Partners in UK offshore wind

MONA OFFSHORE WIND PROJECT

Environmental Statement

Volume 4, Chapter 2: Climate change

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Image of an offshore wind farm

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Acronyms

Acronym	Description
BEIS	Department for Business, Energy and Industrial Strategy
CCC	Climate Change Committee
CCRA	Climate Change Risk Assessment
DESNZ	Department for Energy Security and Net Zero
EIA	Environmental Impact Assessment
FRA	Flood Risk Assessment
GHG	Greenhouse Gas
GWP	Global Warming Potential
HGV	Heavy Goods Vehicles
ICCI	In-combination Climate Impacts
MOHC	Met Office Hadley Centre
MSL	Mean Sea Level
OSP	Offshore Substation Platform
RCP	Representative Concentration Pathway
UKCP18	UK Climate Projections 2018
UNFCCC	United Nations Framework Convention on Climate Change
WTG	Wind Turbine Generator

Units

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

2 Climate change

2.1 Introduction

2.1.1 Overview

2.1.1.1 This chapter of the Environmental Statement 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.

2.1.1.2 Climate change in the context of Environmental Impact Assessment (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. Consideration of in-combination climate impacts (ICCI) is presented within each technical chapter of the Environmental Statement where relevant and appropriate.

2.1.1.3 The assessment presented is informed by the following chapters:

- Volume 2, Chapter 2: Benthic subtidal and intertidal ecology of the Environmental Statement
- Volume 2, Chapter 7: Shipping and navigation of the Environmental Statement
- Volume 3, Chapter 2: Hydrology and flood risk of the Environmental Statement
- Volume 3, Chapter 5: Historic environment of the Environmental Statement
- Volume 3, Chapter 7: Land use and recreation of the Environmental Statement

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

- Volume 6, Annex 7.1: Navigational risk assessment
- Volume 7, Annex 7.1: Published soil and agricultural land classification data
- Volume 8, Annex 2.1: Greenhouse gas assessment technical report of the Environmental Statement
- Volume 8, Annex 2.2 Climate change risk assessment technical report of the Environmental Statement.

2.1.1.5 In particular, this Environmental Statement chapter:

- Presents the existing and future environmental baseline conditions established from desk studies
- Identifies any assumptions and limitations encountered in compiling the environmental information
- Presents the potential environmental effects on climate change (GHG emissions) from the Mona Offshore Wind Project, and from climate change (risk and

resilience) 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.

2.2 Policy context

2.2.1 Legislation

2.2.1.1 The Climate Change Act 2008 (2019), creates a framework for setting a series of interim national carbon budgets and plans for national adaptation to climate risks. The Act requires the UK government to set carbon budgets for the whole of the UK. A carbon budget places restrictions on the total amount of GHGs that can be emitted. The budget balances the input of CO_2 to the atmosphere by emissions from human activities, by the storage of carbon (i.e. in carbon reservoirs on land or in the ocean).

2.2.1.2 At present, the Third, Fourth, Fifth and Sixth Carbon Budgets, set through The Carbon Budget Orders 2009, 2011, 2016, and 2021 are 2.54 giga tonnes carbon dioxide equivalent ($GtCO_2e$) for 2018 to 2022, 1.95 $GtCO_2e$ for 2023 to 2027, 1.73 $GtCO_2e$ for 2028 to 2032 and 0.97 $GtCO_2e$ for 2033 to 2037 respectively. The Sixth Carbon Budget is the first Carbon Budget that is consistent with the UK's net zero target, requiring a 78% reduction in GHG emissions by 2035 from 1990 levels.

2.2.1.3 The UK's nationally determined contribution (HM Government, 2020) under the Paris Agreement to the United Nations Framework Convention on Climate Change (UNFCCC), submitted in December 2020, commits the UK to reducing economy wide GHG emissions by at least 68% by 2030, compared to 1990 levels.

2.2.2 Planning Policy Context

2.2.2.1 The Mona Offshore Wind Project will be located in Welsh offshore waters (beyond 12 nautical miles (nm) from the Welsh coast) and inshore waters, with the onshore infrastructure located wholly within Wales. As set out in Volume 1, Chapter 1: Introduction of the Environmental Statement, the Mona Offshore Wind Project is an offshore generating station with a capacity of greater than 350 MW located in Welsh waters, it is a Nationally Significant Infrastructure Project (NSIP) as defined by Section 15(3) of the Planning Act 2008 (the 2008 Act). As such, there is a requirement to submit an application for a Development Consent Order (DCO) to the Planning Inspectorate to be decided by the Secretary of State for the Department for Energy Security and Net Zero.

2.2.3 National Policy Statements

2.2.3.1 There are currently six energy National Policy Statements (NPSs), three of which contain policy relevant to offshore wind development and the Mona Offshore Wind Project, specifically:

- Overarching NPS for Energy (NPS EN-1) which sets out the UK Government's policy for the delivery of major energy infrastructure (Department for Energy Security & Net Zero, 2024a)
- NPS for Renewable Energy Infrastructure (NPS EN-3) (Department for Energy Security & Net Zero, 2024b)

- NPS for Electricity Networks Infrastructure (NPS EN-5) (Department for Energy Security & Net Zero, 2024c).

2.2.3.2 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. NPS EN-5 includes guidance on what matters are to be considered in the onshore assessment of electrical networks. These are summarised in Table 2.2 below.

Table 2.1: Summary of the NPS EN-1 and NPS EN-3 provisions relevant to climate change

Summary of NPS EN-1 and EN-3 provision	How and where considered in the Environmental Statement
NPS EN-1	
'Operational GHG emissions are a significant adverse impact from some types of energy infrastructure which cannot be totally avoided' and that *'all proposals for energy infrastructure projects should include a GHG assessment as part of their ES'.* [Paragraphs 5.3.11 and 5.3.4].	This chapter (section 2.10) provides an assessment of CO_2e emissions and other relevant greenhouse gases of the Mona Offshore Wind Project. A detailed assessment is provided within Volume 8, Annex 2.1: Greenhouse gas assessment technical report of the Environmental Statement.
With regards specifically to mitigation, *'a GHG assessment should be used to drive down GHG emissions at every stage of the proposed development and ensure that emissions are minimised as far as possible for the type of technology'*. [Paragraph 5.3.5].	Mitigation measures (commitments) to reduce emissions associated with Mona Offshore Wind Project are detailed from paragraph 2.10.4.14.
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'*. [Paragraph 4.10.9].	This chapter (section 2.10.7) provides an assessment of climate risk and resilience for the relevant elements of the Mona Offshore Wind Project. A detailed assessment is provided within Volume 8, Annex 2.2: Climate change risk assessment technical report of the Environmental Statement.
'Where energy infrastructure has safety critical elements… the applicant should apply a credible maximum climate change scenario'. [Paragraph 4.10.12].	
NPS EN-3	
'*Offshore wind farms will not be affected by flooding. However, applicants should demonstrate that any necessary land-side infrastructure (such as cabling and onshore substations) will be appropriately resilient to climate-change induced weather phenomena. Similarly, applicants should particularly set out how the proposal would be resilient to storms'.* [Paragraph 2.4.8].	This chapter (section 2.10.7) provides an assessment of climate risk and resilience for the relevant elements of the Mona Offshore Wind Project. A detailed assessment is provided within Volume 8, Annex 2.2: Climate change risk assessment technical report of the Environmental Statement. Volume 3, Chapter 2: Hydrology and flood risk of the Environmental Statement assesses flood risk to the relevant elements of the Mona Offshore Wind Project, accounting

Summary of NPS EN-1 and EN-3 provision	How and where considered in the Environmental Statement
	for increases in rainfall rates due to climate change.

Table 2.2: Summary of NPS EN-1, NPS EN-3 and NPS EN-5 policy on decision making relevant to climate change.

Summary of NPS EN-1 and EN-3 provision	How and where considered in the Environmental Statement
NPS EN-1	
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. [Paragraphs 2.3.3 to 2.3.4].	Volume 1, Chapter 2: Policy and legislative context of the Environmental Statement.
NPS EN-3	
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 of the Environmental Statement.

