Partners in UK offshore wind

MONA OFFSHORE WIND PROJECT

Preliminary Environmental Information Report

Volume 4, chapter 28: Climate change

Image of an offshore wind farm

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Final

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Prepared by:	Prepared for:
RPS	**Mona Offshore Wind Ltd.**

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Acronyms

Acronym	Description
BEIS	Department for Business, Energy and Industrial Strategy
CCC	Climate Change Committee
GHG	Greenhouse Gas
GWP	Global Warming Potential
HGV	Heavy Goods Vehicles
MOHC	Met Office Hadley Centre
MSL	Mean Sea Level
PEIR	Preliminary Environmental Information Report
RCP	Representative Concentration Pathway
UNFCCC	United Nations Framework Convention on Climate Change

Units

Unit	Description
%	Percentage
CO_2e	Carbon dioxide equivalent
°C	Centigrade
km	Kilometres
kg	Kilograms
kn	Knot
mm	Millimetre
m/s	Metres per second
MW	Megawatts
MWh	Megawatt Hours
g	Grams
t	Tonnes

28 Climate Change

28.1 Introduction

28.1.1.1 This chapter of the Preliminary Environmental Information Report (PEIR) presents the assessment of the potential effects of the Mona Offshore Wind Project on and from climate change. Specifically, this chapter considers the potential impact of the Mona Offshore Wind Project within the climate change study area during the construction, operational and maintenance, and decommissioning phases.

28.1.1.2 Climate change in the context of EIA can be considered broadly in two parts:

- the effect of greenhouse gas (GHG) emissions caused directly or indirectly by the Mona Offshore Wind Project, which may have the potential to contribute to climate change
- the potential effect of changes in climate on the Mona Offshore Wind Project, which could affect it directly or could modify its other environmental impacts.

28.1.1.3 This chapter also draws upon information contained within the following technical reports:

- Volume 8, annex 28.1: Greenhouse gas assessment technical report of the PEIR.
- Volume 8, annex 28.2 Climate change risk assessment technical report of the PEIR.

28.1.2 Purpose of chapter

28.1.2.1 The primary purpose of the PEIR is outlined in volume 1, chapter 1: Introduction of the PEIR. In summary, the primary purpose of an Environmental Statement is to support the Development Consent Order (DCO) application for Mona Offshore Wind Project under the Planning Act 2008 (the 2008 Act). The PEIR constitutes the Preliminary Environmental Information for Mona Offshore Wind Project and sets out the findings of the EIA to date to support the pre-application consultation activities required under the 2008 Act. The EIA will be finalised following completion of pre-application consultation and the Environmental Statement will accompany the application to the Secretary of State for Development Consent.

28.1.2.2 The PEIR forms the basis for statutory consultation which will last for 47 days and conclude on 28 May 2023. At this point, comments received on the PEIR will be reviewed and incorporated (where appropriate) into the Environmental Statement, which will be submitted in support of the application for Development Consent scheduled for quarter one of 2024.

28.1.2.3 In particular, this PEIR chapter:

- Presents the existing environmental baseline established from desk studies.
- Identifies any assumptions and limitations encountered in compiling the environmental information.
- Presents the potential environmental effects on climate change, arising from the Mona Offshore Wind Project, and from climate change on the Mona Offshore wind Project, based on the information gathered and the analysis and assessments undertaken.
- Highlights any necessary monitoring and/or mitigation measures which could prevent, minimise, reduce or offset the possible environmental effects of the Mona Offshore Wind Project on and from climate change.

28.1.3 Study area

28.1.3.1 The Mona Offshore Wind Project climate change study area is illustrated in Figure 28.1 and has been defined as both the onshore and offshore components of the Mona Offshore Wind Project itself, alongside the domestic and international scope as developed on the basis of established IEMA guidance utilised throughout this chapter. Domestic scope considers the local and national policy and targets concerning GHG and climate resilience.

28.1.3.2 GHG emissions have a global (international) effect rather than directly affecting any specific local receptor. The impact of GHG emissions occurring due to the Mona Offshore Wind Project on the global atmospheric concentration of the relevant GHGs, expressed in CO_2-equivalents (CO_2e), is therefore considered within this assessment.

28.1.3.3 The climate change risk study area (Figure 28.1) is concentrated to a 25km grid cell based on the UKCP18 probabilistic projections (MOHC, 2021) for the Mona Proposed Onshore Development Area for the onshore elements. The Mona Array Scoping Area and Offshore Cable Corridor represents the study area for the offshore elements.

28.1.3.4 With regards to Cumulative Effects Assessment (CEA) all developments that emit, avoid or sequester GHGs have the potential to impact the atmospheric mass of GHGs as a receptor, and so may have a cumulative impact on climate change and upon the development. Consequently, cumulative effects due to other specific local development projects are not individually considered but are taken into account when considering the impact of the Project and probabilistic projections used in the climate change risk assessment. As such, no specific study area beyond that of the Mona Offshore Wind Project redline boundary is relevant for the CEA for climate change.

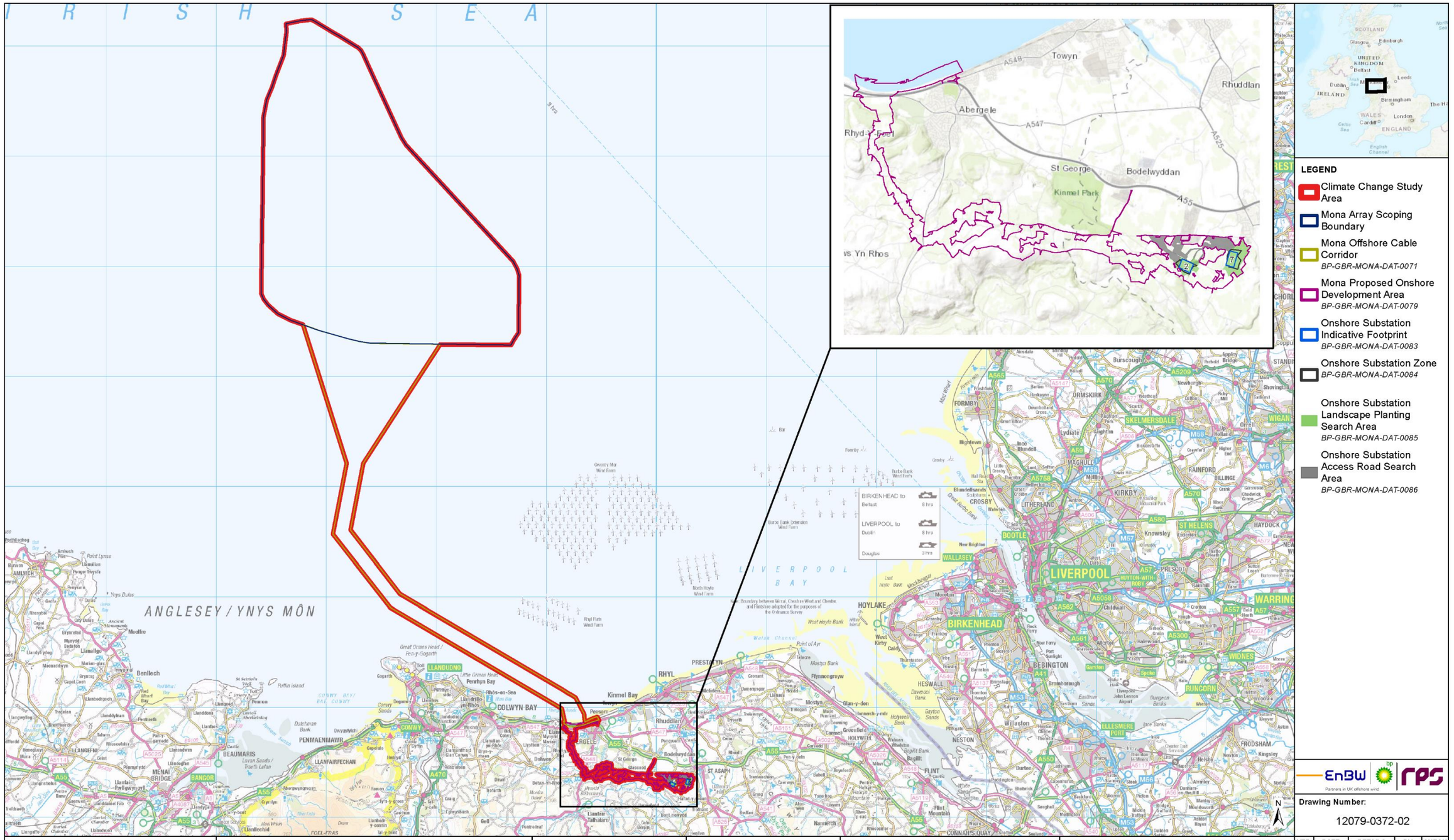

Figure 28.1: Climate change study area.

28.2 Policy context

28.2.1 National Policy Statements

28.2.1.1 Planning policy on renewable energy infrastructure is presented in volume 1, chapter 2: Policy and legislation of the PEIR. Planning policy on offshore renewable energy Nationally Significant Infrastructure Projects (NSIPs), specifically in relation to climate change, is contained in the Overarching National Policy Statement (NPS) for Energy (EN-1; DECC, 2011a) and the NPS for Renewable Energy Infrastructure (EN-3, DECC, 2011b).

28.2.1.2 NPS EN-1 and NPS EN-3 include guidance on what matters are to be considered in the assessment and also highlight a number of factors relating to the determination of an application and in relation to mitigation. These are summarised in Table 28.1 below.

28.2.1.3 Table 28.1 refers to the current NPSs, specifically NPS EN-1 (DECC, 2011a) and NPS EN-3 (DECC, 2011b). If the NPSs are updated prior to the application for Development Consent, the revised NPSs will be fully considered in relation to climate change within the Environmental Statement.

Table 28.1: Summary of NPS EN-1 and NPS EN-3 policy on decision making relevant to climate change.

