Dublin Array
Generation for generations

EIAR Volume 3: Offshore Infrastructure Assessment Chapters
Chapter 18: Climate Change

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Dublin Array Offshore Wind Farm

Environmental Impact Assessment Report

Volume 3, Chapter 18: Climate Change

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Glossary

Term	Definition
Carbon budget	The cumulative amount of carbon dioxide (CO_2) emissions permitted over a period of time to keep within a certain temperature threshold, such as the 1.5 °C or 2 °C targets of the Paris Agreement.
Carbon intensity	The amount of carbon (in CO_2 emissions) released per unit of electricity consumed, typically measured in grams of CO_2 per kilowatt-hour (gCO_2/kWh).
Climate Change Resilience (CCR)	Refers to the ability of a project, system, or environment to anticipate, prepare for, respond to, and recover from the adverse impacts of climate change, such as extreme weather events, rising sea levels, or changing temperature patterns. It focuses on ensuring the project can continue to function effectively under current and future climate conditions.
Climate projections	Estimates of future climate conditions based on simulations by climate models, considering different scenarios of greenhouse gas emissions and other factors.
Combined Cycle Gas Turbine (CCGT)	A type of power plant that uses both gas and steam turbines to generate electricity, improving efficiency by using the waste heat from the gas turbine to produce steam for the steam turbine.
Dublin Array	References to Dublin Array refer to all geographical areas of the proposed development, i.e. both offshore, onshore and including the proposed O&M Base.
Embodied carbon	The total greenhouse gas emissions (CO_2eq) associated with the production, transportation, and installation of a product or material, including raw material extraction and manufacturing processes.
Environmental Impact Assessment (EIA)	Assessment of the likely significant effects of a proposed project on the environment. The EIA will be carried out by An Bord Pleanála in this instance.
EIA Report (EIAR)	As defined in the Planning and Development Act 2000, as amended: "environmental impact assessment report" means a report of the effects, if any, which proposed development, if carried out, would have on the environment and shall include the information specified in Annex IV of the Environmental Impact Assessment Directive.
GHG emissions	The release of greenhouse gases into the atmosphere, which contribute to global warming and climate change. Common greenhouse gases include carbon dioxide (CO_2), methane (CH_4), and nitrous oxide (N_2O).
Landfall	The location where the Offshore Export Cable Corridor comes ashore adjacent to the Shanganagh Waste Water Treatment Plant (WWTP).
Lifecycle Assessment (LCA)	A technique to assess environmental impacts associated with all the stages of a product's life from cradle to grave (i.e. from raw material extraction through materials processing, manufacture, distribution, use, repair and maintenance, and disposal or recycling).
Net zero	Achieving a balance between the amount of greenhouse gas emissions produced and the amount removed from the atmosphere, effectively reducing net emissions to zero.
Offshore Infrastructure	Wind turbine generators, offshore substation platform, inter array cables, and offshore export cables.

Term	Definition
Offshore substation platform (OSP)	Offshore substation, which is necessary to connect the WTGs with the Offshore Export Cable.
Onshore Substation	Part of the OES, the substation is required to facilitate the connection to the existing national electricity transmission system.
Onshore Electrical System (OES)	Collective term for all onshore infrastructure from the landfall/TJB to the grid connection point which is likely to be necessary to connect the project to the national grid. OES works is a term used in the EIAR to describe the construction of the OES.
Renewable energy	Energy from sources that are naturally replenishing and virtually inexhaustible, such as wind, solar, hydro, and geothermal energy.
Scour protection	Measures taken to prevent the erosion of seabed material around the base of offshore structures, such as wind turbine foundations, due to water movement.
Transition Joint Bay (TJB)	The proposed infrastructure at the Landfall location where the offshore and onshore cables connect.

Acronyms

Term	Definition
ADO	Alternative Design Option
CAN	Climate Action Network
CAP	Climate Action Plan
CARO	Climate Action Regional Office
CCAP	Climate Change Action Plan
CCGT	Combined Cycle Gas Turbine
CCPI	Climate Change Performance Index
CCR	Climate Change Resilience
CH_4	Methane
CIfA	Chartered Institute for Archaeologists
CO_2	Carbon Dioxide
CSIP	Cable Specification and Installation Plan
DCC	Dublin City Council
DECC	Department of The Environment Climate and Communications
DEHLG	Department of the Environment, Heritage & Local Government
DLR	Dún Laoghaire-Rathdown
DLRCC	Dún Laoghaire-Rathdown County Council
DPSIR	Driver, Pressure, States, Impacts and Responses
ECC	Export Cable Corridor
EIA	Environmental Impact Assessment
EIAR	Environmental Impact Assessment Report
EMRA	Eastern Midland Regional Authority
EPA	Environmental Protection Agency
EU	European Union
FAME	Archaeological Managers and Employers
FRA	Flood Risk Assessment
GHG	Greenhouse Gas
HDD	Horizontal Directional Drilling
HFCs	Hydrofluorocarbons

Term	Definition
HRA	Habitats Regulations Assessments
ICCI	In-combination Climate Impact
ICCP	Impressed Current Cathodic Protection
ICE	Inventory of Carbon and Energy
IEMA	Institute of Environmental Management and Assessment
IPCC	Intergovernmental Panel on Climate Change
LCA	Lifecycle Assessment
MCA	Maritime & Coastguard Agency
MDO	Maximum Design Option
MHWS	Mean High Water Springs
MLWS	Mean Low Water Springs
MW	Megawatts
N_2O	Nitrous Oxide
NEEAP	National Energy Efficiency Action Plan
NF_3	Nitrogen Trifluoride
NIP	Navigation and Installation Plan
NMPF	National Marine Planning Framework
NO	Nitric Oxide
NO_2	Nitrogen Dioxide
NPF	National Planning Framework
NRA	National Roads Authority
NREAP	National Renewable Energy Action Plan
OA	Ocean Acidification
OES	Onshore Electrical System
OSP	Offshore Substation Platform
PETM	Paleocene-Eocene Thermal Maximum
PFCs	Perfluorocarbons
PM_{10}	Particulate Matter with a diameter less than 10 microns
$PM_{2.5}$	Particulate Matter with a diameter less than 2.5 microns
ppb	Parts per billion
RO	Registered Organisation