Table 2.3: Summary of NPS EN-5 provisions relevant to climate change

Summary of NPS EN-5 provision	How and where considered in the Environmental Statement
'Applicants should in particular set out to what extent the proposed development is expected to be vulnerable, and, as appropriate, how it has been designed to be resilient to: flooding… effects of wind and storms on overhead lines; higher average temperatures leading to transmission losses; earth movement or subsidence caused by flooding or drought…coastal erosion' (paragraph 2.3.2 of NPS EN-5).	This chapter (section 2.10.7) provides an assessment of climate risk and resilience for the relevant elements of the Mona Offshore Wind Project. A detailed assessment is provided within Volume 8, Annex 2.2: Climate change risk assessment technical report of the Environmental Statement.

2.2.4 National energy and climate change policy

2.2.4.1 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 2.4.

Table 2.4: National energy and climate change policy.

Policy	Summary	How and where considered in the Environmental Statement
Future Wales: The National Plan 2040	Key Targets: • *'For 70% of electricity consumption to be generated from renewable energy by 2030*	Volume 1, Chapter 2: Policy and legislative context of the Environmental Statement. This chapter (section 2.10) provides an assessment of CO_2e emissions and other

Policy	Summary	How and where considered in the Environmental Statement
		relevant greenhouse gases of the Mona Offshore Wind Project. A detailed assessment is provided within Volume 8, Annex 2.1: Greenhouse gas assessment technical report of the Environmental Statement. The assessment includes emissions avoided as a result of the displacement of alternative generation sources by the renewable energy generated by the Mona Offshore Wind Project (section 2.10.6 and 2.10.8).
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.	Volume 1, Chapter 2: Policy and legislative context of the Environmental Statement. This chapter (section 2.10) provides an assessment of CO_2e emissions and other relevant greenhouse gases of the Mona Offshore Wind Project. A detailed assessment is provided within Volume 8, Annex 2.1: Greenhouse gas assessment technical report of the Environmental Statement. Such emissions are contextualised within the UK Carbon Budgets (section 2.10.8).
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, such as offshore wind. – 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.	Volume 1, Chapter 2: Policy and legislative context of the Environmental Statement. This chapter (section 2.10) provides an assessment of CO_2e emissions and other relevant greenhouse gases of the Mona Offshore Wind Project. A detailed assessment is provided within Volume 8, Annex 2.1: Greenhouse gas assessment technical report of the Environmental Statement.
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.	Volume 1, Chapter 2: Policy and legislative context of the Environmental Statement. This chapter (section 2.10) provides an assessment of CO_2e emissions and other relevant greenhouse gases of the Mona Offshore Wind Project. A detailed assessment is provided within Volume 8, Annex 2.1: Greenhouse gas assessment technical report of the Environmental Statement.

Policy	Summary	How and where considered in the Environmental Statement
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.	Volume 1, Chapter 2: Policy and legislative context of the Environmental Statement. This chapter (section 2.10) provides an assessment of CO_2e emissions and other relevant greenhouse gases of the Mona Offshore Wind Project. A detailed assessment is provided within Volume 8, Annex 2.1: Greenhouse gas assessment technical report of the Environmental Statement. The assessment includes emissions avoided as a result of the displacement of alternative generation sources by the renewable energy generated by the Mona Offshore Wind Project (section 2.10.6 and 2.10.8). Such emissions are contextualised within the UK Carbon Budgets (section 2.10.8).
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.	Volume 1, Chapter 2: Policy and legislative context of the Environmental Statement. This chapter (section 2.10) provides an assessment of CO_2e emissions and other relevant greenhouse gases of the Mona Offshore Wind Project. A detailed assessment is provided within Volume 8, Annex 2.1: Greenhouse gas assessment technical report of the Environmental Statement. The assessment includes emissions avoided as a result of the displacement of alternative generation sources by the renewable energy generated by the Mona Offshore Wind Project (section 2.10.6 and 2.10.8). Such emissions are contextualised within the UK Carbon Budgets (section 2.10.8).
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.	Volume 1, Chapter 2: Policy and legislative context of the Environmental Statement. This chapter (section 2.10) provides an assessment of CO_2e emissions and other relevant greenhouse gases of the Mona Offshore Wind Project. A detailed assessment is provided within Volume 8, Annex 2.1: Greenhouse gas assessment technical report of the Environmental Statement.

Policy	Summary	How and where considered in the Environmental Statement
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.	Volume 1, Chapter 2: Policy and legislative context of the Environmental Statement. This chapter (section 2.10) provides an assessment of CO_2e emissions and other relevant greenhouse gases of the Mona Offshore Wind Project. A detailed assessment is provided within Volume 8, Annex 2.1: Greenhouse gas assessment technical report of the Environmental Statement.
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)'*	Volume 1, Chapter 2: Policy and legislative context of the Environmental Statement. This chapter (section 2.10) provides an assessment of CO_2e emissions and other relevant greenhouse gases of the Mona Offshore Wind Project. A detailed assessment is provided within Volume 8, Annex 2.1: Greenhouse gas assessment technical report of the Environmental Statement.
UK Marine Policy Statement	• Increasing the generation of energy from low carbon sources will mitigate against climate change, lessen the UK's dependence on fossil fuels and improve energy security by increasing the diversity of electricity supply. • The UK is currently the leading country for offshore wind deployment and the potential sites identified for offshore renewables	Volume 1, Chapter 2: Policy and legislative context of the Environmental Statement. This chapter (section 2.10) provides an assessment of CO_2e emissions and other relevant greenhouse gases of the Mona Offshore Wind Project. A detailed assessment is provided within Volume 8,

Policy	Summary	How and where considered in the Environmental Statement
	(including offshore wind, wave and tidal) show the huge exploitable renewable energy resource in UK waters which would keep the UK as a global leader in renewable energy production from these technologies. • A significant part of the renewable energy required to meet these targets and objectives will come from marine sources. Offshore wind is expected to provide the largest single renewable electricity contribution	Annex 2.1: Greenhouse gas assessment technical report of the Environmental Statement. The assessment includes emissions avoided as a result of the displacement of alternative generation sources by the renewable energy generated by the Mona Offshore Wind Project (section 2.10.6 and 2.10.8). Such emissions are contextualised within the UK Carbon Budgets (section 2.10.8).
Welsh National Marine Plan	SOC_08: Resilience to coastal change and flooding Proposals should demonstrate how they are resilient to coastal change and flooding over their lifetime. SOC_09: Effects on coastal change and flooding Proposals should demonstrate how they: • avoid significant adverse impacts upon coastal processes; and • minimise the risk of coastal change and flooding; Proposals that align with the relevant Shoreline Management Plan(s) and its policies are encouraged SOC_10: Minimising climate change Proposals should demonstrate how they, in order of preference: a. avoid the emission of greenhouse gases; and/or b. minimise them where they cannot be avoided; and/or c. mitigate them where they cannot be minimised. Where significant emission of greenhouse gases cannot be avoided, minimised or mitigated, proposals for regulated activities must present a clear and convincing case for proceeding. SOC_11: Resilience to climate change Proposals should demonstrate that they have considered the impacts of climate change and have incorporated appropriate adaptation measures, taking into account Climate Change Risk Assessments for Wales. Proposals that contribute to climate change adaptation and/or mitigation are encouraged.	Volume 1, Chapter 2: Policy and legislative context of the Environmental Statement. This chapter (section 2.10) provides an assessment of CO_2e emissions and other relevant greenhouse gases of the Mona Offshore Wind Project. A detailed assessment is provided within Volume 8, Annex 2.1: Greenhouse gas assessment technical report of the Environmental Statement. This chapter (section 2.10.7) provides an assessment of climate risk and resilience for the relevant elements of the Mona Offshore Wind Project. A detailed assessment is provided within Volume 8, Annex 2.2: Climate change risk assessment technical report of the Environmental Statement. Volume 3, Chapter 2: Hydrology and flood risk of the Environmental Statement assesses flood risk to the relevant elements of the Mona Offshore Wind Project, accounting for increases in rainfall rates due to climate change.
North West Inshore and North West Offshore Marine Plan	Policy NW-REN-1 • Proposals that enable the provision of renewable energy technologies and associated supply chains, will be supported.	Volume 1, Chapter 2: Policy and legislative context of the Environmental Statement. This chapter (section 2.10) provides an assessment of CO_2e emissions and other relevant greenhouse gases of the Mona