Summary of NPS EN-1 provision	How and where considered in the PEIR
This NPS sets out how the energy sector can help deliver the Government's climate change objectives by clearly setting out the need for new low carbon energy infrastructure to contribute to climate change mitigation (paragraph 2.2.11 of NPS EN-1).	Volume 1, chapter 2: Policy and legislative context
"CO_2 emissions are a significant adverse impact from some types of energy infrastructure which cannot be totally avoided" and that *"Any ES on air emissions will include an assessment of CO_2 emissions"* (paragraph 5.2.2 of NPS EN-1).	This chapter provides an assessment of CO_2e emissions and other relevant greenhouse gases of the Mona Offshore Wind Project.
With regards to climate change adaptation, applicants must consider the impacts of climate change and that an ES *"should set out how the proposal will take account of the projected impacts of climate change"* (section 4.8 of NPS EN-1).	This chapter provides an assessment of climate risk and resilience for the relevant elements of the Mona Offshore Wind Project.
Applicants should apply as a minimum the 10%–90% estimate range for the world's current emission scenario and relevant research based on this. Paragraph 4.8.9 specifies that where the development includes safety critical elements such as sub-stations, the high emissions scenario should be considered (paragraph 4.8.7 pf NPS EN-1).	
Summary of NPS EN-3 provision	**How and where considered in the PEIR**
Provides the primary policy for decisions by the Secretary of State on applications they receive for nationally significant renewable energy infrastructure defined at section 1.6 of NPS EN-3.	Volume 1, chapter 2: Policy and legislative context
Offshore and onshore wind farms are less likely to be affected by flooding, but applicants should particularly set out how the proposal would be resilient to storms (paragraph 2.3.4 of NPS EN-3).	This chapter provides an assessment of climate risk and resilience for the relevant elements of the Mona Offshore Wind Project.

28.2.2 Local Planning Policies

28.2.2.1 The assessment of potential changes to climate change has also been made with consideration to the specific policies set out volume 1, chapter 2: Policy and legislative context of the PEIR. Key provisions are set out in Table 28.2 along with details as to how these have been addressed within the assessment.

Table 28.2: Local Planning Policy relevant to climate change.

Policy	Key provisions	How and where considered in the PEIR
Denbighshire County Council: Climate and Ecological Change Strategy 2021-22 to 2029-30	By 2030: • Become a Carbon Net Zero Council • Become an Ecologically Positive Council.	Volume 4, chapter 28: Climate change
Denbighshire County Council Local Development Plan 2006 – 2021	Objective 11 - Energy • The Local Development Plan will ensure that Denbighshire makes a significant contribution to reducing greenhouse gases through both supporting the principle of large wind farm development within identified zones and other suitable renewable energy technologies, and ensuring that all new developments are built to minimise their carbon footprint. Policy VOE 10 Renewable energy technologies	Volume 4, chapter 28: Climate change
Conwy County Council: Climate Challenge Programme	• Reduce greenhouse gas emissions from the Council's estate, fleet, staff commuting, business travel, supply chain and street lighting to achieve net zero emissions • Offset the remaining emissions by 2030 • Develop and implement a local area energy plan for Conwy County by 2030.	Volume 4, chapter 28: Climate change

Policy	Key provisions	How and where considered in the PEIR
	Strategic Objective SO11. • Reduce energy consumption through the careful siting and design of buildings and the promotion of renewable energy developments where they have prospects of being economically attractive and environmentally and socially acceptable. "*Stand alone renewable energy projects that are sympathetic to landscape character and local amenity will also be supported*."	Volume 4, chapter 28: Climate change

28.2.3 National energy and climate change policy

28.2.3.1 National climate change policy in relation to renewable energy infrastructure, provides overarching guidance for the progression of the Mona Offshore Wind Farm in meeting government targets. These policies are set out in Table 28.3.

Table 28.3: National energy and climate change policy

Policy	Summary
Future Wales: The National Plan 2040	Key Targets: • "*For 70% of electricity consumption to be generated from renewable energy by 2030* • *For one gigawatt of renewable energy capacity to be locally owned by 2030* • *For new renewable energy projects to have at least an element of local ownership from 2020*".
Climate Change Act 2008	• Commits the UK government to reducing greenhouse gas emissions by 100% of 1990 levels by 2050 and created a framework for setting a series of interim national carbon budgets and plans for national adaptation to climate risks.
Clean Growth Strategy 2017	• The 2017 Clean Growth Strategy for the UK (BEIS, 2017) contains a key objective of 'Delivering Clean, Smart, Flexible Power' and details specific policies through which this can be achieved: – Policy 33 of the report states the government's intention to phase out the use of unabated coal for electricity production by 2025 – Policy 35 sets government's intentions to improve the route to market for renewable technologies – Policy 36 details plans to target a total carbon price in the power sector which will give businesses greater clarity on the total price they will pay for each tonne of emissions.
Energy Efficiency in Wales: A strategy for 2016-2026	• The Energy Efficiency in Wales Strategy (Welsh Government, 2016) outlines the opportunities for improved energy efficiency and renewable energy production.
Energy White Paper: Powering Our Net Zero Future 2020	• The Energy White Paper (BEIS, 2020) builds on the Ten Point Plan to set energy-related measures in a long-term strategic vision, working towards the net zero emissions target for 2050. It establishes a shift from fossil fuels to cleaner energy in terms of power, buildings and industry, whilst creating jobs and growing the economy.
National Infrastructure Strategy 2020	• The National Infrastructure Strategy (HM Treasury, 2020) focuses on the investment and delivery of infrastructure, which is fundamental to delivering net zero emissions by 2050. The strategy sets out the UK Government's plans to deliver on this target, decarbonising the economy and adapting to climate change: – Work towards meeting the net zero emissions target by 2050 – Decarbonise the UK's power, heat and transport networks, and take steps to adapt to climate change impacts. This will require increased investments in network infrastructure, storage and increased renewable and low carbon generation capacity. – It is anticipated that the bulk of the low-carbon generation needed by 2050 will be provided by low cost renewables. – Reducing emissions across whole sectors of the economy must be done in a sustainable way that minimises cost.
The Path to Net Zero and Reducing Emissions in Wales 2020	• The Path to Net Zero and Reducing Emissions in Wales (CCC, 2020c) supports the Welsh government's target to reduce all GHG emissions to Net Zero by 2050. A number of carbon budgets have been recommended, as follows: the Third Carbon Budget (2026-2030) should be set at an average 58% reduction compared to 1990 levels; the Second Carbon Budget (2021-2025) should be tightened to a 37% reduction compared to 1990 levels. Both budgets have been recognised within the Climate Change (Carbon Budgets) (Wales) (Amendment) Regulations 2021.
Net Zero Strategy: Build Back Greener, 2021	• This strategy (BEIS, 2021a) sets out the UK's long-term plans to meet net zero emissions by 2050 and gives the vision for a decarbonised economy in 2050.
British Energy Security Strategy, 2022	The offshore Wind process shall be supported by: • *Reducing consent time from up to four years down to one year to speed deployment of offshore wind* • *Strengthening the Renewable National Policy Statements to reflect the importance of energy security and net zero* • *Introducing strategic compensation environmental measures, including for projects already in the system, to offset environmental effects and reduce delays to projects* • *Reviewing the way in which the Habitats Regulations Assessments are carried out for all projects making applications from late 2023 to maintain valued protection for wildlife, whilst reducing volume of paperwork.* • *Implementing a new Offshore Wind Environmental Improvement Package including an industry-funded Marine Recovery Fund and nature-based design standards to accelerate deployment whilst enhancing the marine environment.* • *Working with the Offshore Wind Acceleration Task Force; a group of industry experts brought together to work with Government, Ofgem and National Grid on further cutting the timeline* • *Establishing a fast-track consenting route for priority cases where quality standards are met, by amending Planning Act 2008 so that the relevant Secretary of State can set shorter examination timescales. (BEIS, 2022a) '*

28.3 Consultation

28.3.1.1 A summary of the key issues raised during consultation activities undertaken to date specific to climate change is presented in Table 28.4 below, together with how these issues have been considered in the production of this PEIR chapter.

Table 28.4: Summary of key consultation issues raised during consultation activities undertaken for the Mona Offshore Wind Project relevant to climate change.

Date	Consultee and type of response	Issues raised	Response to issue raised and/or were considered in this chapter
June 2022	The Planning Inspectorate - Scoping Opinion	The Inspectorate is content that the vulnerability of the Proposed Development to flooding can be assessed within a standalone FRA, provided that any likely significant effects are reported within the ES. However, the FRA would not address the vulnerability of the Proposed Development to other climate-related risks for example storm frequency, wind strength and wave strength and height. As such the Inspectorate is of the opinion that this matter cannot be scoped out at this stage. The ES should assess the likely significant effects relating to the vulnerability of the Proposed Development to climate change. The ES should also describe and assess the adaptive capacity that has been incorporated into the design of the Proposed Development	The vulnerability of the Mona Offshore Wind Project to climate change will be assessed within this chapter of the PEIR and is supported by volume 8, annex 28.1: Technical Greenhouse Gas assessment and annex 28.2: Climate change risk assessment of the PEIR.

28.4 Baseline environment

28.4.1 Methodology to inform baseline

28.4.2 Desktop study

28.4.2.1 Information on climate change within the climate change study area was collected through a detailed desktop review of existing studies and datasets. These are summarised at Table 28.5 below.

Table 28.5: Summary of key desktop reports.

Title	Source	Year	Author
Volume 2, chapter 7: Benthic subtidal and intertidal ecology	Mona Offshore Wind Project PEIR	2022	bp/EnBW
Volume 3, chapter 20: Land use and recreation	Mona Offshore Wind Project PEIR	2022	bp/EnBW
Valuation of Energy Use and Greenhouse Gas: Supplementary guidance to the HM Treasury Green Book	Department for Business, Energy and Industrial Strategy (BEIS)	2021	BEIS (2021b)
UK Government GHG Conversion Factors for Company Reporting.	Department for Business, Energy and Industrial Strategy (BEIS) and Department for Environment, Food and Rural Affairs (Defra)	2022	BEIS and Defra
Wind LCA Harmonization	NREL	2013	NREL
Life Cycle Greenhouse Gas Emissions of Utility-Scale Wind Power	Dolan & Heath	2012	Dolan & Heath

28.4.2.2 No site-specific surveys have been undertaken to inform the EIA for climate change.

28.4.3 Baseline environment

28.4.3.1 To understand the impact of the Mona Offshore Wind Project on climate change, the baseline environment must be considered. The Mona Offshore Wind Project is located within the Irish Sea Region and therefore, necessitates the consideration of the offshore climate in addition to the onshore baseline environment.

Greenhouse gas emissions (GHG) emissions assessment baseline environment

28.4.3.2 To determine the baseline environment for the GHG emissions assessment, information has been sourced and cross referenced from volume 3, chapter 20: Land use and recreation and volume 2, chapter 7: Benthic subtidal and intertidal ecology, of the PEIR. The baseline environment is defined as areas that would be occupied by the Mona Offshore Wind Project throughout the construction and operations and maintenance phases.