Term	Definition
SEAI	Sustainable Energy Authority of Ireland
SF_6	Sulphur Hexafluoride
SLR	SLR Consulting Limited
SO_2	Sulphur Dioxide
SPP	Development of a Scour Protection Plan
TII	Transport Infrastructure Ireland
TJB	Transition Joint Bay
UK	United Kingdom
UNFCCC	United Nations Framework Convention on Climate Change
VHF	Very High Frequency
WAM	With Additional Measures
WEM	With Existing Measures
WHO	World Health Organisation
WMO	World Meteorological Organization
WTG	Wind Turbine Generator

Units

Term	Definition
°C	Degrees Celsius
ktoe	kilotonnes of oil equivalent
kWh	kilowatt-hour(s)
µg/m³	Micrograms per cubic metre
ng/m³	nanograms per cubic metre
ppb	Parts per billion

18 Climate Change

18.1 Introduction

18.1.1 This chapter of the Environmental Impact Assessment Report (EIAR) presents the findings of the Environmental Impact Assessment (EIA) concerning the potential impacts of the Dublin Array Offshore Wind Farm (Dublin Array) on climate, and the projects resilience to climate during construction, operation and maintenance, and decommissioning.

18.1.2 In alignment with the Institute of Environmental Management and Assessment (IEMA) EIA Guide to Climate Change Resilience and Adaptation (IEMA, 2020), and the requirements of the Infrastructure Planning Environmental Impact Assessment Regulations (2017) (Department of Communities and Local Government, 2017), the climate change assessment includes an evaluation of the following:

- Greenhouse Gas (GHG) emissions impact assessment: Carbon assessment across the lifetime of Dublin Array, including the nature and magnitude of GHG emissions and an assessment of carbon mitigation actions;
- Vulnerability to climate change: Climate Change Resilience (CCR) assessment evaluates the potential impacts of climate change on Dublin Array and how these impacts can be, and have been, ameliorated through the project design and planning stages; and
- In-combination Climate Impact (ICCI) effects: The extent to which climate change exacerbates the effects of VE on other environmental receptors.

18.1.3 In-combination climate change impacts which assess the extent to which climate change may impact the probability and/or consequence of effects identified elsewhere in the EIAR are considered within this chapter and also within other relevant topic chapters:

18.1.4 This chapter should be read in conjunction with the following EIAR chapters and appendices:

- Volume 2, Chapter 6: Project Description (hereafter referred to as the Project Description Chapter);
- Volume 3, Chapter 1: Marine Geology, Oceanography, and Physical Processes (hereafter referred to as the Marine Geology, Oceanography, and Physical Processes Chapter);
- Volume 3, Chapter 2: Marine Water and Sediment Quality (hereafter referred to as the Marine Water and Sediment Quality Chapter);
- Volume 3, Chapter 3: Benthic Subtidal and Intertidal Ecology (hereafter referred to as the Benthic Subtidal and Intertidal Ecology Chapter);
- Volume 3, Chapter 4: Fish and Shellfish Ecology (hereafter referred to as the Fish and Shellfish Ecology Chapter);

- Volume 3, Chapter 5: Marine Mammals (hereafter referred to as the Marine Mammals Chapter);
- Volume 3, Chapter 6: Offshore and Intertidal Ornithology (hereafter referred to as the Offshore Ornithology Chapter);
- Volume 3, Chapter 7: Bats in the Offshore Environment (hereafter referred to as the Bats in the Offshore Environment Chapter);
- Volume 3, Chapter 8: Nature Conservation (hereafter referred to as the Nature Conservation Chapter);
- Volume 3, Chapter 9: Commercial Fisheries (hereafter referred to as the Commercial Fisheries Chapter);
- Volume 3, Chapter 10: Shipping and Navigation (hereafter referred to as the Shipping and Navigation Chapter);
- Volume 3, Chapter 11: Marine Infrastructure and Other Users (hereafter referred to as the Marine Infrastructure Other Users Chapter);
- Volume 3, Chapter 12: Aviation and Radar (hereafter referred to as the Aviation and Radar Chapter);
- Volume 3, Chapter 13: Marine Archaeology (hereafter referred to as the Marine Archaeology Chapter);
- Volume 3, Chapter 14: Cultural Heritage Settings Assessment (Terrestrial Archaeology and Monuments) (hereafter referred to as the Cultural Heritage Settings Assessment Chapter);
- Volume 3, Chapter 15: Seascape, Landscape and Visual Impact Assessment (hereafter referred to as the SLVIA Chapter);
- Volume 3, Chapter 16: Noise and Vibration (Terrestrial Receptors) (hereafter referred to as the Noise and Vibration Chapter);
- Volume 3, Chapter 17: Socio-Economics, Tourism, Recreation and Land Use (hereafter referred to as the Socio-Economic, Tourism, Recreation and Land Use Chapter);
- Volume 3, Chapter 19: Major Accidents and Disasters (hereafter referred to as the Major Accidents and Disasters Chapter);
- Volume 6, Appendix 6.5.4-1 Water (Hydrology, Hydrogeology, and Flood Risk) Technical Baseline Report (hereafter referred to as Water Technical Baseline Report);

- Volume 6, Appendix 6.5.4-2: Dublin Array Flood Rish Assessment Report (OES) (hereafter referred to as OES Flood Risk Assessment);
- Volume 5, Chapter 3: Land, Soils and Geology (hereafter referred to as the Land Soils and Geology Chapter);
- Volume 5, Chapter 4: Water (Hydrology, Hydrogeology and Flood Risk) (hereafter referred to as the Water Chapter); and
- Volume 5, Chapter 9: Human Health (hereafter referred to as the Human Health Chapter); and
- Volume 5, Chapter 10: Air Quality (hereafter referred to as the Air Quality Chapter).

18.1.5 The GHG Assessment which accompanies this chapter is included in Volume 4, Appendix 4.3.18-1 Greenhouse Gas Assessment, hereafter referred to as the GHG Assessment Report.

18.2 Regulatory background

18.2.1 The regulatory background for the climate chapter is informed by a comprehensive framework of legislation, plans, and guidelines aimed at addressing climate change and transitioning to a low-carbon economy. Central to this framework is the Renewable Energy Directive, which promotes renewable energy adoption across sectors, supports electrification, and sets sustainability criteria for bioenergy. Recent amendments to the directive strengthen these measures, targeting EU climate neutrality by 2050. Complementing this, the EIA Directive ensures climate impacts are integrated into project assessments, aligning with broader EU objectives.

