, AyM's review did identify an opportunity for connection to Gwynt y Môr, via a bi-directional interlink cable that, if built, may provide contingency for some power export from AyM and therefore network redundancy and/ to provide safety and integrity functions to the AyM WTGs, should the AyM transmission system go offline. The existing GyM transmission network is not sufficient to allow full export from AyM so this connection would be a short-term contingency measure only and does not replace the need for the new transmission works bespoke to AyM.

- 39 In February 2021, as part of the Round 4 Leasing process, The Crown Estate announced a number of offshore wind ‘preferred projects’ in Bidding Area 4 (North Wales region, the Irish Sea region, and the northern part of the Anglesey region). At the time of drafting this Statement, The Crown Estate has not completed its Round 4 Plan-Level Habitat Regulations Assessment (HRA) process, or completed Agreements for Lease (Afls) with the preferred projects. Both of these steps are necessary for the projects to proceed. If successful in achieving an Afl, as part of Round 4 these projects are anticipated to fall within the scope of the Pathways to 2030 workstream of OTNR. Projects which fall into that workstream will not have a CION, rather NGESO are undertaking a new process to identify set coordinated connection options – a Holistic Network Design “HND”. NGESO have confirmed that the HND will not include coordination with AyM. Given the uncertainty of the outcome of OTNR in relation to the options and timescales for these projects to connect to the National Grid, the differing programmes for development of these projects relative to AyM, and the fact these projects will fall within an OTNR workstream that does not include AyM, the Applicant concluded coordination with these projects was not possible without compromising AyM’s ability to meet its grid connection date of 2027 and thereby contribute to the government’s 2030 targets.
- 40 In addition to the above offshore wind projects AyM’s review looked at the existing direct current (DC) interconnector between the UK and Ireland that passes in the vicinity of AyM. Given AyM’s alternating current (AC) transmission system is incompatible with a DC interconnector system without significant additional infrastructure and because the existing interconnector is rated to carry less than the generation of AyM, AyM concluded that coordination with the interconnector would not be possible without significant alterations to both projects and significant delay to AyM development. In addition, although not shown on the OTNR Generation Map, there is a proposed DC interconnector between the UK and Ireland that may pass in the vicinity of AyM, although the project is in the early stages of development. For the same technical reasons related to DC/AC systems, and due to the uncertainty in the development of the interconnector, the Applicant concluded coordination would not be possible.

- 41 AyM is therefore not part of the OTNR early opportunities workstream and is progressing on the basis of the radial connection at Bodelwyddan agreed with National Grid. However, an interlink between AyM and GyM remains part of the application as it may offer increased network redundancy and system security.

OTNR and grid coordination in the national policy statements

- 42 At the time of drafting this Statement the extant Energy National Policy Statements (NPSs) (EN-1, EN-3 and EN-5) do not include reference to OTNR or co-ordination of transmission infrastructure for offshore wind projects. The Energy NPSs are subject to consultation and revision, following submission of draft NPSs for consultation in November 2021.
- 43 The draft NPS (draft EN-1, paragraph 1.6.2) specifically note *“that for any application accepted for examination before designation of the 2021 amendments, the 2011 suite of NPSs should have effect in accordance with the terms of those NPS.”* It further notes that *“[T]he 2021 amendments will therefore have effect only in relation to those applications for development consent accepted for examination after the designation of those amendments.”* However, the emerging draft NPSs (or those designated but not having effect) are potentially capable of being important and relevant considerations in the decision-making process.
- 44 Draft EN-1 includes reference to OTNR and grid coordination and states *“applicants should consider co-ordinating their proposals for the onshore-offshore connection.”* This Cable Statement has therefore sought to set out the consideration that has been given to this by the Applicant.

- 45 Draft EN-1 also states that *“The current approach to connecting offshore wind has resulted in individual radial connections developed project-by-project. While this may continue to be the most appropriate approach for some areas with single offshore wind projects that are not located in the proximity of other offshore wind infrastructure, it is expected that for regions with multiple windfarms a more coordinated approach will be adopted wherever possible. For these areas, such an approach is likely to reduce the network infrastructure costs as well as the cumulative environmental impacts and impacts on coastal communities by installing a smaller number of larger connections, each taking power from multiple windfarms instead of individual point-to-point connections for each windfarm.”* At the time of drafting this Statement AyM is the only offshore wind farm project in development the Irish Sea with an AfL from The Crown Estate (TCE), and whilst other projects are expected to be developed, they are on longer timescales and significantly behind AyM in development of transmission system plans. Any coordination with prospective Round 4 projects, which are identified for the Pathways to 2030 OTNR workstream, should they secure their AfLs, would require rescoping, redesign and reassessment of AyM and unduly delay the project’s development and its ability to contribute to the Government’s targets for new offshore wind capacity.