28.4.3.3 The current baseline for the onshore elements primarily comprises agricultural land. This land has been broadly identified as Grades 3a and 3b (within volume 7, annex 20.1: Agricultural land classification published data of the PEIR), however, this land does not have high soil or vegetation carbon stocks (e.g. peat) that would be subject to disturbance by construction.

28.4.3.4 When considering the current baseline for the offshore elements the baseline consists of various subtidal habitats of stony reef, subtidal course, mixed sediments and diverse benthic communities.

28.4.3.5 The Mona Offshore Wind Project will likely contribute to the abatement of the amount of fossil fuel generation within the UK Grid. As such, the current baseline with regard to UK Grid-average intensity for electricity generation, without the Mona Offshore Wind Project, is 239.63 $kgCO_2e/MWh$ (including scope 3 but as-generated, (i.e. excluding transmission and distribution losses)) (BEIS and Defra, 2022).

Climate change risk assessment (CCRA) baseline environment

28.4.3.6 Baseline onshore climate conditions have been sourced from Met Office observed data from Rhyl climate station. The observational data from Rhyl climate station has been collected and averaged over 30 years from 1991-2020 and reviewed alongside regional observational data averaged over the same period (Met Office, 2020).

28.4.3.7 North Wales experiences a temperate climate, with annual average maximum and minimum temperatures of 13.64°C and 7.13°C recorded at the Rhyl climate station, respectively. Average maximum temperatures reach 19.75°C in August, and minimum temperatures fall to an average of 2.85°C in January. This is consistent with regional climate patterns for North Wales and northwest England. In the summer months, regional temperatures often fall between 19.09°C and 9.07°C; in the winter months, regional temperatures range between 6.42°C and 0.94°C. In recent years, temperature fluctuations have resulted in extreme high temperatures above 30°C in the summer months on a number of days.

28.4.3.8 Precipitation recorded at the Rhyl climate station is lower than that reported for the regional annual total of 1,337.87mm, at 828.45mm a year. However, regional precipitation in North Wales and northwest of England exceeds the UK annual average, which totals 1,163.04mm. Therefore, North Wales can be considered as a region that is exposed to high rainfall in comparison to the rest of the UK.

28.4.3.9 Regional annual average wind speeds in North Wales and northwest of England are marginally higher than the annual average for the UK, equalling 9.39kn, and 9.27kn, respectively. Moreover, as onshore substation for the Mona Offshore Wind Project are close to the Irish Sea coastline, it can be predicted that the area will be susceptible to higher wind speeds throughout the year due to its coastal location.

28.4.3.10 Baseline offshore climatic conditions have been sourced from observational data collated within the UK Offshore Energy Strategic Environmental Assessment (BEIS, 2022b) and Intergovernmental Panel on Climate Change's (IPCC) Sixth Assessment Reporting of the physical science (IPCC, 2021).

28.4.3.11 Mean air temperatures range from lows of 7°C in January to 14°C in July, with surface air temperatures exceeding sea surface temperatures during the spring and summer

months and falling below sea surface temperatures during the autumn and winter months (BEIS, 2022b).

28.4.3.12 Precipitation generally falls for an average of 18 days per month during the winter, and 10-15 days per month during the summer. Rainfall intensity and duration varies greatly from day to day (BEIS, 2022b).

28.4.3.13 Higher wind speeds can be expected at the Mona Array than onshore. Wind conditions are generally westerly and south-westerly throughout the year. During the winter, winds occasionally exceed 14 m/s (approximately 20%-25% of the time) in the Irish Sea to the east of the Isle of Man. During the summer the chance of these higher wind speeds drops to 2% (BEIS, 2022b).

28.4.3.14 Mean sea level (MSL) is a crucial element of climate change related risks for offshore wind farms – global MSL rose by 0.2m between 1901 and 2018, and continues to rise (IPCC, 2021). North Wales has been identified as being at high risk of coastal flooding (Natural Resources Wales, 2022).

28.4.4 Future baseline scenario

28.4.4.1 The Infrastructure Planning (Environmental Impact Assessment) Regulations 2017 (as amended) requires that "*an outline of the likely evolution thereof without implementation of the development as far as natural changes from the baseline scenario can be assessed with reasonable effort on the basis of the availability of environmental information and scientific knowledge*" is included within the Environmental Statement. In the event that Mona Offshore Wind Project do not come forward, an assessment of the future baseline conditions has been carried out and is described within this section.

GHG emissions assessment future baseline

28.4.4.2 The future baseline GHG emissions for existing land-use without the Mona Offshore Wind Project are expected to remain similar to the current baseline.

28.4.4.3 The future baseline for electricity generation that would be displaced by the Mona Offshore Wind Project depends broadly on future energy and climate policy in the UK, and more specifically (with regard to day-to-day emissions) on the demand for the Mona Offshore Wind Project to operate compared to other generation sources available, influenced by commercial factors and National Grid's needs.

28.4.4.4 Several future baseline scenarios have therefore been considered, using BEIS projections of the carbon intensity of long-run marginal and grid average electricity generation during the proposed development's operating lifetime (BEIS, 2021b) and assumptions about specific generation sources that could be displaced. These are detailed in volume 8, annex 28.1: Technical Greenhouse Gas assessment of the PEIR.

28.4.4.5 The carbon intensity of baseline UK Grid electricity generation is projected to reduce over time and so too would the intensity of the marginal generation source, displaced at a given time.

CCRA future baseline

28.4.4.6 In the near future, roughly within the next years to decade, variations in average temperature and precipitation will likely be the most visible year-to-year changes in climate. In subsequent decades, within the operating lifetime of the Mona Offshore Wind Project, the anthropogenic climatic changes are expected to become more apparent.

28.4.4.7 The Met Office Hadley Centre (MOHC) publishes both probabilistic climate change projections and downscaled global circulation model outputs for the UK at various spatial scales. This is called the UK Climate Projections 2018 (UKCP18) dataset, first published in November 2018 and at v2.7.0 (MOHC, 2021) at the time of writing. The projections are based on representative concentration pathway (RCP) scenarios used by the IPCC. The RCP scenarios (four scenarios presented in the IPCC fifth Assessment report which are included within the UKCP18 database) describe different climatic futures, all of which are considered possible depending on the volume of GHG emitted. These provide the basis for future assessments of climate change and possible response strategies, thereby giving a low-high range in potential global GHG reduction initiatives and resulting rate of climatic effects over a given time period.

28.4.4.8 The probabilistic projections published at a 25km grid cell scale are considered the most useful for this assessment when considering the onshore elements, being designed to show a range of projection values that reflect uncertainty in modelled outcomes. The CP18 Overview Report (MOHC, 2018a) and supporting factsheets (MOHC, 2018b) for the wider regional and UK context have also been drawn upon.

28.4.4.9 The Mona Offshore Wind Project is expected to have an initial 35-year operating lifetime and fully operational by 2030, but as a key piece of energy infrastructure could also operate in the longer term. Therefore, climate change projections for two periods in the mid- and late century have been considered: average conditions during 2030-2059 and 2060-2089.

28.4.4.10 The risks associated with rising temperatures, more frequent extreme weather patterns and rising sea levels in northwest England are reflected in reactive and preventative legislation.

28.4.4.11 It is expected that sea surface temperatures will continue to increase in the 21st Century, with global mean sea surface temperatures predicted to increase by approximately 2.9 °C by 2100 under RCP8.5. It is anticipated that the north Atlantic will warm at a slower rate in comparison to other oceans (IPCC, 2021).

28.4.4.12 The average wave height is predicted to decrease around much of the UK at a factor of about 10% to 20% over the 21st Century, with average wave heights in the Irish Sea decreasing by approximately 0.1m (Jaroszweski et al. 2021). However, maximum wave heights in the Irish Sea are anticipated to increase, with projections showing a change in elevation of the height of maximum waves of up to 2m to the end of the century (Jaroszweski et al. 2021)

28.4.4.13 Further information has been presented within volume 8 annex 28.2: Climate change risk assessment.

28.4.5 Data limitations

28.4.5.1 There is uncertainty about future climate and energy policy and market responses, which affect the likely future carbon intensity of energy supplies, and thereby the future carbon intensity of the electricity generation being displaced by the Mona Offshore Wind Project. Government projections consistent with national carbon budget commitments have been used in the assessment.

28.4.5.2 The majority of the construction stage GHG emissions associated with the manufacturing of components are likely to occur outside the territorial boundary of the UK and hence outside the scope of the UK's national carbon budget, policy and governance. However, in recognition of the climate change effect of GHG emissions (wherever occurring), and the need to avoid 'carbon leakage' overseas when reducing UK emissions, emissions associated with the construction stage have been presented within the assessment and quantification of GHG emissions as part of the Mona Offshore Wind Project.

28.4.5.3 Additionally, due to the early stage in the development design the specific wind turbine technology and design of associated infrastructure (including the onshore substation etc.) that would be used by the Mona Offshore Wind Project have not yet been specified. Thus, there is a degree of uncertainty regarding the construction stage GHG emissions resulting from the manufacturing and construction of wind turbines and infrastructure. We have sought to limit the impact this might have by utilising peer reviewed published data representing a range with regards to emission intensity to present a conservative position concerning magnitude of GHG impact.

28.4.5.4 Principal sources relied upon for the quantification of GHG emissions for the Mona Offshore Wind Project date back to 2012 (Dolan & Heath, 2012 and RICS, 2012). It is acknowledged that the design and equipment available in the present day compared with pre-2012 is significantly different. Nevertheless, the pre-2012 benchmarks represent a conservative (worst case) assumption concerning GHG emissions for the purposes of the assessment.

28.4.5.5 Furthermore, the specific materials and maintenance and operational vehicles/vessels that would be used by the Mona Offshore Wind Project have not yet been confirmed. Thus, there is a degree of uncertainty regarding the construction and operations and maintenance-stage GHG emissions of the Mona Offshore Wind Project.

28.4.5.6 When assessing climate risks, uncertainty arises from both modelling uncertainty and natural variability in the potential magnitude of future changes in climate. Therefore, a high magnitude of change scenario and the high end of probabilistic projections have been used, to provide a precautionary worst case approach. This is further discussed in volume 8, annex 28.2: Climate change risk assessment of the PEIR.

28.4.5.7 The above uncertainties are integral to the assessment of climate change effects, but a precautionary approach has been taken as far as practicable to provide a reasonable worst case assessment. On the basis of the above, it is considered that limitations to the assessment have been minimised and that the results provide a robust estimate of the effects of the Mona Offshore Wind Project.