Policy	Summary	How and where considered in the Environmental Statement
	NW-REN-2 • Proposals for new activity within areas held under a lease or an agreement for lease for renewable energy generation should not be authorised, unless it is demonstrated that the proposed development or activity will not reduce the ability to construct, operate or decommission the existing or planned energy generation project. NW-REN-3 • Proposals for the installation of infrastructure to generate offshore renewable energy, inside areas of identified potential and subject to relevant assessments, will be supported. NW-CC-2 • Proposals in the north west marine plan areas should demonstrate for the lifetime of the project that they are resilient to the impacts of climate change and coastal change. NW-CC-3 • Proposals in the north west marine plan areas, and adjacent marine plan areas, that are likely to have significant adverse impact on coastal change, or on climate change adaptation measures inside and outside of the proposed project areas, should only be supported if they can demonstrate that they will, in order of preference: a) avoid b) minimise c) mitigate - adverse impacts so they are no longer significant.	Offshore Wind Project. A detailed assessment is provided within Volume 8, Annex 2.1: Greenhouse gas assessment technical report of the Environmental Statement. This chapter (section 2.10.7) provides an assessment of climate risk and resilience for the relevant elements of the Mona Offshore Wind Project. A detailed assessment is provided within Volume 8, Annex 2.2: Climate change risk assessment technical report of the Environmental Statement.

2.2.5 Local Planning Policies

2.2.5.1 The assessment of potential changes to climate change has also been made with consideration to the specific policies set out in Volume 1, Chapter 2: Policy and legislative context of the Environmental Statement. Key provisions are set out in Table 2.5 along with details as to how these have been addressed within the assessment.

Table 2.5: Local planning policy relevant to climate change.

Policy	Key provisions	How and where considered in the Environmental Statement
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. • Deploy renewable energy schemes for electricity including working with schools to submit funding applications to Wind-	This chapter, section 2.10.6.

Policy	Key provisions	How and where considered in the Environmental Statement
	farm funds to install renewable energy (e.g. wind turbines and PV panels) and installing solar car ports at Council office car parks	
Denbighshire County Council Local Development Plan 2006 – 2021 Objective 11 – Energy, Policy VOE 10 Renewable energy technologies	• 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.	This chapter, section 2.10.6.
Denbighshire Local Development Plan 2018 – 2033, Draft Preferred Strategy Objective 3,	• The Local Development Plan will ensure that Denbighshire sustainably develops its natural resources, including renewable energy.	This chapter, section 2.10.6.
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.	This chapter, section 2.10.6.
Conwy Local Development Plan 2007-2022 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. • The policy states that *'standalone renewable energy projects that are sympathetic to landscape character and local amenity will also be supported*.'	This chapter, section 2.10.6.

2.3 Consultation

2.3.1.1 A summary of the key issues raised during consultation activities undertaken to date specific to climate change is presented in Table 2.6 below, together with how these issues have been considered in the production of this Environmental Statement chapter.

Table 2.6: 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 where 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 Flood Risk Assessment (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 Environmental Statement and is supported by Volume 8, Annex 2.1: Greenhouse gas assessment technical report and Annex 2.2: Climate change risk assessment technical report of the Environmental Statement.
June 2023	Stena Line	Climate Change (a) Stena Line acknowledges that the Wind Farms will likely have an overall beneficial effect in respect of climate change. (b) However, the figures estimated do not provide an accurate and complete assessment of the cumulative or individual impact of the Mona, Morecambe and Morgan Offshore Wind Farms on direct/indirect greenhouse gas emissions ('GHG Emissions'): (i) The GHG Emissions for the Transmission Assets for Morecambe and Morgan Wind Farms have not been considered in the assessments. There are GHG Emissions associated with the Transmission Assets for Morecambe and Morgan Wind Farms which should be considered in determining the overall GHG Emissions footprint and carbon payback periods (see Morecambe PEIR Chapter 21, section 21.44). (ii) Indirect GHG Emissions have not been fully considered. Importantly, the increase in GHG Emissions resulting from the additional time spent by vessels (including Stena Line's vessels) in transiting the Wind Farm areas has not been considered. It appears that only GHG Emissions associated with the Wind	As detailed in 2.11.1.1, GHG emissions are not bound by geographical boundaries. 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. This is in accordance with IEMA guidance on Assessing Greenhouse Gas Emissions and Evaluating their Significance (IEMA, 2022). Consideration has been given to the indirect impact of route deviation within the greenhouse gas technical report (Volume 8, Annex 2.1: Technical greenhouse gas assessment) and has been considered in the operations and maintenance assessment (section 2.10.6). This draws on information presented within Volume 2, Chapter 7: Shipping and navigation of the Environmental Statement and the navigation risk assessment (Volume 6, Annex 7.1).

Date	Consultee and type of response	Issues raised	Response to issue raised and/or where considered in this chapter
		Farms have been considered (i.e., GHG Emissions from vessels transporting materials to the Wind Farms) (see Morecambe PEIR Chapter 21, Table 21.9). (iii) There have been no cumulative assessments on the impact of the Mona, Morecambe and Morgan Offshore Wind Farms on direct/indirect GHG Emissions or the climate generally. This is particularly relevant where different phases of the Projects are predicted to produce different levels of GHG Emissions (i.e., as the construction phase of the Wind Farms are anticipated to produce the most direct GHG Emissions (see, for example, Morecambe PEIR Chapter 21, section 21.57)), this means that there may be a cumulative adverse impact for a significant period across the Projects before any cumulative net benefit is seen. It is impossible to make an assessment on this point given that insufficient information is available on the Morgan and Morecambe Transmission Assets (see Morgan PEIR Chapter 17, section 17.13.1.2). (c) Stena Line is committed to reducing its emissions both onshore and at sea and invests in clean energy technology. The increased time it will take for Stena Line to perform its routes (in normal and adverse weather conditions) as a result of the footprint of the Wind Farms will lead to increased GHG Emissions and will be counter-productive to Stena Line's current policies, and the purpose and intent of the Wind Farms. (d) This increase in GHG Emissions is not anticipated to be insubstantial. Indeed, in considering increased shipping movements in respect of vessel movements related solely to the operations and maintenance of an example windfarm, the Morecombe PEIR suggests that these movements alone contribute 14.3% to total GHG emissions of the example windfarm (Morecambe PEIR Chapter 21, section 21.16). (e) Inaccurate GHG Emissions statistics make it impossible to assess the efficacy of the Wind Farms and their net climate benefit.	
June 2023	Isle of Man Government	In addition, noting the concerns regarding the potential effects on shipping and navigation route as a result of this proposed development; from a climate change point of view the shipping	Consideration has been given to the indirect impact of route deviation within the greenhouse gas technical report (Volume 8, Annex 2.1) and has been considered in the operations and

Date	Consultee and type of response	Issues raised	Response to issue raised and/or where considered in this chapter
		and navigation section seems to be well assessed, and since ferries are by far the lowest emitting way to travel to and from the Island, it is very important that these routes are not significantly affected by this development proposal.	maintenance assessment (section 2.10.6). This draws on information presented within Volume 2, Chapter 7: Shipping and navigation of the Environmental Statement and the navigation risk assessment (Volume 6, Annex 7.1).

2.4 Baseline Methodology

2.4.1 Relevant guidance

2.4.1.1 The main guidance used for the assessment of GHG emissions in EIA is the Institute of Environmental Management and Assessment (IEMA) guide to 'Assessing Greenhouse Gas Emissions and Evaluating their Significance' (IEMA, 2022).