18.2.2 National policies such as Ireland's National Energy and Climate Plan 2021-2030 and Climate Action Plan (CAP) 2024 outline strategies for renewable energy expansion, energy efficiency, and resilience to climate impacts, underlining the need for systemic change and collective action. The Climate Action and Low Carbon Development Act 2015 provides a legislative framework with binding sectoral emission reduction targets and oversight mechanisms.

18.2.3 The Dún Laoghaire-Rathdown and Dublin City (2022-2028) Plan embeds climate considerations into urban planning, transportation, and infrastructure to reduce emissions and enhance resilience. Technical guidelines, such as those from IEMA, provide methodologies for GHG assessment and climate adaptation, while international performance indices offer benchmarks and recommendations for policy improvement.

18.2.4 Further details on these laws and policies, including their key provisions and how they are specifically addressed in the EIAR, are provided in Appendix A.

18.3 Methodology

Study area

GHG assessment

18.3.1 The study area of the GHG assessment encompasses the offshore array area, offshore substation platform (OSP), inter array electricity cables, operations and maintenance (O&M) base, the landfall including the Transition Joint Bay (TJB) and the Onshore Electrical System (OES) including the Onshore Substation (OSS).

Climate Change Resilience (CCR) assessment

18.3.2 The study area for the CCR assessment was determined based on the availability of publicly accessible climate data, prioritising sources that were both relevant and geographically representative. Historical climate data was obtained from the Casement weather station, providing localised observations for past climate conditions. Future climate projections for Ireland were sourced from the World Bank Climate Knowledge Portal (World Bank, n.d), which offers national-level data. While finer spatial resolution was not available for future projections, the assessment used the most appropriate and up-to-date datasets to characterise expected climate trends.

Baseline data

18.3.3 The data sources used to inform the CCR assessment are listed in Table 1. To avoid repetition, the methods and data sources used for the GHG assessment are summarised throughout this chapter, with full details provided in the GHG Assessment.

Table 1 Summary of data sources

Data type	Data source	Details of the information
Ireland's GHG Emissions Projections 2019-2040	EPA	Ireland's GHG emissions are tracked and projected by the EPA for submission to the EU UNFCCC annually. Carbon dioxide (CO_2) emissions are reported alongside methane (CH_4), nitrous oxide (N_2O), hydrofluorocarbons (HFC_s), perfluorocarbons (PFCs), sulphur hexafluoride (SF_6), and nitrogen trifluoride (NF_3).
Historical climatic conditions	Met Éireann	The climatic conditions for the wider geographical area have been derived from historical meteorological measurements compiled by Met Éireann at Casement weather station.
Future climate projections for Ireland	World Bank Knowledge Portal for Ireland	Future projections from the World Bank Knowledge Portal for Ireland (World Bank, n.d) present an analysis of the projected maximum of daily max temperatures by season, and projected change in seasonal precipitation.

18.3.4 Data for the GHG assessment involved collecting data from six stages of the life cycle of Dublin Array, including both onshore and offshore: raw materials, manufacturing, installation, operation, freight and end of life. The following three potential wind turbine generator (WTG) layouts were considered in the assessment, as detailed in the Project Description Chapter:

- Option A: 50 WTG, 236 m minimum rotor diameter;
- Option B: 45 WTG, 250 m minimum rotor diameter; and
- Option C: 50 WTG, 278 m minimum rotor diameter.

18.3.5 In addition, five options for the WTG foundation design, and four options for the OSP foundation design have been included in the GHG assessment.

18.3.6 The three potential array options, five WTG foundation options, and four OSP foundation options are detailed in Table 2.

Table 2 Layout options, WTG and OSP foundation options

Layout options	WTG foundation options	OSP foundation options
A. 50 x 15 MW WTGs B. 45 x 18 MW WTGs C. 39 x 21.5 MW WTGs	1. Monopile, TP, steel, grout, and cement; 2. Jacket & pin-pile and steel, 3 leg structure; 3. Jacket & pin-pile and steel, 4 leg structure; 4. Jacket & pin-pile and grout, 4 leg structure; and 5. Jacket suction bucket foundation, steel, and grout, 4 leg structure.	1. Jacket & pin-pile steel, 4 leg structure; 2. Monopile, TP, J-Tube cage, and steel; 3. Monopile & grout; and 4. Jacket & grout.

18.3.7 Main materials in the Dublin Array components, and their amounts (indicative values), manufacturing and installation burdens, vessel activities, and freight requirements are provided in the GHG Assessment, Table 3-1.

Assessment methodology

GHG assessment

18.3.8 The assessment of carbon emissions was carried out to determine the likely GHG emissions (CO_2eq) predicted for the lifecycle of Dublin Array, which encompasses construction, operation, maintenance, and decommissioning phases.

18.3.9 GHG emissions embedded in these phases arise from a variety of activities, such as the manufacturing and transportation of construction materials, on-site assembly and installation, routine and emergency maintenance operations, and the eventual decommissioning and disposal of infrastructure.

18.3.10 Data was gathered on as many aspects of the design and construction details as were available and supplemented with proxy data from similar previously completed projects. Together, this described the materials, the manufacture, the transportation of identified construction materials to the respective construction site, the construction process itself, the construction compounds (including plant and machinery to be used in the construction process) and the wastes which will be generated across all project phases. Emission factors were applied to translate this activity data into carbon emission equivalents and summed across life cycle stages to determine the total impacts of Dublin Array.

18.3.11 The University of Bath's (via Circular Ecology) carbon calculator (Version 1.1, November 2019)[1] was used to calculate the embodied carbon of cement and concrete mixtures in terms of carbon dioxide equivalency (CO_2eq). The calculator uses data from the ICE Database – Embodied Carbon Model of Cement, Mortar and Concrete.

18.3.12 The Circular Ecology carbon calculator includes emissions associated with the transport of materials to the respective construction sites. Relevant transport distances for each material have been incorporated into the calculations.

18.3.13 For materials not covered by the Circular Ecology calculator, the Transport Infrastructure Ireland (TII) Carbon Assessment Tool for Road and Light Rail projects (2018) was used to estimate carbon emissions.

Climate change resilience assessment

18.3.14 The assessment methodology for the CCR assessment has been developed in line with the IEMA EIA Guide to Climate Change Resilience and Adaptation (IEMA, 2020).

18.3.15 To assess the resilience of Dublin Array to projected changes in the climate, the CCR assessment considers Dublin Array itself as the receptor. To facilitate a detailed assessment of each potential impact and effect, the project receptors have been separated into categories as detailed in section 18.9.4.