28.5 Impact assessment methodology

28.5.1 Overview

28.5.1.1 The climate change impact assessment has followed the methodology set out in volume 1, chapter 5: EIA methodology of the PEIR. Specific to the climate change impact assessment, the following guidance documents have also been considered:

- Institute of Environmental Management and Assessment (IEMA) Guidance on Climate Change Adaption and Resilience (IEMA, 2020)
- IEMA guidance on 'Assessing Greenhouse Gas Emissions and Evaluating their Significance' (IEMA, 2022).

28.5.1.2 In addition, the climate change impact assessment has considered the legislative framework as defined by:

- Local planning policies
- National climate change policies (See Section 28.2)
- International climate change legislation.

28.5.1.3 In order to undertake a climate change impact assessment, information gathered in volume 8, annex 28.1: Technical Greenhouse Gas assessment and annex 28.2: Climate change risk assessment of the PEIR have been utilised. This information is sourced from primary calculations and secondary sources to calculate the effect of the Mona Offshore Wind Project on and from climate change.

GHG emissions assessment methodology

28.5.1.4 GHG emissions have been estimated by applying published emissions factors to activities in the baseline and to those required for the Mona Offshore Wind Project. The emissions factors relate to a given level of activity, or amount of fuel, energy or materials used, to the mass of GHGs released as a consequence. The GHGs considered in this assessment are those in the 'Kyoto basket' of global warming gases expressed as their CO_2-equivalent (CO_2e) global warming potential (GWP). This is denoted by CO_2e units in emissions factors and calculation results. GWPs used are typically the 100-year factors in the Intergovernmental Panel on Climate Change (IPCC) Fifth Assessment Report (IPCC, 2013) or as otherwise defined for national reporting under the United Nations Framework Convention on Climate Change (UNFCCC).

28.5.1.5 Additional guidance used for the quantification of GHG emissions includes:

- BEIS (2021b) Valuation of Energy Use and Greenhouse Gas: Supplementary guidance to the HM Treasury Green Book
- UK Government GHG Conversion Factors for Company Reporting (BEIS and Department for Environment, Food and Rural Affairs (Defra), 2022)
- the Greenhouse Gas Protocol suite of documents (World Resources Institute (WRI) and World Business Council for Sustainable Development (WBCSD), 2004);

28.5.1.6 GHG emissions caused by an activity are often categorised into ‘scope 1’, ‘scope 2’ or ‘scope 3’ emissions, following the guidance of the WRI and the WBCSD Greenhouse Gas Protocol suite of guidance documents (WRI and WBSCD, 2004).

- Scope 1 emissions: direct GHG emissions from sources owned or controlled by the company, (e.g. from combustion of fuel at an installation)
- Scope 2 emissions: caused indirectly by consumption of purchased energy, (e.g. from generating electricity supplied through the UK Grid to an installation)
- Scope 3 emissions: all other indirect emissions occurring as a consequence of the activities of the company e.g. in the upstream extraction, processing and transport of materials consumed or the use of sold products or services.

28.5.1.7 This assessment has sought to include emissions from all three scopes, where this is material and reasonably possible from the information and emissions factors available, to capture the impacts attributable most completely to the Mona Offshore Wind Project. These emissions shall not be separated out by defined scopes (scopes 1, 2 or 3) in the assessment.

28.5.1.8 Emissions resulting from the manufacturing and construction of the Wind Turbine Generators and site infrastructure (including cabling, substation etc.) have been calculated via published benchmark carbon intensities and published life-cycle assessment (LCA) literature regarding wind turbine technology.

28.5.1.9 The assessment has considered:

1. The GHG emissions arising from the Mona Offshore Wind Project.
2. Any GHG emissions that it displaces or avoids, compared to the current or future baseline.
3. The net impact on climate change due to these changes in GHG emissions overall.

28.5.1.10 As previously discussed in paragraph 28.4.5.2, the majority of the construction-stage GHG emissions associated with the manufacturing of components are likely to occur outside the territorial boundary of the UK and hence outside the scope of the UK’s national carbon budget. However, in recognition of the climate change effect of GHG emissions (wherever occurring) and the need, as identified in national policy, to avoid ‘carbon leakage’ overseas when reducing UK emissions, the full life cycle GHG emissions of the Mona Offshore Wind Project, including construction-stage emissions, have been evaluated where possible when determining the significance of effects.

CCRA methodology

28.5.1.11 Potential climatic conditions in the 2040-2069 time period at the Mona Offshore Wind Project have been considered based on the Met Office Hadley Centre ‘UKCP18’ probabilistic projections (MOHC, 2022). Projections for the global emissions representative concentration pathway (RCP) 8.5 have been used as a worst-case approach, as this is a high-emissions scenario assuming ‘business as usual’ growth globally with little additional mitigation to combat climate change. Baseline offshore climatic conditions have been sourced from observational data collated within the UK Offshore Energy Strategic Environmental Assessment (BEIS, 2022b) and Intergovernmental Panel on Climate Change’s (IPCC) Sixth Assessment Reporting of the physical science (IPCC, 2021).

28.5.1.12 Further detail of the approach and data input is given in volume 8, annex 28.2: Climate change risk assessment.

28.5.1.13 A high level screening risk assessment has been undertaken, considering the hazard, potential severity of impact on the Mona Offshore Wind Project and its users, probability of that impact, and level of influence the design can have on the risk.

28.5.1.14 Where potentially significant risks have been identified at the screening stage prior to any mitigation, further assessment has been undertaken with consideration of appropriate mitigation to determine whether significant residual risks are likely.

28.5.1.15 The assessment of flood risk, including increases in rainfall rates due to climate change, has been addressed in volume 3, chapter 17: Hydrology and flood risk of the PEIR.

28.6 Impact assessment criteria

28.6.1.1 The criteria for determining the significance of effects have been divided into two categories:

- Assessment of the significance of the effect of the Mona Offshore Wind Project on climate change (GHG assessment)
- Assessment of the significance of the effect from climatic changes on the Mona Offshore Wind Project.

28.6.2 Impact assessment criteria: GHG emissions

28.6.2.1 Determining the overall significance of the effect of the Mona Offshore Wind Project on GHG emissions is a three-stage process that involves defining:

- Magnitude of the impact
  - In accordance with the IEMA Guidance (2022) GHG emissions can be quantified directly and expressed based on their GWP as tonnes of CO_2e emitted, the magnitude of impact is reported numerically. Where a quantifiable figure is not possible this is expressed qualitatively.
- Sensitivity of receptor
  - GHG emissions have a global effect rather than directly affecting any specific local receptor to which a level of sensitivity can be assigned. The global atmospheric mass of the relevant GHGs and consequent warming potential, expressed in CO_2e, has therefore been treated as a single receptor of **high sensitivity** (given the importance of the global climate as a receptor).
- Significance of effect.
  - Assessment guidance for GHG emissions (IEMA, 2022) describes five levels of significance for emissions resulting from a development, each based on whether the GHG emission impact of the development will support or undermine a science-based 1.5°C compatible trajectory towards net zero. To aid in considering whether effects are significant, the guidance recommends that GHG emissions should be contextualised against pre-determined carbon budgets, or applicable existing and emerging policy and

performance standards where a budget is not available. It is a matter of professional judgement to integrate these sources of evidence and evaluate them in the context of significance

- Taking the guidance into account, the following have been considered in contextualising the Mona Offshore Wind Project GHG emissions:
  - The magnitude of net GHG emissions as a percentage of national and local carbon budgets (where feasible)
  - Whether the Mona Offshore Wind Project contributes to, and is in line with, the UK's policy for GHG emissions reductions, where these are consistent with science-based commitments to limit global climate change to an internationally agreed level (as determined by the UK's nationally determined contribution (NDC) to the Paris Agreement (BEIS 2022c)
- Effects from GHG emissions are described in this chapter as adverse, negligible or beneficial based on the following definitions, which closely follow the examples in Box 3 of the IEMA guidance (IEMA, 2022) as detailed in Table 28.6.

Table 28.6: IEMA (2022) Guidance definitions of significance.

Significance	Definition
Major adverse	The Mona Offshore Wind Project's GHG impacts are not mitigated or are only compliant with do-minimum standards set through regulation, and do not provide further reductions required by existing local and national policy for projects of this type.
Moderate adverse	The Mona Offshore Wind Project's GHG impacts are partially mitigated and may partially meet the applicable existing and emerging policy requirements but would not fully contribute to decarbonisation in line with local and national policy goals for projects of this type.
Minor adverse	The Mona Offshore Wind Project's GHG impacts would be fully consistent with applicable existing and emerging policy requirements and good practice design standards for projects of this type.
Negligible	The Mona Offshore Wind Project's GHG impacts would be reduced through measures that go well beyond existing and emerging policy and design standards for projects of this type, such that radical decarbonisation or net zero is achieved well before 2050.
Beneficial	The Mona Offshore Wind Project's net GHG impacts are below zero and it causes a reduction in atmospheric GHG concentration, whether directly or indirectly, compared to the without-project baseline.

28.6.2.2 Major and moderate adverse effects and beneficial effects are considered to be significant in EIA terms. Minor adverse and negligible effects are not considered to be significant in EIA terms.

28.6.2.3 GHG emissions associated with a proposed project are often reported as a whole life figure (net emissions) that takes account of all Mona Offshore Wind Project stages. The net whole life figure is the key element for determining Mona Offshore Wind Project's whole life impact on climate change. However, it is noted in the IEMA guidance (2022) that due to the nature of GHG emissions, it is good practice to include a section that reports on the whole life GHG emissions associated with the Mona Offshore Wind Project, alongside the sections that assess construction, operation and decommissioning effects in isolation

28.6.3 Impact assessment criteria: climate change risk

28.6.3.1 IEMA guidance (IEMA, 2020) defines climate change resilience as the 'ability to respond to changes in climate. If a receptor or project has good climate change resilience, it is able to respond to the changes in climate in a way that ensures it retains much of its original function and form. A receptor or project that has poor climate change resilience will lose much of its original function or form as the climate changes'.

28.6.3.2 The climate change risk assessment differs from many other EIA topics in that it considers how the resilience of a development is affected by an external factor (climate change) and not specifically how potential environmental receptors are affected by a development's impacts. Consequentially, the climate change risk assessment cannot easily be assigned significance with respect to the severity of impacts in the same way as for the other topics. Instead, a risk-analysis based approach has been used for the assessment.