2.4.1.2 The main guidance document with regard to climate risk and resilience assessment (including an ICCI assessment) within the context of EIA is the Environmental Impact Assessment Guidance on: Climate Change Resilience & Adaptation (IEMA, 2020).

2.4.1.3 Additional guidance used for the quantification of GHG emissions has included:

- the Greenhouse Gas Protocol suite of documents (World Resources Institute (WRI) and World Business Council for Sustainable Development (WBCSD), 2004); and
- UK Government GHG Conversion Factors for Company Reporting (DESNZ and Department for Environment, Food and Rural Affairs (Defra), 2023).

2.4.2 Scope of the assessment

2.4.2.1 The scope of this Environmental Statement has been developed in consultation with relevant statutory consultees (the Planning Inspectorate) as detailed in Table 2.6. This assessment of climate change considers both the effect of GHG emissions caused directly or indirectly (including vessel rerouting) by the Mona Offshore Wind Project, which have the potential to contribute to climate change (e.g., emissions arising from the manufacturing and installation of the Mona Offshore Wind Project) and the potential effect of changes in climate on the Mona Offshore Wind Project.

2.4.2.2 Taking into account the scoping and consultation process, Table 2.7 summarises the issues considered as part of this assessment.

Table 2.7: Issues considered within this assessment.

Activity	Potential effects scoped into the assessment
Construction phase	
Manufacturing and installation of the Mona Offshore Wind Project such as use of plant, fuel and vessel use, embodied carbon of materials.	GHG emissions arising from such activities would contribute to global GHG emissions and climate change.
Installation of the Mona Offshore Wind Project.	Land use change – GHG emissions arising from land use change would contribute to a change in global GHG emissions concentrations and climate change.
Operations and maintenance	
Consumption of materials (replacement) and activities required to facilitate the operations and maintenance phase such as use of plant, fuel and vessel use, embodied carbon of materials, in addition to deviation for ferry and cargo vessels.	GHG emissions arising from such activities would contribute to a change in global GHG emissions concentrations and climate change.

Activity	Potential effects scoped into the assessment
Operations and maintenance of the Mona Offshore Wind Project.	Land use change – GHG emissions arising from land use change would contribute to a change in global GHG emission concentrations and climate change.
	Effect of projected future climate change on the Mona Offshore Wind Project (i.e. climate risk).
Decommissioning	
Decommissioning activities, such as use of plant, fuel and vessel use, and the recovery (or disposal) of materials.	GHG emissions arising from such activities would contribute to global GHG emissions concentrations and climate change.
Decommissioning of the Mona Offshore Wind Project.	Land use change – GHG emissions arising from land use change would contribute to a change in global GHG emissions concentrations and climate change.

2.4.2.3 Effects which are not considered likely to be significant have been scoped out of the assessment. A summary of the effects scoped out, together with justification for scoping them out as agreed with key stakeholders through scoping, is presented in Table 2.8

Table 2.8: 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 operations and maintenance of the Mona Offshore Wind Project during the construction and decommissioning phases.	Only applicable to the operations 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.

2.4.3 Methodology to inform baseline

2.4.3.1 No site-specific surveys have been undertaken to inform the EIA for climate change. This is because climatic data and GHG emissions is gathered from recognised third party published data as detailed in Table 2.9.

2.4.4 Study area

2.4.4.1 The Mona Offshore Wind Project climate change study area is illustrated in Figure 2.1 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 (IEMA, 2022) utilised throughout this chapter. Domestic scope considers the local and national policy and targets concerning GHG and climate resilience.

2.4.4.2 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.

2.4.4.3 The climate change risk study area (Figure 2.1) is concentrated to a 25 km grid cell based on the UKCP18 probabilistic projections (MOHC, 2021) for the Mona Onshore Development Area for the onshore elements. The Mona Array Area and Mona Offshore Cable Corridor represents the study area for the offshore elements.

2.4.4.4 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 Mona Offshore Wind 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.

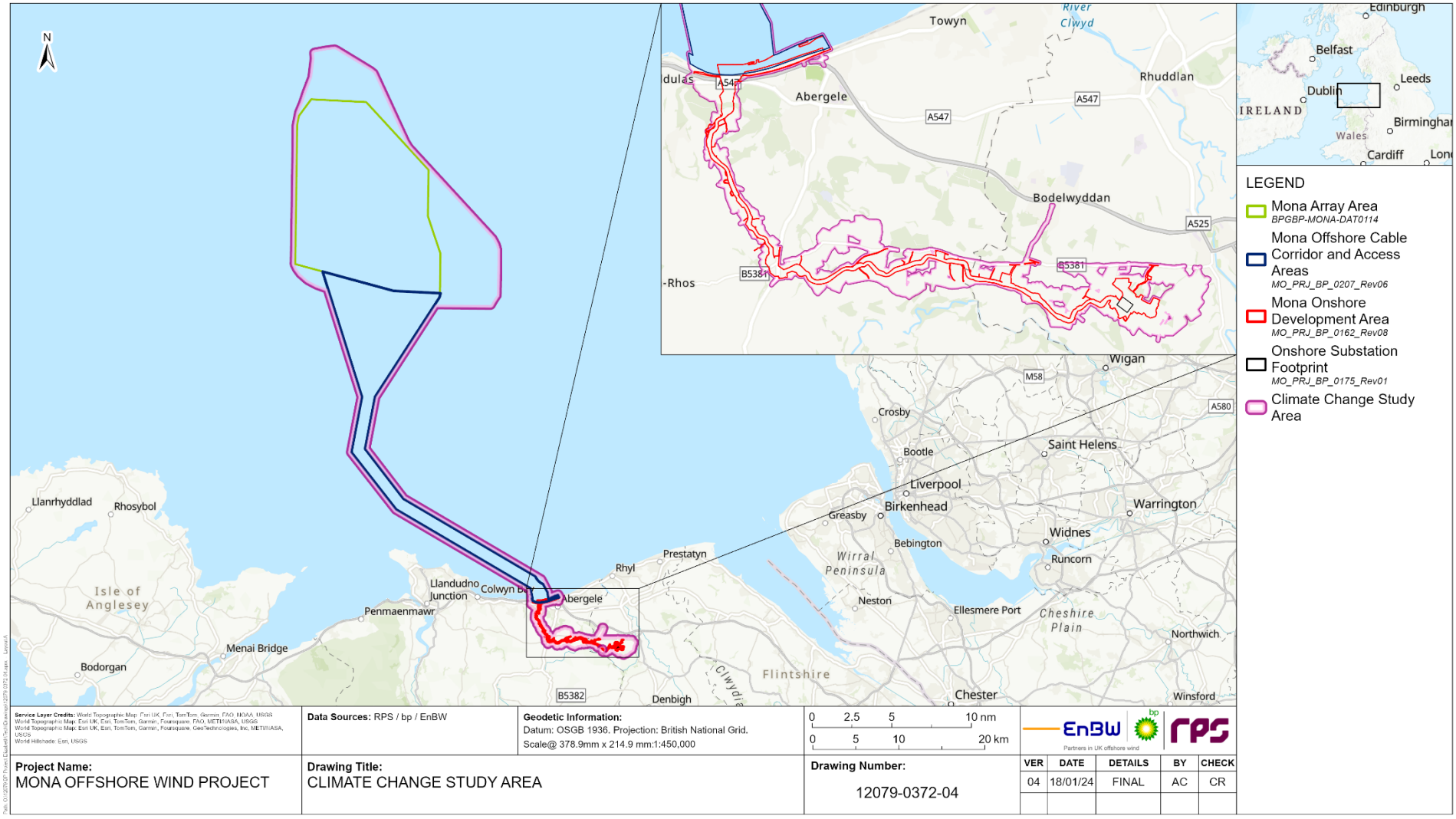

Figure 2.1: Climate change study area

2.4.5 Desktop study

2.4.5.1 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 2.9 below.