1 University of Bath (2019) Carbon calculator (Version 1.1, November 2019). Circular Ecology. Available at: https://circularecology.com.

18.3.16 For each potential impact, the sensitivity of the receptor and the magnitude of the impact was assessed according to the criteria outlined in Section 18.5. Informed by EPA Climate projections, expert judgment informed the determination of the level of sensitivity and magnitude attributable to each receptor and impact across the lifetime of Dublin Array. Given the maximum 35-year operational lifetime, 2040 data was used to inform the CCR assessment of climate change impacts affecting the operational stage, and 2070 data was used to inform the assessment of decommissioning stage impacts.

18.3.17 The sensitivity and magnitude outcomes were used to determine the significance of the effect using a significance matrix, as shown in Table 3. The matrix was used to categorise the significance of the effect as negligible, minor, or moderate; as well as showing whether the outcome was of an adverse or beneficial nature. Any effect of moderate or major significance is deemed to be significant, while effects of negligible or minor significance are deemed to be insignificant in EIA terms.

18.3.18 As part of the climate vulnerability and resilience assessment, potential ICCI effects were also considered. The ICCI assessment methodology follows the IEMA EIA guidance on Climate Change Resilience and Adaptation (IEMA, 2020) to consider whether projected climate conditions can be expected to change the significance of the environmental effects identified elsewhere in the EIAR.

18.4 Assessment criteria

GHG assessment

18.4.1 The IEMA Environmental Impact Assessment Guide to Assessing Greenhouse Gas Emissions and Evaluating their Significance 2nd Edition (IEMA, 2022) provides a context by which a measurement of significance can be applied to the assessment of a project for the purposes of EIA. IEMA notes the following principles:

- The GHG emissions from all projects will contribute to climate change, the largest interrelated cumulative environmental effect;
- The consequences of a changing climate have the potential to lead to significant environmental effects on all topics in the EIA Directive; and
- GHG emissions have a combined environmental effect that is approaching a scientifically defined environmental limit; as such any GHG emissions or reduction from a project might be considered to be significant.

18.4.2 The IEMA Guidance (2022) states that the GHG assessment should evaluate the difference in emissions between the proposed project and a baseline scenario (which represents an alternative option or the "do-nothing" scenario). The assessment should reflect the net whole-life GHG emissions for both the proposed project and the baseline, highlighting the variation in emissions across their entire life cycle.

18.4.3 The IEMA guidance states:

'When evaluating significance, all new GHG emissions contribute to a negative environmental impact; however, some projects will replace existing development or baseline activity that has a higher GHG profile. The significance of a project's emissions should therefore be based on its net impact over its lifetime, which may be positive, negative, or negligible.'

18.4.4 The IEMA Guidance (2022) emphasises that the crux of significance is not whether a project emits GHG emissions, nor even the magnitude of GHG emissions along, but whether it contributes to reducing GHG emissions relative to a comparable baseline consistent with a trajectory towards net zero.

18.4.5 Significance principles and criteria are outlined in section 6.3 of the IEMA Guidance (2022). In terms of assigning significance, projects are assessed based on their alignment with emission reduction trajectories and policy measures. Those following a 'business-as-usual' approach, incompatible with net zero goals, result in either moderate or major significant adverse effects. Conversely, projects compatible with emission reduction trajectories and policies have minor adverse effects which are not significant. Projects exceeding reduction trajectories with minimal residual emissions are assessed as having negligible effects that are not significant. Only projects that are actively removing emissions from the atmosphere are deemed as having a beneficial effect.

18.4.6 For the purposes of this assessment, Dublin Array's GHG emissions have been evaluated in relation to the broader carbon budget, which refers to the allowable emissions required to meet national or global emission reduction goals.

18.4.7 The significance of effects in relation to GHG emissions (as determined in Table 3), is dependent on the net GHG impacts compare to the without project baseline scenario impacts, and overall net zero aspirations.

18.4.8 A systems expansion approach is adopted in the GHG assessment to account for the benefits of the electricity generated across the lifetime of Dublin Array which is anticipated to displace Republic of Ireland marginal electricity derived from gas until at least 2050. The net significance of the GHG impacts is quantified through comparison of Dublin Array derived electricity to the electricity mix.

18.4.9 The complete methodology applied is included in the GHG Assessment Report.

Climate change resilience assessment

18.4.10 To determine the significance of effects arising from projected changes in the climate, the following criteria was applied.

18.4.11 Sensitivity was assessed as a combination of the susceptibility, vulnerability, and importance of the receptor. The susceptibility of a receptor indicates a receptor's ability to be affected by a change and can also be thought of as the opposite of resilience. The vulnerability of a receptor measures the potential exposure of a receptor to change, in this case changes in the climate. The importance of the receptor reflects the economic value of the receptor and/or the number of Project dependencies associated with the receptor.

18.4.12 The susceptibility of the receptor in the context of climate resilience has been informed by best practice guidance, including frameworks provided by the IEMA and other recognised methodologies in EIA, as follows:

- **High susceptibility**: the receptor has no ability to withstand or not be substantially altered by the projected changes to the existing/prevailing climatic factors (e.g. lose much of its original function and form);
- **Moderate susceptibility**: the receptor has some ability to withstand or not be substantially altered by the projected changes to the existing/prevailing climatic factors (e.g. lose much of its original function and form); and
- **Low susceptibility**: the receptor has the ability to withstand or not be substantially altered by the projected changes to the existing/prevailing climatic factors (e.g. retain much of its original function and form).

18.4.13 Similarly, the vulnerability of the receptor was scored using the following three-point scale:

- **High vulnerability**: the receptor is directly dependent on existing/prevailing climatic factors and reliant on these specific existing climatic factors continuing in future or only able to tolerate an extremely limited variation in climate conditions;
- **Moderate vulnerability**: the receptor is dependent on some climatic factors but able to tolerate a range of conditions; and
- **Low vulnerability**: climatic factors have little influence on the receptor.

18.4.14 Finally, the importance of the receptor was assessed across the following three scales:

- **High importance**: High economic value, large number of dependencies that are important to the functioning of the project;
- **Moderate importance**: Moderate economic value, moderate number of dependencies that are important to the functioning of the project; and

- **Low importance**: Low economic value, low number of dependencies that are important to the functioning of the project.

18.4.15 Each receptor was given a separate score of between 1 and 3 for its susceptibility, vulnerability, and importance. These scores were multiplied together and then normalised to give a combined overall sensitivity score from 1 to 100. Scores of 1-6 were 'negligible' sensitivity, scores between 7-29 were 'low' sensitivity, scores between 30-66 were 'medium' sensitivity, scores above 67 were 'high' sensitivity.