28.6.3.3 As is detailed in Climate Change Risk Assessment Technical Report (volume 8, annex 28.2) a risk assessment has been undertaken, considering the hazard, potential severity of impact on the Mona Offshore Wind Project and its users (including their sensitivity and vulnerability), probability of that impact, and level of influence the Mona Offshore Wind Project design can have on the risk. A risk score of five or more (the minimum score where more than one element of the risk assessment score is above 'one') has been defined as a risk that could lead to a significant adverse or beneficial effect in EIA terms. By considering measures adopted as part of the Mona Offshore Wind Project, professional judgement is used in determining whether impacts are likely to result in significant adverse or beneficial, or non-significant negligible effects in EIA terms.

28.6.3.4 The criteria for defining severity, probability and influence factor in this chapter are outlined in Table 28.7 below.

Table 28.7: Severity, probability and influence factor definitions.

Factor	Score definitions
Severity: the magnitude and likely consequences of the impact should it occur.	**1 =** unknown or low impact (e.g. low-cost and easily repaired property damage; small changes in occupiers' behaviour).
	2 = moderate impacts with greater disruption and/or costs
	3 = severe impact, (e.g. risk to individual life or public health, widespread property damage or disruption to business)
Probability: reflects both the range of possibility of climatic parameter changes illustrated in CP18 projections and the probability that the possible changes would cause the impact being considered	**1 =** unknown or low probability of impact; impact would occur only at the extremes of possible change illustrated in projections
	2 = moderate probability of impact, plausible in the central range of possible change illustrated in projections
	3 = high probability of impact, likely even with the smaller changes illustrated as possible in the projections
Influence: the degree to which design of the proposed development can affect the severity or probability of impacts	**1 =** no or minimal potential to influence, outside control of developer, (e.g. reliance on national measures or individuals' attitudes/actions; or hypothetical measures would be impracticable)
	2 = moderate potential to influence, (e.g. a mixture of design and user behaviour or local and national factors; measures may have higher costs or practicability challenges)
	3 = strong potential to influence through measures that are within the control of the developer and straightforward to implement

28.7 Key parameters for assessment

28.7.1 Maximum design scenario

28.7.1.1 The maximum design scenarios identified in Table 28.8 have been selected as those having the potential to result in the greatest effect on an identified receptor or receptor group. These scenarios have been selected from the Mona Offshore Wind Project Design Envelope provided in volume 1, chapter 3: Project description of the PEIR. Effects of greater adverse significance are not predicted to arise should any other development scenario, based on details within the Mona Offshore Wind Project Design Envelope (e.g. different infrastructure layout), to that assessed here be taken forward in the final design scheme.

28.7.1.2 This assessment will be used to inform stakeholders of the costs and benefits of the Mona Offshore Wind Project in relation to climate change risk and GHG emissions respectively.

Table 28.8: GHG: Maximum design scenario considered for the assessment of potential impacts on climate change.

[a] C=construction, O=operational and maintenance, D=decommissioning

Potential impact	Phase[a]			Maximum Design Scenario	Justification
	C	O	D		
The impact of GHG emissions arising from the consumption of materials and activities required to facilitate the operation and maintenance	×	✓	×	**Operation and maintenance phase** • The greatest number of maintenance vehicles and machinery across the lifetime of the Mona Offshore Wind Project • The greatest volume of consumables and frequency of replacement.	The greatest number and size of structures and maximum length of the export cables will result in the greatest consumption of fuel and materials representing the greatest potential for GHG emissions.
The impact of GHG emissions arisings from land-use change during the construction, operation and maintenance decommissioning phases	✓	✓	✓	**Construction, operation and maintenance and decommissioning phases** • The total array area is 449.97km^2 • The area of the permanent onshore cable corridor is up to 540,000m^2 based on a corridor measuring 30m wide and 18km in length. The temporary working corridor requires an additional 70m wide corridor (making the total width of the onshore cable corridor (temporary and permanent requirements) 100m wide – The maximum number of joint bays along the Onshore Cable Corridor is 96 (based on a distance of 750m between each joint bay on up to four trenches). The area of each joint bay is 200m^2 – The maximum number of link boxes along the Onshore Cable Corridor is 96 (based on a distance of 750km between each link box on up to four trenches). The area of each link box is 6m^2 • The maximum footprint of the Onshore Substation is 125,000m^2: this area will include the substation buildings and the earthworks to create the platform. The Onshore Substation will comprise up to four buildings. The maximum dimensions of the main building are 20m high, 40m wide and 90m long. • A construction compound will be required to support the construction of the substation extending up to 250,000m^2 • Access to the substation will be via a new permanent access road measuring up to 8m wide and 1.2km in length. • The area of the permanent 400kV Grid Connection Cable Corridor is up to 48,000m^2 based on a corridor measuring 16m wide and 3km in length – The maximum number of joint bays along the 400kV Grid Connection Cable Corridor is 10 (based on a distance of 500m between each joint bay) – The maximum number of link boxes along the 400kV grid connection is 10 (based on a distance of 500m between each link box).	The greatest number and size of structures and maximum length of the export cables and wind turbine area will result in the greatest area of disturbance and therefore, representing the greatest potential for GHG emissions from land use and sea bed change.
The impact of GHG emissions arising from the manufacturing and installation of the generation assets.	✓	×	×	**Construction phase** • There are up to 107 wind turbines, with a blade tip of 324m and a tower diameter of. 5.5 to 8m. There are foundations for 107 wind turbines that will be constructed using piling or drilling methods • There are four offshore substation platforms of 375MW capacity; the substations are 70m high, 80m long 60m wide. There are foundations for four substations that will be constructed using piling or drilling methods • The maximum length of the inter-array cables is 500km.	The greatest number of wind turbines and foundations and maximum length of the export cables represent the greatest potential for GHG emissions from the construction and installation of generation assets.
The impact of GHG emissions arising from the manufacturing and installation of the transmission assets.	✓	×	×	**Construction phase** • The maximum total length of the interconnector cables is 50km with a trench width of up to 3m and a depth of up to 3m. • The maximum length of the export cables is 360km with a trench width of up to 3m and a depth of up to 3m. • The area of the permanent onshore cable corridor is up to 540,000m2 based on a corridor measuring 30m wide and 18km in length. The temporary working corridor requires an additional 70m wide corridor (making the total width of the onshore cable corridor (temporary and permanent requirements) 100m wide • The maximum number of joint bays along the Onshore Cable Corridor is 96 (based on a distance of 750m between each joint bay on up to four trenches). The area of each joint bay is 200m2 • The maximum number of link boxes along the Onshore Cable Corridor is 96 (based on a distance of 750km between each link box on up to four trenches). The area of each link box is 6m2 • The maximum footprint of the Onshore Substation is 125,000m$^{2:}$ this area will include the substation buildings and the earthworks to create the platform. The Onshore Substation will comprise up to four buildings. The maximum dimensions of the main building are 20m high, 40m wide and 90m long. • A construction compound will be required to support the construction of the substation extending up to 250,000m2 • Access to the substation will be via a new permanent access road measuring up to 8m wide and 1.2km in length.	The greatest number and size of structures and maximum length of the export cables will result in the greatest consumption of fuel and materials representing the greatest potential for GHG emissions from the construction and installation of the transmission assets.

Potential impact	Phase[a] C	O	D	Maximum Design Scenario	Justification
				• The area of the permanent 400kV Grid Connection Cable Corridor is up to 48,000m2 based on a corridor measuring 16m wide and 3km in length • The maximum number of joint bays along the 400kV Grid Connection Cable Corridor is 10 (based on a distance of 500m between each joint bay) The maximum number of link boxes along the 400kV Grid connection is 10 (based on a distance of 500m between each link box).	
The impact of GHG emissions from decommissioning works (plant, fuel and vessel use) and recovery or disposal of materials	×	×	✓	**Decommissioning phase** • There are up to 107 wind turbines, with a blade tip of 324m and a tower diameter of 5.5 to 8m. There are foundations for 107 wind turbines that will be constructed using piling or drilling methods • There are four offshore substation platforms of 375MW capacity; the substations are 70m high, 80m long, 60m wide. There are foundations for four substations that will be constructed using piling or drilling methods • The maximum length of the inter-array cables is 500km • The maximum length of the inter-connector cables is 60km • The maximum length of offshore export cables is 360km • Greatest number of maintenance vehicles and machinery across the decommissioning period. • The maximum number link boxes on the Onshore Cable Corridor is 96. • The maximum number of link boxes on 400kV Grid Connection Cable Corridor is 10. • The maximum footprint of the Onshore Substation is 125,000m^2 and comprises up to four buildings. The dimensions of the main building are 15m high, 40m wide and 90m long • Access to the substation will be via a new permanent access road measuring up to 8m wide and 1.2km in length.	The greatest number and size of structures and maximum length of the inter-array and inter-connector cables will result in the greatest consumption of fuel and materials representing the greatest potential for GHG emissions from the decommissioning works.
The impact of estimated abatement of UK Grid emissions during the operations and maintenance phase.	×	✓	×	**Operation and maintenance phase** The proposed export capacity of the Mona Offshore Wind Project is 1.5GW.	The greatest generating capacity represents the greatest abatement of fossil fuels from the Grid.

Table 28.9: Climate change risk: Maximum design scenario considered for the assessment of potential impacts on climate change.

Potential impact	Phase[a] C	O	D	Maximum Design Scenario	Justification
Impact of the effects of climate change on the Mona Offshore Wind Project onshore and offshore infrastructure	×	✓	×	**Operation and maintenance phase** • Consistently heightened temperatures, changes to rainfall patterns, increased wind speeds and increased frequency of extreme events such as floods and storms could lead to efficiency losses due to overheating, the failure of electrical equipment or damage to infrastructure which would result in an increase in operations and maintenance activities.	The worst case scenario of the effects of climate change on the onshore and offshore infrastructure.

28.7.2 Impacts scoped out of the assessment

28.7.2.1 On the basis of the baseline environment and the description of development outlined in volume 1, chapter 5: Project description of the PEIR, a number of impacts are proposed to be scoped out of the assessment for climate change. These impacts are outlined, together with a justification for scoping them out, in Table 28.10.

Table 28.10: Impacts scoped out of the assessment for climate change.