Table 2.9: Summary of key desktop reports.

Title	Source	Year	Author
Valuation of Energy Use and Greenhouse Gas: Supplementary guidance to the HM Treasury Green Book	DSENZ	2023	DESNZ
UK Government GHG Conversion Factors for Company Reporting.	DESNZ and Department for Environment, Food and Rural Affairs (Defra)	2023	DESNZ and Defra
Inventory of Carbon and Energy (ICE) database	Jones & Hammond	2019	Jones & Hammond
UK Offshore Energy Strategic Environmental Assessment: Appendix 1F: The Physical Science Basis	IPCC	2021	IPCC

2.5 Baseline environment

2.5.1 Current baseline

2.5.1.1 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.

GHG emissions assessment baseline environment

2.5.1.2 To determine the baseline environment for the GHG emissions assessment, information has been sourced and cross referenced from Volume 3, Chapter 7: Land use and recreation and Volume 2, Chapter 2: Benthic subtidal and intertidal ecology, of the Environmental Statement, and Volume 3, Chapter 5: Historic environment of the Environmental Statement. 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.

2.5.1.3 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 7.1: Published soil and agricultural land classification data of the Environmental Statement), however, this land does not have high soil or vegetation carbon stocks (e.g. peat) that would be subject to disturbance by construction. Intertidal surveys with specific reference to the potential presence of peat or similar organic material have been undertaken, and did not identify any areas of peat or similar organic material (Volume 3, Chapter 5: Historic environment of the Environmental Statement).

2.5.1.4 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.

2.5.1.5 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 252.97 $kgCO_2e/MWh$ (including scope 3 but as-generated (i.e. excluding transmission and distribution losses)) (DESNZ and Defra, 2023).

Climate change risk assessment (CCRA) baseline environment

2.5.1.6 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 1981-2010 (consistent with UKCP18 baseline data) and reviewed alongside regional observational data averaged over the same period (Met Office, 2020).

2.5.1.7 North Wales experiences a temperate climate, with annual average maximum and minimum temperatures of 13.36°C and 6.92°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 2.48°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.

2.5.1.8 Precipitation recorded at the Rhyl climate station is lower than that reported for the regional annual total of 1,304.57 mm, at 814.14 mm a year. However, regional precipitation in North Wales and northwest of England exceeds the UK annual average, which totals 1,142.04 mm. Therefore, North Wales can be considered as a region that is exposed to high rainfall in comparison to the rest of the UK.

2.5.1.9 Regional annual average wind speeds in North Wales and northwest of England are marginally higher than the annual average for the UK, equalling 9.52 kn, and 9.38 kn, respectively. Moreover, as the Onshore Development Area for the Mona Offshore Wind Project is 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.

2.5.1.10 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).

2.5.1.11 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).

2.5.1.12 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).

2.5.1.13 Higher wind speeds can be expected at the Mona Array Area 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).

2.5.1.14 Mean sea level (MSL) is a crucial element of climate change related risks for offshore wind farms – global MSL rose by 0.2 m 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).

2.5.2 Future baseline scenario

2.5.2.1 The Infrastructure Planning (Environmental Impact Assessment) Regulations 2017 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 the Mona Offshore Wind Project does 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

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

2.5.2.3 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.

2.5.2.4 Several future baseline scenarios have therefore been considered, using DESNZ projections of the carbon intensity of long-run marginal and grid average electricity generation during the proposed development's operating lifetime (DESNZ, 2023a) and assumptions about specific generation sources that could be displaced. These are detailed in Volume 8, Annex 2.1: Greenhouse gas assessment technical report of the Environmental Statement.

2.5.2.5 The carbon intensity of baseline UK Grid electricity generation (See 2.5.1.5) 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

2.5.2.6 In the near future (the next few 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.

2.5.2.7 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 v2.8.0 (MOHC, 2023) 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.

2.5.2.8 The probabilistic projections published at a 25 km 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.

2.5.2.9 The Mona Offshore Wind Project is expected to have a 35 year operating lifetime (as outlined in paragraph 2.5.3.4) and be 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.

2.5.2.10 The risks associated with rising temperatures, more frequent extreme weather patterns and rising sea levels in North Wales are reflected in reactive and preventative legislation.

2.5.2.11 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).

2.5.2.12 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 0.1 m (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 2 m to the end of the century (Jaroszweski et al. 2021).

2.5.2.13 Further information has been presented within Volume 8, Annex 2.2: Climate change risk assessment.

2.5.3 Data limitations

2.5.3.1 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.

2.5.3.2 Construction stage GHG emissions associated with the manufacturing of components may 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.

2.5.3.3 Additionally, due to the early stage in the development design, the specific wind turbine technology and design of associated infrastructure (including the onshore substation) 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. The assessment seeks to limit the impact this might have by using maximum design scenario material quantities, as informed by the design team, in the calculation of

construction stage emissions. Such emissions are likely to present a conservative maximum design scenario.

2.5.3.4 An assumed operational lifetime of 35 years has been applied to the assessment of avoided GHG emissions associated with the operations and maintenance stage of the Mona Offshore Wind Project and consideration of replacement and maintenance activities.

2.5.3.5 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 maximum design scenario approach. This is further discussed in Volume 8, Annex 2.2: Climate change risk assessment technical report of the Environmental Statement.

2.5.3.6 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 maximum design 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.

2.6 Impact assessment methodology

2.6.1 Overview

2.6.1.1 The climate change impact assessment has followed the methodology set out in Volume 1, Chapter 5: EIA methodology of the Environmental Statement. 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).

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

- Local planning policies
- National climate change policies (see Section 2.2)
- International climate change legislation.

2.6.1.3 In order to undertake a climate change impact assessment, information gathered in Volume 8, Annex 2.1: Greenhouse gas assessment technical report and Annex 2.2: Climate change risk assessment technical report of the Environmental Statement 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

2.6.1.4 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).

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

- DESNZ (2023a) Valuation of Energy Use and Greenhouse Gas: Supplementary guidance to the HM Treasury Green Book
- UK Government GHG Conversion Factors for Company Reporting (DESNZ and Department for Environment, Food and Rural Affairs (Defra), 2023)
- the Greenhouse Gas Protocol suite of documents (World Resources Institute (WRI) and World Business Council for Sustainable Development (WBCSD), 2004)).

2.6.1.6 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 to construct, operate, maintain and decommission 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.

2.6.1.7 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.

2.6.1.8 The assessment has considered:

1. The GHG emissions arising from the Mona Offshore Wind Project.
2. Any GHG emissions that the Mona Offshore Wind Project 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.

2.6.1.9 As previously discussed in paragraph 2.5.3.2, construction-stage GHG emissions associated with the manufacturing of components may 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

2.6.1.10 Potential climatic conditions in the 2040-2069 time period at the Mona Offshore Wind Project have been considered based on the UKCP18 probabilistic projections (MOHC, 2022). Projections for the global emissions 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).

2.6.1.11 Further detail of the approach and data input is given in Volume 8, Annex 2.2: Climate change risk assessment technical report of the Environmental Statement.

2.6.1.12 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.

2.6.1.13 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.

2.6.1.14 The assessment of flood risk, including increases in rainfall rates due to climate change, has been addressed in Volume 3, Chapter 2: Hydrology and flood risk of the Environmental Statement.

2.7 Impact assessment criteria

2.7.1 Overview

2.7.1.1 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.

2.7.2 Impact assessment criteria: GHG emissions

2.7.2.1 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 2.10.

Table 2.10: 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.

2.7.2.2 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.

2.7.2.3 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, operations and maintenance and decommissioning effects in isolation.

2.7.3 Impact assessment criteria: climate change risk

2.7.3.1 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*'.

2.7.3.2 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.

2.7.3.3 As is detailed in the Climate Change Risk Assessment Technical Report (Volume 8, Annex 2.2) 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.