18.4.16 Separately, the magnitude of the impact experienced by the receptor was scored by evaluating the probability of the impact and consequence of the effect. The probability of an impact indicates the chance of the impact occurring within the lifetime of the project. The consequence of an impact reflects the scale of the impact, which encompasses geographic extent, number of receptors affected, complexity of impact, degree of harm to those affected, duration, frequency, and reversibility.

18.4.17 The probability of the impact was scored across the following five-point scale:

- **Very high probability**: Equivalent to a 90-100% probability of occurring during the lifetime of the project. This can otherwise be thought of as 'very likely' to occur;
- **High probability**: Equivalent to a 66%-100% probability of occurring during the lifetime of the project. This can otherwise be thought of as 'likely' to occur;
- **Medium probability**: Equivalent to a 33-66% probability of occurring during the lifetime of the project. This can otherwise be thought of as 'possible' to occur, or about as likely as not to occur;
- **Low probability**: Equivalent to a 0-33% probability of occurring during the lifetime of the project. This can otherwise be thought of as 'unlikely' to occur; and
- **Minimal probability**: Equivalent to a 0-10% probability of occurring during the lifetime of the project. This can otherwise be thought of as 'very unlikely' to occur.

18.4.18 The consequence of the impact was scored across the following five-point scale:

- **Very high impact**: The scale of impact has the potential to be existentially material for the project;
- **High impact**: The scale of impact has the potential to be significant and material for the project;
- **Medium impact**: The scale of impact has the potential to be material for the project;
- **Low impact**: The scale of impact is expected to be minor and not considered material for the project; and
- **Negligible impact**: The scale of impact is expected to be immaterial for the project.

18.4.19 Each receptor was given a separate score of between 1 and 5 for its probability of impact and consequence of the effect. These scores were multiplied together and then normalised to give a combined overall magnitude score from 1 to 100. Scores between 1-15 were 'negligible' magnitude, scores between 16-35 were 'low' magnitude, scores between 36-63 were 'medium' magnitude, scores above 64 were 'high' magnitude.

18.4.20 The magnitude of the impact was then also assigned a direction: adverse or beneficial. All impacts identified in the CCR were defined as adverse.

18.4.21 Significance is determined according to the combined sensitivity and magnitude matrix presented in Table 3.

Table 3 Significance matrix

Description of Impact - Magnitude			Existing Environment - Sensitivity			
			High	**Medium**	**Low**	**Negligible**
	Adverse impact	**High**	Profound or Very Significant (significant)	Significant	Moderate*	Imperceptible
	Adverse impact	**Medium**	Significant	Moderate*	Slight	Imperceptible
	Adverse impact	**Low**	Moderate*	Slight	Slight	Imperceptible
	Neutral impact	**Negligible**	Not significant	Not significant	Not significant	Imperceptible
	Positive impact	**Low**	Moderate*	Slight	Slight	Imperceptible
	Positive impact	**Medium**	Significant	Moderate*	Slight	Imperceptible
	Positive impact	**High**	Profound or Very Significant (significant)	Significant	Moderate*	Imperceptible

*Moderate levels of effect have the potential, subject to the assessor's professional judgement, to be significant. Moderate will be considered as significant or not significant in EIA terms, depending on the sensitivity and magnitude of change factors evaluated. These evaluations are explained as part of the assessment, where they occur.

18.5 Receiving environment

Irelands carbon emissions

18.5.1 Ireland's GHG emissions are tracked and projected by the EPA for submission to the EU UNFCCC annually. Carbon dioxide (CO_2) emissions are reported alongside methane (CH_4), nitrous oxide (N_2O), hydrofluorocarbons (HFC_s), perfluorocarbons (PFCs), sulphur hexafluoride (SF_6), and nitrogen trifluoride (NF_3).

18.5.2 The EPA's latest projections report, Ireland's Greenhouse Gas Emissions Projections 2023-2050 (EPA, 2024) projected Ireland's GHG emissions under two scenarios:

- With Existing Measures scenario (WEM); and
- With Additional Measures (WAM) scenario.

18.5.3 The WEM scenario is a projection of future emissions based on the measures currently implemented and actions committed to by Government. To become part of the WEM scenario a policy or measure must be in place by the end of 2022 (the latest inventory year) and, in parallel, the resources and/or legislation already in place or committed to by Government Departments or Agencies. The WAM scenario is the projection of future emissions based on the measures outlined in the latest Government plans at the time projections are compiled. This includes all policies and measures included in the WEM scenario, plus those included in Government plans but not yet implemented. If policies and measures in the WAM scenario are implemented, EPA projections show that Ireland can achieve a reduction of emissions of 25% by 2030.

18.5.4 Figure 1 illustrates the WEM and WAM projected emissions in relation to the Energy Industries Sector.

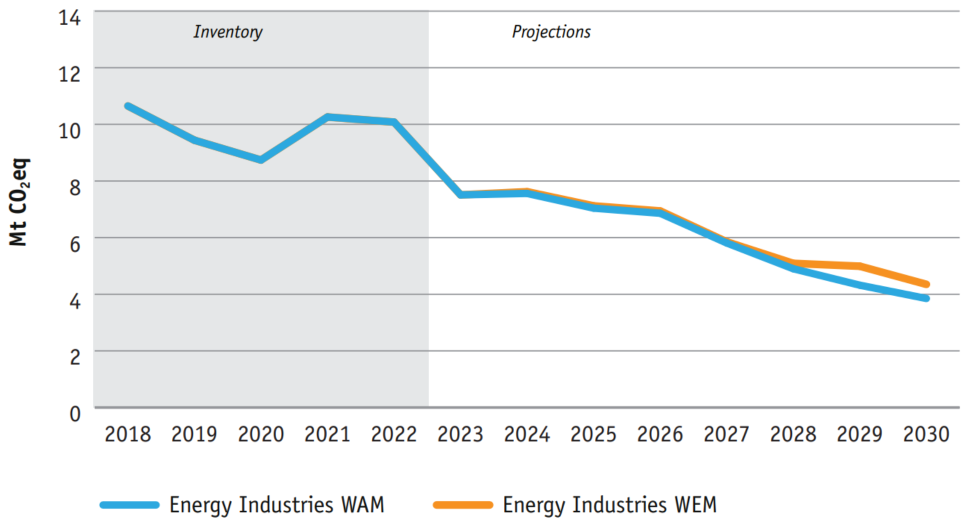

Figure 1 GHG projections from the Energy Industries Sector under the WEM and WAM scenarios to 2030

18.5.5 Emissions in the Energy Industries Sector showed that energy emissions contributed 17% of Ireland's total emissions in 2022. Over the period 2022-2030, Ireland's emissions from the Energy Industries Sector are projected to decrease by 57% from 10.1 to 4.4 Mt CO_2eq under the WEM scenario and by 62% from 10.1 to 3.9 Mt CO_2eq under the WAM scenario.