Potential impact	Justification
The impact of GHG emissions arising from the consumption of materials and activities required to facilitate the operation and maintenance of the Mona Offshore Wind Project during the construction and decommissioning phases.	Only applicable to the operational and maintenance phase of the Mona Offshore Wind Project.
The impact of estimated abatement of UK Grid emissions during construction or decommissioning phases.	Only applicable to the operations and maintenance phase of the Mona Offshore Wind Project. No abatement of fossil fuels will be possible throughout the decommissioning or construction phases.
The impact of the effects of climate change on the Mona Offshore Wind Project through construction and decommissioning	Due to the length of the programme for construction and decommissioning phases, variations in climatic parameters would be minimal compared to the present day baseline. Construction work practices are adapted to existing climate conditions and weather in the UK. It is assumed that construction work practices would likely evolve with time with climatic variations. Such impacts are assessed within the operations and maintenance stage only.

28.8 Measures adopted as part of the Mona Offshore Wind Project

28.8.1.1 For the purposes of the EIA process, the term 'measures adopted as part of the project' is used to include the following measures (adapted from IEMA, 2016):

- Measures included as part of the Mona Offshore Wind Project design. These include modifications to the location or design of the Mona Offshore Wind Project which are integrated into the application for consent. These measures are secured through the consent itself through the description of the development and the parameters secured in the DCO and/or marine licences (referred to as primary mitigation in IEMA, 2016).

28.8.1.2 A number of measures (primary in relation to climate change) have been adopted as part of the Mona Offshore Wind Project to reduce the potential for impacts on climate change. These are outlined in Table 28.11 below. As there is a commitment to implementing these measures, they are considered inherently part of the design of the Mona Offshore Wind Project and have therefore been considered in the assessment presented in section 28.9 below (i.e. the determination of magnitude and therefore significance assumes implementation of these measures).

Table 28.11: Measures adopted as part of the Mona Offshore Wind Project.

Measures adopted as part of the Mona Offshore Wind Project	Justification	How the measure will be secured
Primary measures: Measures included as part of the Mona Offshore Wind Project design		
Application of anti-corrosion protective coatings and integrated scour protection to offshore equipment.	The potential increased temperatures and ocean acidification may lead to accelerated corrosion of submerged structures, including export cables and as such appropriate measures are required to reduce the potential effect.	Committed with the Mona Offshore Wind Project design (see volume 1, chapter 5: Project description of the PEIR
Safety margin within the turbine design to be fitted with automatic shutdowns/lockdowns with regards to spinning too fast	Overheating and higher winds/extreme weather pose a risk of increased degradation and need for replacement. In addition to inhibition and potential export capacity.	Committed with the Mona Offshore Wind Project design (see volume 1, chapter 5: Project description of the PEIR
The substation will house auxiliary equipment e.g. appropriate cooling plant for an in building substation solution to account for a range of temperature conditions.	Consistently heightened temperatures could lead to efficiency losses due to overheating, or the failure of electrical equipment.	Committed with the Mona Offshore Wind Project design (see volume 1, chapter 5: Project description of the PEIR

28.8.1.3 Where significant effects have been identified, further mitigation measures (referred to as secondary mitigation in IEMA (2016)) have been identified to reduce the significance of effect to acceptable levels following the initial assessment. These are measures that could further prevent, reduce and, where possible, offset any adverse effects on the environment. These measures are set out, where relevant, in the assessment sections below.

28.9 Assessment of significant effects

28.9.1.1 The impacts of the construction, operation and maintenance, and decommissioning phases of the Mona Offshore Wind Project on and from climate change have been assessed. The potential impacts arising from the construction, operation and maintenance and decommissioning phases of the Mona Offshore Wind Project are listed in Table 28.8, along with the maximum design scenario against which each impact has been assessed.

28.9.1.2 The assessment of significant effects relating to climate change is divided into the effects of GHG emissions on climate change and the effects of climate change risk.

28.9.2 Assessment of significant effects: GHG emissions

28.9.2.1 The impacts of the construction, operation and maintenance and decommissioning phases of the Mona Offshore Wind Project on GHG emissions have been assessed below in line with the GHG emissions impact assessment criteria:

- Magnitude of the impact
- Sensitivity of receptor
- Significance of effect.

28.9.2.2 The operation and maintenance of the Mona Offshore Wind Project would lead to consumption of fuel and replacement of materials throughout the operational lifetime of the Mona Offshore Wind Project. This would result in the greatest potential for GHG emissions. In volume 8, annex 28.1: Technical Greenhouse Gas emission assessment of the PEIR, the life cycle assessment embodied carbon is divided into:

- Materials and construction (A1-A5)
- Operation and maintenance (B1-B5)
- Decommissioning (C1-C4).

28.9.3 The impact of GHG emissions arisings from land-use change during the construction, operation and maintenance decommissioning phases

Construction, Operation and Maintenance and Decommissioning

Magnitude of impact

28.9.3.1 The impact is predicted to be of regional spatial extent, long-term duration, intermittent and medium reversibility. It is predicted that the impact will affect the receptor directly. The habitat along the Mona Offshore Wind Project red line boundary would be impacted for the duration of the construction (excavation for buildings, access roads, cable route and construction compounds) and in some cases operations and maintenance phases primarily through the land take for turbines, and substations. However, through the decommissioning process it is anticipated that the existing baseline environment, which is not a significant carbon store, would be restored. As such, the quantify of change in a tCO_2e owing to land use and sea bed change across the Mona Offshore Wind Project's whole life is considered to be negligible.

Sensitivity of receptor

28.9.3.2 In accordance with paragraph 28.6.2.1, the receptor is deemed to be of high vulnerability, low recoverability and high value. The sensitivity of the receptor is therefore, considered to be **high**.

Significance of effect

28.9.3.3 Overall, the magnitude of the impact is deemed to be negligible and the sensitivity of the receptor is considered to be high. The effect will, therefore, be of **negligible** effect, which is not significant in EIA terms.

28.9.4 The impact of GHG emissions arising from the manufacturing and installation of the generation and transmission assets during construction.

28.9.4.1 Consideration of the embodied carbon emissions associated with materials for both onshore and offshore elements (WTG, substation, cabling) and associated transportation emissions. This impact entails an assessment of the greatest number of wind turbines and foundations and maximum length of the export cables representing the greatest potential for GHG emissions from the construction and installation of generation and transmission assets as a conservative estimate of impact.

Construction

28.9.4.2 As detailed in paragraph 28.9.1.2 and volume 8, annex 28.1: Technical Greenhouse Gas emissions assessment, the life cycle assessment embodied carbon is divided into three stages. The GHG emissions arising from the consumption of materials and activities required to construct the Mona Offshore Wind Project are presented in Table 28.12 below.

Table 28.12: Construction stage wind turbine GHG emissions.

LCA Stage	Intensity ($kgCO_2e/MWh$)	35 year output (MWh)	Mona Offshore Wind Project emissions (tCO_2e)
A1-A5	9.46	122,221,092	1,156,212

28.9.4.3 The potential impact of the proposed substation has been estimated using an intensity for the manufacturing GWP of 2,190 $kgCO_2e$ per MW (ABB, 2003). This was scaled by the Mona Offshore Wind Project output capacity of 1,500 MW to give an estimated embodied emission value of 3,285 tCO_2e.

28.9.4.4 At this stage of design, materials estimates have some uncertainty in terms of the amounts and in the grouping into the main categories of material rather than it being possible to specify all products to be used in the final, detailed design. As a means of comparison, a published benchmark (RICS, 2012) has therefore also been used to estimate possible emissions from the substation buildings.

28.9.4.5 The benchmark data is expressed in kg CO_2e/m^2 of floorspace as an intensity which is applied against the total floor area for all four substation buildings. When using the RICS intensity for other Industrial/utilities/specialist uses with the substation floor area we result this results in in an estimated embodied carbon emission of 57,225 tCO_2e.

Magnitude of impact

28.9.4.6 The impact is predicted to be of international spatial extent, short term duration, intermittent and low reversibility. It is predicted that the impact will affect the receptor indirectly. The magnitude is therefore, considered to be 1,216,722 tCO_2e for the construction period.

Sensitivity of receptor

28.9.4.7 In accordance with paragraph 28.6.2.1 the receptor is deemed to be of high vulnerability, low recoverability and high value. The sensitivity of the receptor is therefore, considered to be **high**.

Significance of effect

28.9.4.8 Overall, the magnitude of the impact is deemed to be 1,216,722 tCO_2e and the sensitivity of the receptor is considered to be high. The effect will, therefore, be of **moderate adverse** effect, which is significant in EIA terms.

Further mitigation and residual effect

28.9.4.9 A moderate adverse effect is predicted for GHG emissions produced as a result of construction activity associated with the Mona Offshore Wind Project. This is significant in EIA terms. In order to mitigate this effect, the Mona Offshore Wind Project is committed to exploring options to reduce construction related emissions. Areas to be explored by the Mona Offshore Wind Project could include:

- Optimization of construction activity to reduce emissions (e.g. potentially related to vessel scheduling, co-ordination of shipping/delivery of materials and the identification energy efficiency mechanisms)
- Identification of opportunities to reduce emissions in the supply chain
- Inclusion of low carbon criteria within procurement activities

28.9.4.10 Any further risk controls will be explored through engagement with the relevant stakeholders, where necessary, to ensure they are appropriate for reducing risks to ALARP.

28.9.4.11 With these commitments to look at opportunities to reduce construction related emissions, the impact magnitude is predicted to reduce to minor and the residual effect will be minor adverse, which is not significant in EIA terms

28.9.5 The impact of GHG emissions (plant, fuel and vessel use) and recovery or disposal of materials during decommissioning

28.9.5.1 The greatest number (e.g. link boxes) and size of structures (e.g. onshore substation) and maximum length of the inter-array and inter-connector cables will result in the greatest consumption of fuel and materials representing the greatest potential for GHG emissions from the decommissioning works.

Decommissioning

28.9.5.2 The GHG emissions arising from the consumption of materials and activities required to facilitate the decommissioning of the Mona Offshore Wind Project are presented in Table 28.13 below. Further detailed consideration can be found in volume 8, annex 28.1: Technical Greenhouse Gas emissions assessment of the PEIR.

Table 28.13: Decommissioning stage GHG emissions.

LCA Stage	Intensity ($kgCO_2e/MWh$)	35 year output (MWh)	Mona Offshore Wind Project Emissions (tCO_2e)
C1-C4	0.55	122,221,092	67,222

28.9.5.3 The majority of decommissioning emissions relate to the use of plant for Mona Offshore Wind Project decommissioning, disassembly, transportation to a waste site, and ultimate disposal and/or recycling of the equipment and other site materials. The components of the wind turbines are considered to be highly recyclable. When disposing of wind turbines, recycling is the preferred solution. This not only prevents the materials from being sent to landfill, but also reduces the need for the extraction of primary materials. Material which cannot be recycled might be used for incineration or energy from waste. Additionally, the carbon emissions associated with use of plant and fuel is expected to have achieved good levels of decarbonisation at the decommissioning phase of the Mona Offshore Wind Project. As such, the above quantified emissions is anticipated to be a worst case estimate.