2.7.3.4 The criteria for defining severity, probability and influence factor in this chapter are outlined in Table 2.11 below.

Table 2.11: 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

2.8 Key parameters for assessment

2.8.1 Maximum design scenario

2.8.1.1 The Maximum Design Scenarios (MDSs) identified in Table 2.12 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 Environmental Statement. 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.

2.8.1.2 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 2.12: 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] C	O	D	Maximum Design Scenario	Justification
The impact of GHG emissions arising from the consumption of materials and activities required to facilitate the operations and maintenance	×	✓	×	**Operations and maintenance phase** • The greatest number of maintenance vehicles and machinery across the lifetime of the Mona Offshore Wind Project (254,625 no. lightweight vehicle movements, 63,875 no. heavy vehicle movements, 849 no. vessel movements, 730 no. helicopter movements). • The greatest volume of consumables and frequency of replacement (3 no. major component replacement on OSPs, 1 no. inter-array cable repair event every 3 years, 3 no. inter-connector cable repair event in 10 years, 2 no. offshore export cable (subtidal) repair every 5 years per cable, 1 no. export cable (intertidal) repair event every 5 years per cable).	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, operations and maintenance decommissioning phases	✓	✓	✓	**Construction, operations and maintenance and decommissioning phases** • The total array area is approximately 300 km^2 • The area of the permanent onshore export cable corridor is up to 450,000 m^2 based on a corridor measuring 30 m wide and 15 km in length. The temporary working corridor requires an additional 44 m wide corridor (making the total width of the onshore export cable corridor (temporary and permanent requirements) 74 m wide – The maximum number of joint bays along the Onshore Export Cable Corridor is 80 (based on a distance of 750 m between each joint bay on up to four trenches). The area of each joint bay is 200 m^2 – The maximum number of link boxes along the Onshore Export Cable Corridor is 80 (based on a distance of 750 km between each link box on up to four trenches). The area of each link box is 6 m^2 • The maximum footprint of the Onshore Substation is 75,000 m^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 15 m high, 40 m wide and 90 m long. • A construction compound will be required to support the construction of the substation extending the maximum footprint (75,000 m^2) up to 250,000 m^2. • Access to the substation will be via a new permanent access road measuring up to 15 m wide (accounting for drainage and services) and 1.25 km in length. • The area of the permanent 400 kV Grid Connection Cable Corridor is up to 16,000 m^2 based on a corridor measuring 16 m wide and up to 1 km in length	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.

Potential impact	Phase[a] C	O	D	Maximum Design Scenario	Justification
				– The maximum number of joint bays along the 400 kV Grid Connection Cable Corridor is 2 (based on a distance of 500 m between each joint bay) – The maximum number of link boxes along the 400 kV grid connection is 2 (based on a distance of 500 m between each link box).	
The impact of GHG emissions arising from the manufacturing and installation of the generation assets.	✓	×	×	**Construction phase** • There are up to 96 wind turbines above lowest astronomical tide (LAT) and a tower diameter of 7 to 10 m. There are steel suction bucket jacket (SBJ) foundations for 96 wind turbines that will be constructed using piling or drilling methods • There are up to four OSPs of 375 MW capacity; the main OSP structures are 55 m high (above LAT, excluding the helideck, lightening protection and antenna), 65 m long, 45 m wide. There are steel SBJ foundations for four substations that will be constructed using piling or drilling methods • The maximum length of the inter-array cables is 325 km.	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. SBJ foundations represent the greatest potential for GHG emissions due to material quantities and their emissions intensities.
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 50 km. • The maximum length of the offshore export cables is 360 km. • The maximum length of the onshore export cable route is 15 km. • The area of the permanent onshore export cable corridor is up to 450,000 m^2 based on a corridor measuring 30 m wide and 15 km in length. The temporary working corridor requires an additional 44 m wide corridor (making the total width of the onshore export cable corridor (temporary and permanent requirements) 74 m wide • The maximum number of joint bays along the Onshore Export Cable Corridor is 80 (based on a distance of 750 m between each joint bay on up to four trenches). The area of each joint bay is 200 m^2 • The maximum number of link boxes along the Onshore Export Cable Corridor is 80 (based on a distance of 750 km between each link box on up to four trenches). The area of each link box is 6 m^2	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 maximum footprint of the Onshore Substation is 70,000 $m^{2:}$ this area will include the substation buildings (including associated foundations) and the earthworks to create the platform. The Onshore Substation will comprise up to four buildings. The maximum dimensions of the main building are 15 m high, 40 m wide and 90 m long. • A construction compound will be required to support the construction of the substation extending up to 250,000 m^2 • Access to the substation will be via a new permanent access road measuring up to 8m wide and 1.2 km in length. • The area of the permanent 400 kV Grid Connection Cable Corridor is up to 48,000 m^2 based on a corridor measuring 16 m wide and 3 km in length • The maximum number of joint bays along the 400 kV Grid Connection Cable Corridor is 2 (based on a distance of 500 m between each joint bay) • The maximum number of link boxes along the 400 kV Grid connection is 2 (based on a distance of 500 m 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** • Removal of up to 96 wind turbines, with a tower diameter of 7 to 10 m. There are steel SBJ foundations for 96 wind turbines. • Removal of up to four OSP of 375 MW capacity; the main OSP structures are 55 m high (above LAT, excluding the helideck, lightening protection and antenna), 65 m long, 45 m wide. There are foundations for four SBJ substations • Removal of the maximum length of the inter-array cables which is 325 km • Removal of the maximum length of the interconnector cables which is 50 km • Removal of the maximum length of offshore export cables which is 360 km • Greatest number of maintenance vehicles and machinery across the decommissioning period. • Removal of the maximum footprint of the Onshore Substation which is 75,000 m^2 and comprises up to four buildings. The dimensions of the main building are 15 m high, 40 m wide and 90 m long	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.	×	✓	×	**Operations and maintenance phase** • The proposed export capacity of the Mona Offshore Wind Project is 1.5 GW.	The greatest generating capacity represents the greatest abatement of fossil fuels from the Grid.

Table 2.13: 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	×	✓	×	**Operations 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 following industry best practice measures have been included within Project design and operational planning to ensure resilience of the Project to the effects of climate change: – Application of anti-corrosion protective coatings; – Integrated scour protection to offshore equipment where necessary; – Safety margin within the turbine design to be fitted with automatic shutdowns/lockdowns with regards to spinning too fast; – If located internally, the substation building will house auxiliary equipment e.g. appropriate cooling plant for an in building substation solution to account for a range of temperature conditions; – Regular inspections to be carried out to assess turbine condition; and – Regular inspections to be carried out to assess substation condition where appropriate (i.e. following severe weather events).	The worst case scenario of the effects of climate change on the onshore and offshore infrastructure.

2.9 Measures adopted as part of the Mona Offshore Wind Project

2.9.1.1 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 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).
- Measures required to meet legislative requirements, or actions that are generally standard practice used to manage commonly occurring environmental effects and are secured through the DCO requirements and/or the conditions of the marine licences (referred to as tertiary mitigation in IEMA, 2016).

2.9.1.2 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. Industry best practice approaches are included within the standard design and operation of the Mona Offshore Wind Project which enable the Project to be resilient to future predicted climate change, detailed provided in full within Volume 8, Annex 2.2: Climate change risk assessment technical report (refer to Table 1.3). Such design approaches are as follows:

- Application of anti-corrosion protective coatings;
- Integrated scour protection to offshore equipment where this is considered necessary and appropriate;
- Safety margin within the turbine design to be fitted with automatic shutdowns/lockdowns with regards to spinning too fast;
- If located internally, the substation building will house auxiliary equipment e.g. appropriate cooling plant for an in building substation solution to account for a range of temperature conditions;
- Regular inspections to be carried out to assess turbine condition; and
- Regular inspections to be carried out to assess substation condition where appropriate (i.e. following severe weather events).

2.9.1.3 As these design approaches are considered inherently part of the design of the Mona Offshore Wind Project and have therefore been considered in the assessment presented in section 2.10 below (i.e. the determination of magnitude and therefore significance assumes implementation of these measures).