18.5.6 The share of renewable energy sources used in the generation of electricity in Ireland has increased from 5% in 1990 to 41% in 2023. Wind has been the main source of renewable energy production in Ireland in recent years, with 57% of renewable energy production attributable to wind in 2023 (CSO, 2023). Renewables are projected to account for 69% of electricity consumption in 2030, up from 29.6% of electricity generated in 2017 under the WEM scenario. Under the WAM scenario it is assumed that by 2030 renewable electricity share increases to at least 80% by 2030 (EPA, 2024).

18.5.7 Sustainable Energy Authority of Ireland states that in 2023, Ireland generated 11.7 TWh of renewable energy from wind generation, exceeding the previous record of 11.6 TWh set in 2020 by 0.1 TWh. In 2023, Ireland had 4.74 GW of installed wind capacity, up 4.5% on the previous year.

18.5.8 A new Effort Sharing Regulation (EU) 2021/1119, adopted by the European Council, sets out the emissions reduction targets for EU Member States for 2030. Under this regulation, Ireland's target is a 42% reduction in emissions by 2030, compared to 2005 levels, with binding annual limits from 2021-2030 to ensure compliance with this target (European Council, 2021). The Climate Action and Low Carbon Development Act 2015, as amended, requires that the State shall 'pursue and achieve' a climate neutral economy by 2050. This transition to 'a climate resilient, biodiversity rich, environmentally sustainable and climate neutral economy' is referred to in the Act as the 'national climate objective'.

Climate Change Performance Index

18.5.9 The Climate Change Performance Index (CCPI) is published annually by Germanwatch, a non-governmental organisation based in Germany, in cooperation with the NewClimate Institute and Climate Action Network Europe (CAN Europe). The index uses a framework of standardised criteria to evaluate and compare the climate protection performance of countries around the world. These criteria include: GHG emissions; renewable energy; energy use, and climate policy. Once scored against these criteria, the performance of each country is ranked overall.

18.5.10 In the 2025 CCPI scorecard (Germanwatch, NewClimate Institute & Climate Action Network, 2025), Ireland has improved significantly, rising 14 places to rank 29th. Ireland ranks in the medium-performance category for renewable energy, energy use and climate policy, while still facing challenges in the low performance category for the current amount of GHG emissions generated. Despite the positive development, especially in renewable energy, further efforts will be needed to continue making progress towards Ireland's climate targets.

18.5.11 In 2022, Ireland introduced legally binding carbon budgets and emissions ceilings, along with a CAP, to meet its 2030 net emissions reduction target of 51% compared to 2018 levels. The 2025 CCPI report emphasises the need for consistent enforcement and specific strategies to phase out fossil fuel and transition investments towards renewable energy sources.

Climate and weather in the existing environment

18.5.12 The EPA’s Climate Change Research Programme conducts relevant and up to date studies on climate change in Ireland (Environmental Protection Agency, n.d). Analysis of the meteorological records shows that Ireland’s climate is changing in line with global patterns. The clearest trend is evident in the temperature records which show a mean temperature increase of 0.7^{o}C between 1890 and 2008, i.e. an increase of 0.06 ^{o}C per decade. The increase was 0.4^{o}C during the period 1980- 2008, i.e. equivalent to 0.14^{o}C per decade. The dominant influence on Ireland's climate is the Gulf Stream. Consequently, Ireland does not suffer from the extremes of temperature experienced by many other countries at similar latitudes. However, recent studies have shown that the Gulf Stream is weakening (Baringer & Larsen, 2001).

18.5.13 The climatic conditions for the study area have been derived from historical meteorological measurements compiled by Met Éireann at Casement weather station which is located at Casement Aerodrome (also known as Baldonnel Aerodrome), approximately 10 km southwest of Dublin. These meteorological conditions are presented in Table 4 for the period January 2018-June 2021 (source www.met.ie/climate). The average temperature at the Casement weather station in the period 2018-June 2021 is 9.6^{o}C with 15.8^{o}C peaks in July to 5^{o}C lows in January. The warmest July was in 2018 with a monthly average of 16.8^{o}C.

18.5.14 The baseline period for day-to-day weather and climate comparisons is presented for the time period 1981 – 2010. Meteorological data recorded at Casement of the 30-year period shows that the wettest month on average was October and the driest month on average was February. The warmest month was July at 19.8^{o}C and the coolest month was January at 8.0^{o}C.

Table 4 Climate record for Casement weather station 2018-2021

Total rainfall in millimetres for CASEMENT												
Jan	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**	**Annual**
95.8	69.7	29.6	17.9	112.7	17.8	94.0	47.3	42.1	16.0			542.9
49.3	155.4	32.5	19.3	10.7	87	114.4	85.1	48.1	81.7	58.6	77.9	820
33.1	22.2	86.2	69.1	26.8	92.5	46.7	113	108.7	74.2	143.5	49.3	865.3
91.5	25.8	69.1	76.1	16.8	18.5	30.1	43.3	37	56	104.6	88.9	657.7
63.8	48.5	50.7	51.9	59.1	62.5	54.2	72.3	60.3	81.6	73.7	75.7	754.3
Mean temperature in degrees Celsius for CASEMENT												
Jan	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**	**Annual**
3.8	6.1	7.4	6.5	9.5	15.2	18.3	15.9	15.2	N/A			10.7
6.1	5.6	6.1	9.4	12.1	13.5	14.6	15.1	13	9.4	8.2	4.6	9.8
5.2	7.2	7.1	8.4	10.9	12.9	16.3	15.6	13	9.1	6	6.1	9.8
5.2	3.4	4.5	8.5	12	15.5	16.8	15.6	12.3	9.2	8.3	7.9	10
5.1	5.1	6.6	8	10.7	13.4	15.5	15.1	13	10.1	7.2	5.4	9.6
Mean 10 cm soil temperature for CASEMENT at 09:00 UTC												
Jan	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**	**Annual**
3.4	4.7	6.6	8.1	11.1	15.9	18.3	15.9	15.2	N/A			11.1
5	4.5	5.2	9.4	13.4	14.9	15.7	15.9	13.1	9.4	7.5	4.5	9.9
5.3	5.3	6.2	8.1	11.8	13.6	17	15.7	13.1	8.8	5.8	4.7	9.6
4	2.3	3.5	8.1	13.1	17.3	18.8	16	12.1	8.7	6.9	6.7	9.8
3.9	3.8	5.2	7.6	11.4	14.6	16.2	15.3	12.6	9.2	6.2	4.4	9.2
Potential evapotranspiration (mm) for CASEMENT												
Jan	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**	**Annual**
11	26.2	37	57	75.4	91.4	95.1	67.2	47.0	20.2			527.5
16.6	21.8	38.8	62.1	101.8	75.3	76.8	63.8	47.5	28.6	15.2	11.3	559.6