Magnitude of impact

28.9.5.1 The impact is predicted to be of international spatial extent, short term duration, intermittent and low reversibility. It is predicted that the impact will affect the receptor indirectly. The magnitude is therefore, considered to be **67,222 tCO_2e.**

Sensitivity of receptor

28.9.5.2 In accordance with 28.6.2.1 the receptor is deemed to be of high vulnerability, low recoverability and high value. The sensitivity of the receptor is therefore, considered to be **high**.

Significance of effect

28.9.5.3 Overall, the magnitude of the impact is deemed to be 67,222 tCO_2e, and the sensitivity of the receptor is considered to be high. The effect will, therefore, be of **minor adverse** effect, which is not significant in EIA terms.

28.9.6 The impact of GHG emissions arising from the consumption of materials and activities required to facilitate the operation and maintenance of the Mona Offshore Wind Project and estimated abatement of UK Grid emissions

28.9.6.1 The greatest generating capacity represents the greatest abatement of fossil fuels from the UK Grid. The primary purpose of the operational stage of a wind farm is to generate electricity which avoids the need for fossil fuel generated electricity and reduces the UK Grid carbon intensity. The avoided emissions associated with the displacement of projected marginal generation of the UK Grid should be considered in combination with impact of GHG emissions arising from the consumption of materials and activities required to facilitate the operation and maintenance of the Mona Offshore Wind Project.

28.9.6.2 The GHG emissions arising from the consumption of materials and activities required to facilitate the operation and maintenance of the Mona Offshore Wind Project are presented in Table 28.14 below.

Table 28.14: Operation and maintenance stage GHG emissions.

LCA Stage	Intensity ($kgCO_2e/MWh$)	35 year output (MWh)	Mona Offshore Wind Project emissions (tCO_2e)
Ongoing (B1-B5)	0.99	122,221,092	120,999

28.9.6.3 It should be noted that when considering the Mona Offshore Wind Project's impact on climate change the emissions as a result of operation and maintenance activities must be considered alongside the displacement marginal alternative sources of electricity generation. This element is further considered in the assessment below.

Table 28.15: Energy flows from Mona Offshore Wind Project.

* It should be noted that the BEIS Allocation Framework for Rounds 3 (BEIS, 2019) and 4 (BEIS 2021b) states that all new offshore wind projects shall achieve a load factor of 58.4% and 63.1% respectively. Use of higher load factors would result in higher output and subsequent avoided emissions. As such, a lower capacity factor (based on average actual offshore wind load factors between 2004 & 2021 as opposed to forward looking projected factors) represents a conservative assumption for this assessment. Further detail can be found in Volume 8, annex 28.1: Technical Greenhouse gas assessment technical report of the PEIR.

Parameter	Value	Unit	Source
Input parameter - rated power	1,500	MW	Project Description
Input parameter – capacity factor	34.5	%	BEIS (2022d)
Input parameter – degradation factor	1.6	%	Staffell & Green (2014)
Input parameter – total annual operating hours	8,760	hrs	Mona Offshore Wind Project PDE
Output parameter - annual energy output	4,533,300	MWh	Mona Offshore Wind Project PDE

28.9.6.4 The input and output figures for the operation and maintenance stage of the Mona Offshore Wind Project are then calculated against the assumptions stated within the BEIS long-run marginal. This allows for a direct presentation of the cumulative GHG emissions avoided throughout the operational lifetime of the Mona Offshore Wind Project and therefore, how the Mona Offshore Wind Project contributes towards reaching net zero targets.

28.9.6.5 The resulting estimated avoided emissions associated with the operation and maintenance stage of the Mona Offshore Wind Project would be 2,377,416 tCO_2e avoided emissions associated with the abatement of the UK Grid.

Sensitivity analysis

28.9.6.6 The long run marginal carbon intensity figures, which have been used in the assessment are dynamic and show year-on-year decarbonisation of UK electricity Grid towards the UK's committed net zero 2050 pledge. The long run marginal carbon intensity figures account for variations over time for both generation and consumption activity reflecting the different types of power plants generating electricity across the day and over time, each with different emissions factors. However, the long run marginal figures are projections and cannot be taken with absolute certainty. Furthermore, the long-run marginal includes assumed abatement of fossil fuel generation sources within the UK electricity Grid. As such it is likely that the true value of the avoided emissions displaced as a result of the Morgan Generation Assets' contribution to the UK electricity Grid would be higher than that of avoided emissions detailed above in paragraph 28.9.6.5.

28.9.6.7 Although the use of the current UK electricity Grid average and BEIS 'non-renewable fuels' carbon intensities would conclude greater avoided emissions (Table 28.16) and an ultimate reduction in carbon payback period, these are static baselines and do not account for future UK electricity Grid decarbonisation. As such, the long run marginal provides a conservative quantification of avoided emissions for the purpose of this assessment.

Table 28.16: Whole life avoided emissions sensitivity test.

Operating years	Output (MWh)	BEIS long-run marginal avoided emissions (tCO_2e)	Current UK Grid average avoided emissions (tCO_2e)	BEIS 'non-renewable fuels' avoided emissions (tCO_2e)
35	122,221,092	2,377,416	29,287,840	52,799,512

Magnitude of impact

Sensitivity of receptor

28.9.6.9 In accordance with 28.6.2.1 the receptor is deemed to be of high vulnerability, low recoverability and high value. The sensitivity of the receptor is therefore, considered to be **high**.

Significance of effect

28.9.6.10 Overall, the magnitude of the impact is deemed to be 2,256,416 tCO_2e avoided emissions, and the sensitivity of the receptor is considered to be high. The effect will, therefore, be of **beneficial effect**, which is significant in EIA terms.

28.9.7 Assessment of significant effects: climate change risk

28.9.7.1 The risks identified in volume 8, annex 28.2: Climate change risk assessment, are summarised in this section in relating to their impact upon the construction, operations and maintenance and decommissioning phases of the Mona offshore Wind Project, in accordance with the following assessment criteria:

- Severity of the impacts.
- Probability of the potential impacts.
- Influence factor.

Impact of the effects of climate change on the Mona Offshore Wind Project onshore and offshore infrastructure through the operation and maintenance phase

28.9.7.2 This issue condenses the worst case scenarios identified in volume 8, annex 28.2: Climate change risk assessment of the PEIR and the effects of climate change on the onshore and offshore infrastructure.

Operation and maintenance

28.9.7.3 Consistently heightened temperatures, changes to rainfall patterns, increased wind speeds and increased frequency of extreme events such as floods and storms could lead to efficiency losses due to overheating, the failure of electrical equipment or damage to infrastructure which would result in an increase in operations and maintenance activities.

28.9.7.4 The impact is predicted to be of national spatial extent, long term duration, continuous and low reversibility. It is predicted that the impact will affect the receptor indirectly. Annex 27.2 summarises the potential climatic changes in the coming decades and considers the potential consequences for the Mona Offshore Wind Project in a risk assessment format. The most significant risk from climate change to the Mona Offshore Wind Project is likely to arise from flooding. This is assessed separately in detail in Volume 3 Chapter 17: Hydrology and Flood Risk of the PEIR and appropriate flood management and resilience measures have been provided, including an allowance for climate change effects. No further consideration and inclusion of flooding risk is presented in this assessment.

28.9.7.5 The risk assessment in Volume 8 Annex 28.2 considers in its scoring the level of influence the design of the construction and operation and maintenance of the Mona Offshore Wind Project can have upon the remaining risks, in addition to its severity and probability. Those risks over which the developer has little or no influence are therefore typically not considered significant effects of the Mona Offshore Wind Project, save where the severity and/or probability are highest.

28.9.7.6 With the exception of flood risks, the greatest risks to the Mona Offshore Wind Project due to climate change have been identified as those arising from high temperatures affecting operational equipment and storms affecting power transmission, wind turbines or building damage. Four of the identified risk issues were screened with a score of five or more (the minimum score where more than one element of the risk assessment score is above 'one') before mitigation.

28.9.7.7 As the three potentially significant effects excluding flood risk will be mitigated through the incorporation of measures adopted, the effect on the Mona Offshore Wind Project has been determined to be **negligible**. Good practice design measures adopted as part of the Mona Offshore Wind Project include the following

- Consideration of external location of substation and use of appropriate cooling plant designed to account for a range of temperature conditions for in building design.
- Safety margin within the turbine design to be fitted with automatic shutdowns/lockdowns with regards to spinning too fast.
- Application of anti-corrosion protective coatings and more frequent inspection routine as increased sea surface temperatures are observed.

28.9.8 GHG Emissions – Net Effects and context

28.9.8.1 As detailed in 28.6.2.3 consideration of a Mona Offshore Wind Project's whole life impact is an important consideration when assessing the Mona Offshore Wind Projects impacts and subsequent effects on climate change. As such, the consideration of the Mona Offshore Wind Project net emissions in the context of existing and emerging policy commitments and UK Carbon budgets is important.

28.9.8.2 Over the lifetime of the Mona Offshore Wind Project would result in 972,473 tCO_2e of avoided emissions. The Mona Offshore Wind Project would likely have a carbon payback period[1] of four years when accounting for 1,216,722 tCO_2e construction stage emissions and 2,256,416[2] tCO_2e operational avoided emissions.

28.9.8.3 Consideration of the Mona Offshore Wind Project's net emissions performance can be considered with the following contextualisation:

- it contributes to reducing carbon budget expenditure at a national and local level; and
- it is in keeping with local and UK energy and climate policy.

28.9.8.4 The Mona Offshore Wind Project net emissions accounting for both construction and operational stages up to the end of the Sixth Carbon Budget are detailed in the Table 28.17 below. When accounting for the total Mona Offshore Wind Project construction stage GHG emissions (1,216.722 tCO_2e) against the operational and maintenance avoided emissions (-1,572,861 tCO_2e) from full operating year (2030) to the end of the Sixth Carbon Budget (2037), the net emissions would be -723,266 tCO_2e, approximately -0.04% of the UK Carbon Budget for the same period.

Table 28.17: GHG Impacts in the Context of the UK's Carbon Budgets.