2.9.1.4 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.

2.10 Assessment of significant effects

2.10.1 Overview

2.10.1.1 The impacts of the construction, operations 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, operations and maintenance and decommissioning phases of the Mona Offshore Wind Project are listed in Table 2.12, along with the maximum design scenario against which each impact has been assessed.

2.10.1.2 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.

2.10.2 Assessment of significant effects: GHG emissions

2.10.2.1 The impacts of the construction, operations 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.

2.10.2.2 The operations 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 2.1: Greenhouse gas assessment technical report of the Environmental Statement, the life cycle assessment embodied carbon is divided into:

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

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

Construction, Operations and Maintenance and Decommissioning

Magnitude of impact

2.10.3.1 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 within the Mona Offshore Wind Project Boundary would be impacted for the duration of the construction (excavation for buildings, access roads, construction compounds, cable route, and piling or drilling for WTG foundations) and in some cases operations and maintenance phases primarily through the sea bed/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

2.10.3.2 In accordance with paragraph 2.7.2.1, 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

2.10.3.3 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.

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

2.10.4.1 The below considers the embodied carbon emissions associated with materials for both onshore and offshore elements 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

2.10.4.2 As detailed in paragraph 2.10.2.2 and Volume 8, Annex 2.1: Greenhouse gas assessment technical report, 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 outlined below. Calculations to reach such emissions consider the maximum number of Wind Turbine Generator (WTGs) and Offshore Substation Platforms (OSPs), and maximum lengths of all cables, representing the greatest potential for GHG emissions from the construction and installation of the Mona Offshore Wind Project as a conservative estimate of impact. The following items are considered within this assessment:

- WTGs
- OSPs
- Inter-array cables
- Interconnector cables
- Offshore export cables
- Onshore export cables
- 400 kV grid connection cables
- Onshore substation
- Vessel, helicopter and onshore traffic movements.

2.10.4.3 Detailed and current LCA are not available for all items specific to generation and transmission infrastructure. As such, a combined approach has been used to calculate embodied carbon, informed largely by conservative estimates of construction materials or fuels scaled by relevant emissions factors, and also in part by LCA data.

2.10.4.4 The potential impact of the WTGs, OSP topsides and foundation, and cabling (including inter-array, interconnector, offshore export, onshore export, and 400 kV grid

connection cables) has been estimated using appropriate material emission intensities (sourced from the ICE database, Jones & Hammond, 2019), scaled by material estimates for each element. Material quantities and the emissions factor by which they have been scaled are listed within Volume 8, Annex 2.1: Greenhouse gas assessment technical report of the Environmental Statement.

2.10.4.5 Construction stage emissions associated with the proposed substations (both the onshore substation, and plant included on the OSPs) has been captured 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. The same calculation was carried out for the onshore substation plant (consisting of 3 x 850 MVA power transformers) resulting in an additional 5,585 tCO_2e.

2.10.4.6 At this stage of design, material estimates regarding the onshore substation buildings have some uncertainty in terms of the amounts and 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.

2.10.4.7 The benchmark data is expressed in $kgCO_2e/m^2$ 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 7,848 tCO_2e.

2.10.4.8 Material quantities associated with the construction of joint bays and transition joint bays were estimated based on best practice dimensions (National Grid, 2015) and scaled by the relevant material emissions factor. Total emissions were estimated at 1,310 tCO_2e.

2.10.4.9 Emissions associated with fuel combustion from vessel, helicopter, and onshore traffic movements have been calculated based on the maximum number of movements proposed during the construction phase, assuming the longest journey distance travelled to reach a conservative estimate. Anticipated fuel consumption for each movement was scaled by an appropriate emissions factor to give total estimated emissions of 126,387 tCO_2e during the construction phase.

2.10.4.10 Table 2.14 summarises the calculated construction stage emissions based on conservative estimates and a maximum design scenario (Section 2.5.3) associated with the Mona Offshore Wind Project, which totals 2,040,818 tCO_2e. It is anticipated that the actual construction stage emissions would be lower than those detailed in Table 2.15 as this is a conservative maximum emission scenario.

Table 2.14: Construction stage GHG emissions.

Item	Value (tCO_2e)
WTGs	1,658,383
OSPs	108,680
Inter-array cables	20,617
Interconnector cables	9,516
Offshore export cables	22,838
Onshore export cables	11,419
400 kV grid connection cables	1,142

Item	Value (tCO_2e)
Scour protection	63,809
Joint Bays and Transition Joint Bays	1,310
Mona Onshore Substations and associated plant	16,718
Transport	126,387
Total	**2,040,818**

Magnitude of impact

2.10.4.11 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 2,040,818 tCO_2e for the construction period.

Sensitivity of receptor

2.10.4.12 In accordance with paragraph 2.7.2.1 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

2.10.4.13 Overall, the magnitude of the impact is deemed to be 2,040,818 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

2.10.4.14 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 Applicant is committed to exploring options to reduce construction related emissions. Areas to be explored by the Applicant could include:

- improving construction and operational activity to reduce emissions (e.g. potentially related to vessel scheduling, co-ordination of shipping/delivery of materials and the identification energy efficiency mechanisms)
- working with the supply chain and its partners to reduce emissions during construction and operation.
- consideration of low carbon criteria within procurement activities, in partnership with the supply chain.

2.10.4.15 Any further risk controls will be explored through engagement with the relevant stakeholders, where necessary, to ensure they are appropriate for reducing risks to as low as reasonably practicable.

2.10.4.16 It is expected that the above measures would be included within the relevant future final management plans such as, Construction Traffic Management Plan, Code of Construction Practice, and Design Principles. 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.

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

Decommissioning

2.10.5.1 The majority of emissions during this phase 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.

2.10.5.2 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 landfills, 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. As such, emissions associated with the disposal of materials at the end of their lifetime is considered to be immaterial and may even result in future avoided emissions. This impact is not assessed further.

2.10.5.3 In the absence of detailed information regarding onshore and offshore transport movements during the decommissioning phase, it has been assumed that such emissions equal those associated with the construction phase. Given 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, this is likely to present a conservative maximum design scenario.

2.10.5.4 The GHG emissions arising from activities required to facilitate the decommissioning of the Mona Offshore Wind Project total 126,387 tCO_2e.

Magnitude of impact

2.10.5.5 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 126,387 tCO_2e.

Sensitivity of receptor

2.10.5.6 In accordance with 2.7.2.1 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

2.10.5.7 Overall, the magnitude of the impact is deemed to be 126,387 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.

2.10.6 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 estimated abatement of UK Grid emissions

2.10.6.1 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 operations and maintenance of the Mona Offshore Wind Project.

2.10.6.2 The GHG emissions arising from the consumption of materials and activities required to facilitate the operations and maintenance of the Mona Offshore Wind Project are presented in Table 2.15, and further details are presented in Volume 8, Annex 2.1: Greenhouse gas assessment technical report of the Environmental Statement. The majority of emissions result from the replacement of substations and cables, informed by conservative assumptions for material replacement rates. Remaining emissions are associated with vessel, helicopter, and onshore traffic movements required to undertake maintenance activities over the Mona Offshore Wind Project's lifetime.

2.10.6.3 In addition, there are indirect impacts on existing ferry and cargo vessels as a result of the Mona Offshore Wind Project causing deviations to shipping routes. This has indirect emissions increases that have been considered within the operations and maintenance phase. The Navigation and Risk Assessment (NRA) (Volume 6, Annex 7.1) and the shipping and navigation chapter (Volume 2, Chapter 7) have conducted navigation simulations to establish the impact and consequential route deviation for existing routes as a result of the Mona Offshore Wind Farm. Based on information from the NRA, a number of ferry operators (Stena Line, Seatruck and Isle of Man Steam Packet Company) and cargo routes would be affected. As detailed in Volume 8, Annex 2.1: Greenhouse gas assessment technical report, the deviation of ferry and cargo routes would result in 1,202 tCO_2e per annum. This figure has reduced in response to a decrease in the array area since presented within this Environmental Statement, resulting in reduced deviation of ferry and cargo routes in response. This figure does not account for any decarbonisation in vessel fuel emissions or fluctuations in route crossings.