12.5	23.8	37.5	51.9	77.6	82.7	93.4	85.2	47.4	26.7	12	15.6	566.3
16.1	19.4	29.3	53.8	83.2	104.7	101.9	74	52.6	29.2	19.2	15.4	598.8

Table 5 Climate and weather conditions at Casement weather station between 1981 – 2010

Parameter	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
Temperature (degrees Celsius)													
Mean daily max	8.0	8.2	10.2	12.4	15.2	17.9	19.8	19.5	17.1	13.6	10.2	8.3	13.4
Mean daily min	2.1	2.0	3.3	4.1	6.6	9.4	11.5	11.3	9.5	7.0	4.2	2.4	6.1
Mean temperature	5.1	5.1	6.8	8.2	10.9	13.6	15.7	15.4	13.3	10.3	7.2	5.4	9.7
Absolute max	15.2	15.9	17.3	22.7	24.9	27.6	31.0	29.5	25.4	21.3	17.7	14.8	31.0
Min. Maximum	-3.0	-0.7	2.3	4.5	7.1	10.2	10.6	11.7	10.8	5.2	-3.1	-4.7	-4.7
Max. Minimum	11.3	13.0	11.5	12.6	13.8	17.2	18.1	18.3	17.8	16.4	13.8	12.7	18.3
Absolute min.	-12.4	-8.0	-9.0	-5.5	-2.4	0.4	4.6	2.2	0.2	-4.1	-9.1	-15.7	-15.7
Mean num of days with air frost	7.5	7.7	4.6	3.4	0.8	0.0	0.0	0.0	0.0	1.3	4.3	7.6	37.2
Mean num of days with ground frost	14.0	14.0	11.0	11.0	4.0	0.0	0.0	0.0	1.0	4.0	9.0	14.0	82.0
Mean 5 cm soil	3.7	3.6	5.3	8.4	12.6	15.7	17.1	16.0	12.8	9.2	6.0	4.2	9.6
Mean 10 cm soil	3.9	3.8	5.2	7.6	11.4	14.6	16.2	15.3	12.6	9.2	6.2	4.4	9.2
Mean 20 cm soil	4.6	4.5	5.9	8.1	11.5	14.5	16.3	15.8	13.4	10.1	7.1	5.1	9.7
Relative Humidity (%)													
Mean at 09:00 UTC	87.2	86.7	84.5	80.1	77.4	77.7	79.7	82.2	84.5	86.3	88.9	88.4	83.6
Mean at 15:00 UTC	82.2	76.7	71.8	67.7	67.3	67.9	68.9	69.0	71.8	76.6	81.6	84.1	73.8
Sunshine (hours)													
Mean daily duration	1.7	2.5	3.3	5.1	6.0	5.3	4.9	4.8	4.1	3.3	2.2	1.5	3.7

Parameter	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
Greatest daily duration	8.1	9.2	10.9	13.2	15.4	16.0	15.5	14.4	12.3	10.1	8.5	6.9	16.0
Mean no of days with no sun	8.9	5.8	4.4	2.5	1.8	2.1	1.6	1.1	2.4	4.5	7.0	9.9	52.0
Rainfall (mm)													
Mean monthly total	63.8	48.5	50.7	51.9	59.1	62.5	54.2	72.3	60.3	81.6	73.7	75.7	754.2
Greatest daily total	30.0	32.2	31.1	38.7	29.8	97.5	33.7	89.3	51.1	50.1	82.0	46.8	97.5
Mean num. of days with >= 0.2 mm	17	14	16	14	15	14	15	16	14	16	16	16	183
Mean num. of days with >= 1.0 mm	12	10	11	10	11	10	10	11	10	12	11	12	130
Mean num. of days with >= 5.0 mm	4	3	3	3	3	3	3	4	4	4	4	5	43
Wind (knots)													
Mean monthly speed	13.6	12.9	12.4	9.8	9.1	8.6	8.8	9.0	9.6	11.1	11.6	12.3	10.7
Max gust	80	78	71	59	63	51	58	55	59	65	66	82	82
Max. mean 10-minute speed	57	54	47	43	43	36	39	36	38	44	46	57	57
Mean num. of days with gales	4.5	3.2	2.1	0.6	0.4	0.1	0.1	0.2	0.3	1.2	1.9	3.5	18.1
Weather (mean no of days with…)													
Snow or sleet	4.1	3.9	2.5	1.1	0.1	0.0	0.0	0.0	0.0	0.0	0.5	2.3	14.6
Snow lying at 09:00 UTC	1.8	1.0	0.2	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.1	1.0	4.1
Hail	1.0	1.5	2.7	2.4	1.5	0.2	0.2	0.1	0.2	0.2	0.7	0.6	11.3
Thunder	0.1	0.1	0.3	0.4	1.1	1.0	1.0	1.2	0.6	0.4	0.1	0.1	6.3
Fog	1.8	1.9	1.6	1.6	1.5	1.2	1.1	2.0	2.8	2.0	2.1	2.4	22.1

Temperature projections

18.5.15 Future projections from the World Bank Knowledge Portal for Ireland (World Bank, n.d) present an analysis of the projected maximum of daily max temperatures by season (Table 6). This indicator is crucial in understanding heat risks and provides insights into extreme heat conditions during the hottest parts of the day. The data spans three distinct time horizons: 2020-2039, 2040-2059, and 2060-2079, and assesses temperatures under two climate scenarios: SSP2-4.5 (medium warming scenario) and SSP3-7.0 (high warming scenario). The SSP2-4.5 scenario represents a medium warming scenario where emissions peak around mid-century and decline thereafter, while SSP3-7.0 is a high warming scenario characterized by continuously increasing emissions throughout the century. Notably, under both scenarios, the projected average single-day maximum value of the daily maximum temperatures peaks in the Jun-Aug season across all time periods, illustrating the season's susceptibility to the highest temperatures. For instance, under SSP2-4.5, the temperatures rise from 26.55 °C in 2020-2039 to 27.58 °C in 2060-2079 during these summer months. Similarly, under the more severe SSP3-7.0 scenario, the summer peaks escalate from 26.53 °C to 28.10 °C in the same period.