Onshore cable

- 46 The onshore ECC is approximately 12km running generally in a north-south direction, and it has been sub-divided into the following route sections. Route sections have been defined to assist in describing the onshore elements of AyM but do not reflect any proposed phasing of works. The sections are as follows:

- Route Section A: Intertidal Area;
- Route Section B: Intertidal to B5119;
- Route Section C: B5119 to A525;
- Route Section D: A525 to A547;
- Route Section E: A547 to A55;
- Route Section F: A55 to B5381 including OnSS; and
- Route Section G: B5381 to National Grid Connection.

- 47 Further details of the Route Sections are provided in the Onshore Project Description chapter of the ES (application ref: 6.3.1).
- 48 Up to two HVAC circuits will be required to transmit the power from the TJBs to the OnSS. The cable circuits will be installed within an onshore ECC generally up to 40 to 60 m wide during the construction phase. Each cable circuit will consist of three electricity cables as well as up to three fibre optic cables and one earth cable. The cables will be installed in individual lengths varying from approximately 500 m to 1700 m and then jointed. The fibre optic cables may be installed in longer sections.
- 49 Each circuit will typically have three main ducts: one for each electrical cable, and four smaller ducts for fibre optic and earth cables.
- 50 There will also be up to 50 link boxes along the length of the onshore ECC where the cables are jointed to allow future inspection, maintenance and repair.

Cable installation

- 51 The cables will be installed in one trench per circuit (maximum of two trenches for up to two circuits), with each trench up to 5 m wide and up to 2 m deep (although this depth could increase where cables cross obstacles). The indicative maximum burial depth is 1.64 m (to top of the duct) and the indicative minimum burial depth is 0.60 m (to top of duct).
- 52 The cables are typically installed in a trefoil (cables banded together in a triangular shape) or flat (cables laid adjacently and horizontally) formation, depending on detailed cable system design, with appropriate horizontal separation between circuits to ensure thermal separation.
- 53 The main cable installation method will be through the use of open-cut trenching with High Density Polyethylene ducts installed, the trench backfilled and cables pulled through the pre-laid ducts.
- 54 HDD or other trenchless crossing techniques will be used in certain specific locations to cross significant environmental and physical features such as main rivers, major drains, roads and railways for example, the River Clwyd and A55.

- 55 Following the installation of all cables and joint pits in a section, the construction working width will be cleared and reinstated.

6 Transmission

- 56 The network transmission voltage will be up to 400 kV, with a maximum of two circuits (as described in section 4 above), and will use HVAC technology.
- 57 An HVAC export cable solution has been chosen for AyM as it is an efficient solution both in terms of minimising electrical losses and in minimising the size and amount of infrastructure required.

OnSS and connection to the National Grid Substation

- 58 One OnSS (HVAC) will be required for AyM and will be sited to the west of SABP in order to facilitate ease of connection to the National Grid Bodelwyddan substation. The OnSS will contain a number of elements including switchgear, busbars, transformers, capacitors, reactors, reactive power compensation equipment, filters, cooling equipment, control and welfare buildings, lightning protection rods (if required) and internal road access.
- 59 The guiding principles for locating the OnSS are to achieve an economic and efficient connection (i.e. as close as possible to the National Grid connection point) whilst taking into account environmental constraints including siting principles in National Grid's Horlock Rules. An Area of Search for the OnSS was broadly defined as a 3 km buffer around the AyM connection point at the National Grid Bodelwyddan substation. A number of zones were identified within the area of search which were later refined through consultation to a single zone that was consulted upon in the Preliminary Environmental Information Report (PEIR). Following statutory consultation, the zone was refined to an OnSS footprint for the basis of the DCO application.
- 60 Flexibility has been retained with regards to the technology that will be deployed and the option to construct the substation with either air-insulated switchgear or a gas-insulated switchgear has been included in the AyM application.

- 61 The onshore ECC will continue southwards and then eastwards from the proposed OnSS to connect to the existing National Grid Bodelwyddan substation.
- 62 AyM's 400kV connection will rely on 'Enabling Works' that will be undertaken by National Grid to facilitate the connection of AyM. Works for the National Grid substation extension are excluded from the DCO and will be consented separately by National Grid. As such, the boundary of the AyM DCO works includes the termination of the 400 kV cables inside the existing footprint of the National Grid substation.

7 Grid Connection

- 63 The agreement with National Grid is for a connection at Bodelwyddan substation in 2027.



RWE Renewables UK Swindon Limited

Windmill Hill Business Park
Whitehill Way
Swindon
Wiltshire SN5 6PB
T +44 (0)8456 720 090
www.rwe.com

Registered office:
RWE Renewables UK Swindon Limited
Windmill Hill Business Park
Whitehill Way
Swindon