Table 2.15: Operations and maintenance stage GHG emissions.

Item	Value	Unit
Materials	65,344	tCO_2e
Transport	41,762	tCO_2e
Third Party Route Deviation	1,202	tCO_2e
Total	**108,308**	**tCO_2e**

2.10.6.4 It should be noted that when considering the Mona Offshore Wind Project's impact on climate change the emissions as a result of operations 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 2.16: 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 & 2022 as opposed to forward looking projected factors) represents a conservative assumption for this assessment. Further detail can be found in Volume 8, Annex 2.1: Greenhouse gas assessment technical report of the Environmental Statement.

Parameter	Value	Unit	Source
Input parameter - rated power	1,500	MW	Assumed export capacity in line with Crown Estates Round 4 leasing requirements (Crown Estates, 2021)

Parameter	Value	Unit	Source
Input parameter – capacity factor	34.9	%	DESNZ (2023b)
Input parameter – degradation factor	1.6	%	Staffell & Green (2014)
Input parameter – total annual operating hours	8,760	hrs	Total number of hours in year
Output parameter - annual energy output	4,585,860	MWh	Calculation of MW multiplied by total hours

2.10.6.5 The input and output figures for the operations and maintenance stage of the Mona Offshore Wind Project are then scaled against the assumptions stated within the DESNZ 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.

2.10.6.6 The resulting estimated avoided emissions associated with the operations and maintenance stage of the Mona Offshore Wind Project would be 2,404,980 tCO_2e avoided emissions associated with the abatement of the UK Grid.

Sensitivity analysis

2.10.6.7 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 Mona Offshore Wind Project's contribution to the UK electricity Grid would be higher than that of avoided emissions detailed above in paragraph 2.10.6.6.

2.10.6.8 Although the use of the current UK electricity Grid average and BEIS 'non-renewable fuels' carbon intensities would conclude greater avoided emissions (Table 2.17) 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 2.17: Whole life avoided emissions sensitivity test.

Operating years	Output (MWh)	DESNZ long-run marginal avoided emissions (tCO_2e)	Current UK Grid average avoided emissions (tCO_2e)	DESNZ 'non-renewable fuels' avoided emissions (tCO_2e)
35	123,638,148	2,404,980	31,277,273	52,422,575

Magnitude of impact

2.10.6.9 The impact is predicted to be of international spatial extent, long term duration, continuous and low reversibility. It is predicted that the impact will affect the receptor directly. The magnitude is considered to be GHG emissions reductions from displacement of projected typical marginal generation sources at approximately -2,296,671 tCO_2e**.**

Sensitivity of receptor

2.10.6.10 In accordance with 2.7.2.1 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

2.10.6.11 Overall, the magnitude of the impact is deemed to be -2,296,671 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.

2.10.7 Assessment of significant effects: climate change risk

2.10.7.1 The risks identified in Volume 8, Annex 2.2: Climate change risk assessment technical report of the Environmental Statement, 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 operations and maintenance phase

Operations and maintenance

2.10.7.2 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.

2.10.7.3 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. Volume 8, Annex 2.2: Climate change risk assessment 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.

2.10.7.4 Risk from climate change to the Mona Offshore Wind Project from flooding is assessed separately in detail in Volume 3, Chapter 2: Hydrology and flood risk of the Environmental Statement 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.

2.10.7.5 The risk assessment presented in Volume 8, Annex 2.2: Climate change risk assessment technical report of the Environmental Statement considers in its scoring the level of influence the design of the construction and operations 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.

2.10.7.6 The assessment of effects has considered the design measures included within the Mona Offshore Wind Project (as listed at paragraph 2.9.1.2) in determining the combined risk score. As detailed in paragraph 2.7.3.3 a score of 5 or more is assessed as a significant effect which is presented in the 'significant effect' column. Should an effect be significant, further mitigation is presented where relevant to reduce the residual effect to negligible and not significant in EIA terms.

2.10.7.7 No risks to the Mona Offshore Wind Project due to climate change have been identified as significant before mitigation. As such, the effect on the Mona Offshore Wind Project has been determined to be **negligible**.

2.10.8 GHG Emissions – Net Effects and context

2.10.8.1 As detailed in 2.7.2.3 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.

2.10.8.2 Over the lifetime of the Mona Offshore Wind Project would result in -129,466 tCO_2e of avoided emissions. The Mona Offshore Wind Project would likely have a carbon payback period[1] of 12 years when accounting for 2,040,818 tCO_2e construction stage emissions and -2,296,671[2] tCO_2e operational avoided emissions.

2.10.8.3 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
- it is in keeping with local and UK energy and climate policy.

2.10.8.4 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 2.18 below. When accounting for the total Mona Offshore Wind Project construction stage GHG emissions (2,040,818 tCO_2e) against the operational and maintenance avoided emissions -1,819,807 tCO_2e) from full operating year (2030) to the end of the Sixth Carbon Budget (2037), the net emissions would be 221,011 tCO_2e, approximately 0.012% of the UK Carbon Budget for the same period.

[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 operations and maintenance activities.

Table 2.18: 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)	1,010,101	-789,090	221,011
Development avoided emissions as percentage of UK carbon budget	0.117%	-0.082%	0.012%

2.10.8.5 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 1.5 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.

2.10.8.6 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.

2.10.8.7 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.

Magnitude of impact

2.10.8.8 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 -129,466 tCO_2e for the whole life time of the Project.

Sensitivity of receptor

2.10.8.9 In accordance with paragraph 2.7.2.1 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

2.10.8.10 When considering the above magnitude of avoided emissions across the whole life time of the Project (-129,466 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.

2.11 Cumulative effects

2.11.1.1 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.

2.12 Inter-related effects

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

- Volume 3, Chapter 3: Onshore ecology and Volume 2, Chapter 2: 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 2: Hydrology and flood risk – changes in rainfall frequency and intensity
- Volume 3, Chapter 6: Landscape and visual resources - consideration of climate resilience (e.g. drought tolerance) in the design and species mix of landscape planting proposed
- Volume 2: Chapter 7: Shipping and navigation – consideration of GHG emissions associated with deviation of ferry and cargo routes.

2.13 Transboundary effects

2.13.1.1 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 5.2: Transboundary impacts screening of the Environmental Statement.

2.13.1.2 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.

2.14 Summary of impacts, mitigation measures and monitoring

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

2.14.1.2 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 2.19 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 and 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.

2.14.1.3 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 2,040,818 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, to account for emissions arising from its operation and maintenance, and decommissioning, alongside emissions avoided through the generation of renewable energy (see point below, and paragraphs 2.14.1.4 to 2.14.1.6).
- 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 2,296,671 tCO_2e savings by 2064. This would result in a significant **beneficial effect** in EIA terms.

2.14.1.4 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 12th year of operation (carbon payback period).

2.14.1.5 Over the lifetime of the Mona Offshore Wind Project, it would result in 129,466 tCO_2e of avoided emissions.

2.14.1.6 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
- It is in keeping with local and UK energy and climate policy.

2.14.1.7 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.

2.14.1.8 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.

2.14.1.9 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 2.19: 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, operations 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	2,040,818 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: • Optimisation 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	Minor adverse effect (Not Significant)	None

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
								• Inclusion of low carbon criteria within procurement activities		
The impact of GHG emissions (plant, fuel and vessel use) and recovery or disposal of materials during decommissioning	X	X	✓	None	126,387 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 operations and maintenance of the Mona Offshore Wind Project and estimated abatement of UK Grid emissions	X	✓	X	None	-2,296,671 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 operations 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	N/A	N/A	Negligible	None	Negligible	None

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
				shutdowns/lockdowns to prevent spinning too fast from storms.						

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