*represent only two year of the budget for 2030-2032 in line with Mona Offshore Wind Project opening year.

LCA Stage	2028-2032*	2033-2037	Total
UK Carbon Budget (tCO_2e)	865,000,000	960,000,000	1,825,000,000
Mona Offshore Wind Project GHG impacts (tCO_2e)	474,077.11	-830,217.00	-356,140
Development avoided emissions as percentage of UK carbon budget	0.055%	-0.086%	-0.020%

28.9.8.5 The Mona Offshore Wind Project is in line with the NPS EN-3's principle of supporting new renewable and low carbon energy developments, in addition to their associated infrastructure, in order to contribute to reductions in GHG emissions. In addition, the

[1] The period of time for which a wind turbine needs to be in operation before it has, by displacing generation from fossil-fuelled power stations, avoided as much carbon dioxide as was released in its lifecycle.

[2] When accounting for both avoided emissions and fuel/energy usage throughout the operation and maintenance activities.

1.5 GW capacity from the Mona Offshore Wind Project would contribute towards the UK Government's commitment for 50 GW capacity from offshore wind by 2030.

28.9.8.6 Further, the Mona Offshore Wind Project is supported by national energy and climate change policy (including the National Infrastructure Strategy, Sixth Carbon Budget, Net Zero Strategy, and Net Zero Wales) which highlight the need for an end to the use of unabated fossil fuel generation, whilst also significantly ramping up electricity generation capacity in order to meet the demands of increased electrification of transport, heat and industry. As such, government policy dictates that large-scale deployment of renewable energy generators such as the Mona Offshore Wind Project are necessary in order to meet GHG reduction targets.

28.9.8.7 By facilitating the expansion of renewable energy supply, the Mona Offshore Wind Project would assist the UK Government target of achieving a fully decarbonised power system by 2035, and both the UK and Welsh Government's aim to become net zero by 2050.

28.9.8.8 When considering the above magnitude of avoided emissions across the whole life time of the project (972,473 tCO_2e of avoided emissions), in addition to, the contribution toward the UK achieving its net zero goals and policy, and the high sensitivity of the climate as a receptor, the Mona Offshore Wind Project would have a beneficial net effect which would be significant in EIA terms.

28.10 Cumulative effects

28.10.1.1 All developments that emit, avoid or sequester GHGs have the potential to impact the atmospheric mass of GHGs as a receptor, and so may have a cumulative impact on climate change. Consequently, cumulative effects due to other specific local development projects are not individually considered but are taken into account when considering the impact of the Mona Offshore Wind Project by defining the atmospheric mass of GHGs as a **high sensitivity** receptor. The construction, operational and decommissioning phase effects of the assessment of the Mona Offshore Wind Project takes account of cumulative changes in greenhouse gas emissions from other energy generation sources.

28.11 Inter-related effects

28.11.1.1 The assessment of inter-related effects with climate change is provided in each topic chapter of this EIA Report. The main areas where there is a potential for inter-related effects, subject to assessment, are considered to be:

- Volume 3, chapter 18: Onshore ecology and volume 2, chapter 1: Benthic subtidal and intertidal ecology – potential changes in the sensitivity of habitats or species to development impacts in the future due to the effects of climate change
- Volume 3, chapter 17: Hydrology and flood Risk – changes in rainfall frequency and intensity
- Volume 4, chapter 26: Seascape. landscape and visual resources - consideration of climate resilience (e.g. drought tolerance) in the design and species mix of landscape planting proposed.

28.12 Transboundary effects

28.12.1.1 A screening of transboundary impacts has been carried out and any potential for significant transboundary effects with regard to climate change from the Mona Offshore Wind Project upon the interests of other states has been assessed within volume 5, annex 5.4 of the PEIR.

28.12.1.2 All developments which emit GHGs have the potential to impact the atmospheric mass of GHGs as a receptor, and so may have a transboundary impact on climate change. Consequently, transboundary effects due to other specific international development projects are not individually identified but would be taken into account when considering the impact of the Mona Offshore Wind Project by defining the atmospheric mass of GHGs as a high sensitivity receptor. Each country has its own policy and targets concerning carbon and climate change which are intended to limit GHG emissions to acceptable levels within that county's defined budget and international commitments.

28.13 Summary of impacts, mitigation measures and monitoring

28.13.1.1 Information on climate change within the climate change study area was collected through desktop review.

28.13.1.2 The potential impact of GHG emissions due to the Mona Offshore Wind Project, resulting in an effect on the global atmospheric GHG concentration that contributes to climate change, has been assessed and reported in this chapter. The impacts of climate change on the Mona Offshore Wind Project have also been assessed and reported.

- Table 28.18 presents a summary of the potential impacts, measures adopted as part of the Mona Offshore Wind Project and residual effects in respect to climate change. The impacts assessed include:
  - The impact of GHG emissions arisings from land-use & sea bed change.
  - The impact of GHG emissions arising from the manufacturing and installation of the generation and transmission assets
  - The impact of GHG emissions from decommissioning works (plant, fuel and vessel use) and recovery or disposal of materials
  - The impact of GHG emissions arising from the consumption of materials and activities required to facilitate the operations and maintenance of the Mona Offshore Wind Project and of the estimated abatement of UK Grid emissions during the operations and maintenance phase
  - Impact of the effects of climate change on the Mona Offshore Wind Project onshore and offshore infrastructure.

28.13.1.3 Overall, it is concluded that there will be the following significant effects arising from the Mona Offshore Wind Project during the construction, operations and maintenance or decommissioning phases.

- Construction stage: emissions from the manufacturing the onshore and offshore infrastructure would result in emissions of up to 1,216,722 tCO_2e. This would be a **significant moderate adverse** effect (in EIA Terms) with a residual effect of minor adverse, which is not significant in EIA terms, when accounting

for further mitigation. The construction phase must also be evaluated in terms of whole life time emissions from the Mona Offshore Wind Project

- Operations and maintenance stage: The operational phase of the Mona Offshore Wind Project would enable the use of excess renewable electricity (avoiding generation curtailment) and the displacement of fossil fuels. This would result in a positive GHG impact. When considering the avoided emissions, in addition to operational/maintenance emissions, the operational impact results in the order of approximately **2,256,416 tCO_2e** savings by 2064. This would result in a significant **beneficial effect** in EIA terms:

28.13.1.4 Despite the GHG emissions resulting from the construction-stage of the development, the magnitude of avoided emissions resulting from the operational-stage of the development allows the Mona Offshore Wind Project to enable avoided emissions from the end of the third year of operation (carbon payback period).

28.13.1.5 Over the lifetime of the Mona Offshore Wind Project, it would result in 972,473 tCO_2e of avoided emissions.

28.13.1.6 Consideration of the Mona Offshore Wind Project's net emissions performance can be considered with the following contextualisation:

- it contributes to reducing carbon budget expenditure at a national and local level; and
- it is in keeping with local and UK energy and climate policy.

28.13.1.7 The Mona Offshore Wind Project is in line with the NPS EN-3's principle of supporting new renewable and low carbon energy developments, in addition to their associated infrastructure, in order to contribute to reductions in GHG emissions.

28.13.1.8 Further, the Mona Offshore Wind Project is supported by national energy and climate change policy (including the National Infrastructure Strategy, Sixth Carbon Budget, Net Zero Strategy, and Net Zero Wales) which highlight the need for an end to the use of unabated fossil fuel generation, whilst also significantly ramping up electricity generation capacity in order to meet the demands of increased electrification of transport, heat and industry. As such, government policy dictates that large-scale deployment of renewable energy generators such as the Mona Offshore Wind Project are necessary in order to meet GHG reduction targets.

28.13.1.9 By facilitating the expansion of renewable energy supply, the Mona Offshore Wind Project would assist the UK Government target of achieving a fully decarbonised power system by 2035, and both the UK and Welsh Government's aim to become net zero by 2050.

Table 28.18: Summary of potential environmental effects, mitigation and monitoring.

[a] C=construction, O=operations and maintenance, D=decommissioning

Description of impact	Phase[a] C	O	D	Measures adopted as part of the Mona Offshore Wind Project	Magnitude of impact	Sensitivity of the receptor	Significance of effect	Further mitigation	Residual effect	Proposed monitoring
The impact of GHG emissions arisings from land-use change during the construction, operation and maintenance decommissioning phases	✓	✓	✓	None	C: Negligible O: Negligible D: Negligible	C: High O: High D: High	C:Negligible O: Negligible D: Negligible (Not Significant)	None	C:Negligible O: Negligible D: Negligible (Not Significant)	None
The impact of GHG emissions arising from the manufacturing and installation of the generation and transmission assets during construction.	✓	X	X	None	1,216,722 tCO_2e	High	Moderate adverse effect (Significant)	The Mona Offshore Wind Project is committed to exploring options to reduce construction related emissions. Areas to be explored by the Mona Offshore Wind Project could include: • Optimization of construction activity to reduce emissions (e.g. potentially related to vessel scheduling, co-ordination of shipping/delivery of materials and the identification energy efficiency mechanisms) • Identification of opportunities to reduce emissions in the supply chain • Inclusion of low carbon criteria within procurement activities	Minor adverse effect (Not Significant)	None
The impact of GHG emissions (plant, fuel and vessel use) and recovery or disposal of materials during decommissioning	X	X	✓	None	67,222 tCO_2e	High	Minor adverse effect (Not Significant),	None	Minor adverse effect (Not Significant)	None
The impact of GHG emissions arising from the consumption of materials and activities required to facilitate the operation and maintenance of the Mona Offshore Wind Project and estimated abatement of UK Grid emissions	X	✓	X	None	2,256,416 tCO_2e avoided emissions	High	Beneficial effect (Significant)	None	Beneficial effect (Significant)	None
Impact of the effects of climate change on the Mona Offshore Wind Project onshore and offshore infrastructure through the operation and maintenance phase	X	✓	X	• Application of anti-corrosion protective coatings and integrated scour protection to offshore equipment. • Wind turbine design to incorporate control of blade speed/braking and power backup system, retro fits to improve airflow and reduce drag and to be fitted with automatic shutdowns/lockdowns to prevent spinning too fast from storms.	N/A	N/A	Negligible	None	Negligible	None

28.14 Next steps

28.14.1.1 Where additional information concerning materials, transportation and other variations becomes available throughout the design evolution, updated calculations would be completed and presented within the Environmental Statement, where required. This would also consider potential further mitigation measures to reduce the significant adverse effect associated with construction stage emissions presented within the PEIR.

28.15 References

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