18.5.16 There is a gradual increase in temperatures from the short term into the long term, indicating a clear warming pattern. This is particularly pronounced during the Jun-Aug season, which consistently records the highest temperatures across all periods and scenarios. Moreover, each successive period registers a slight but steady increase in maximum temperatures for the respective seasons, suggesting an escalation in heat intensity and duration. For instance, under the SSP3-7.0 scenario, the winter months (Dec-Feb) see an increase from 13.77 °C in the early period to 14.75 °C in the late period.

Table 6 Projected maximum daily temperatures by season

Units: °C	2020-2039				2040-2059				2060-2079			
Scenario	**Dec - Feb**	**Mar-May**	**Jun-Aug**	**Sep-Nov**	**Dec - Feb**	**Mar-May**	**Jun-Aug**	**Sep-Nov**	**Dec - Feb**	**Mar-May**	**Jun-Aug**	**Sep-Nov**
SSP2-4.5	13.93	22.09	26.55	23.77	14.23	22.98	27.39	23.9	14.31	23.17	27.58	24.61
SSP3-7.0	13.77	22.55	26.53	23.52	14.18	23.06	27.03	23.94	14.75	23.83	28.1	24.96

18.5.17 Future projections from the Climate Change Knowledge Portal (World Bank, n.d) for the projected change in number of frost days by season, underscore the shifting climatic patterns Ireland may face. The data is segmented into three future periods (2020-2039, 2040-2059, and 2060-2079) and evaluates two climate scenarios: SSP2-4.5 (medium warming scenario) and SSP3-7.0 (high warming scenario). A discernible trend is observed in the decreasing number of frost days across all seasons, with the largest reductions seen during the winter months (Dec-Feb). For example, under SSP2-4.5, frost days decrease from 7.23 days in the first period to 5.95 days in the final period. Similarly, under SSP3-7.0, the decrease is more pronounced, from 7.75 to 4.07 days.

18.5.18 The reduction in frost days signals a notable warming trend that could have profound implications on Ireland's ecological and agricultural systems. Winter months consistently show the highest reduction, which might indicate milder winters ahead. This trend is complemented by reductions in frost days during the transitional seasons of Mar-May and Sep-Nov, which progressively become less pronounced towards the end of the century. Under both scenarios, the Jun-Aug period remains frost-free throughout, suggesting an extension of warmer summer conditions. For instance, the March to May transition shows a decrease from 1.86 days under SSP2-4.5 in the first period to 1.16 days in the last, and from 1.75 days to 0.76 days under SSP3-7.0.

Table 7 Projected change in number of frost days (T min<0ºC) by season

Units: Days	2020-2039				2040-2059				2060-2079			
Scenario	**Dec - Feb**	**Mar-May**	**Jun-Aug**	**Sep-Nov**	**Dec - Feb**	**Mar-May**	**Jun-Aug**	**Sep-Nov**	**Dec - Feb**	**Mar-May**	**Jun-Aug**	**Sep-Nov**
SSP2-4.5	7.23	1.86	0	0.48	6.6	1.51	0	0.42	5.95	1.16	0	0.25
SSP3-7.0	7.75	1.75	0	0.44	5.3	1.19	0	0.33	4.07	0.76	0	0.14

Rainfall projections

18.5.19 Future projections from the Climate Change Knowledge Portal (World Bank, n.d) concerning the projected change in seasonal precipitation indicate climatic shifts that Ireland may face over the next six decades. Analysing data from three time periods (2020-2039, 2040-2059, and 2060-2079) and under two climate scenarios, SSP2-4.5 (medium warming scenario) and SSP3-7.0 (high warming scenario), it is evident that there are nuanced variations in precipitation across different seasons. For instance, under the SSP2-4.5 scenario, the winter months (Dec-Feb) show a slight increase in precipitation from 103.22% in the initial period to 107.14% in the latter period, suggesting wetter winters. Conversely, summer months (Jun-Aug) display a decrease, with precipitation dropping from 97.74% to 92.87%, indicating drier summers as the century progresses.

18.5.20 These trends highlight a dynamic shift in seasonal weather patterns, which could have profound implications for Ireland's water resources, agriculture, and flood management systems. The winter months are consistently marked by increased precipitation, potentially leading to heightened flood. This increase contrasts with the decreasing precipitation trends observed during the summer months, which could impact agricultural productivity and water availability. Particularly notable are the differences under the SSP3-7.0 scenario, where the winter of 2060-2079 projects a significant increase to 109.56%, the highest across all periods and scenarios, enhancing concerns over extreme wet weather events. Conversely, the substantial drop to 89.01% during the same period's summer months could suggest a risk of drought conditions.

Table 8 Projected change in seasonal precipitation as percentage

Units: %	2020-2039				2040-2059				2060-2079			
Scenario	Dec - Feb	Mar-May	Jun-Aug	Sep-Nov	Dec - Feb	Mar-May	Jun-Aug	Sep-Nov	Dec - Feb	Mar-May	Jun-Aug	Sep-Nov
SSP2-4.5	103.22	99.72	97.74	101	103.36	99.88	93.57	99.22	107.14	97.81	92.87	101.31
SSP3-7.0	103.44	100.21	96.6	99.57	105.57	98.98	93.84	101.53	109.56	99.07	89.01	100.55

18.5.21 The future projections from the Climate Change Knowledge Portal (World Bank, n.d) concerning the projected change in the average largest 1-Day precipitation reveals insights into the shifts in extreme precipitation events Ireland might experience over the coming decades. Analysing periods from 2020-2039 to 2060-2079 under two climate scenarios, SSP2-4.5 (medium warming scenario) and SSP3-7.0 (high warming scenario), a noticeable trend in the increase of the largest single-day precipitation events across different seasons becomes apparent. In the SSP2-4.5 scenario, winter precipitation peaks increase progressively from 24.16 mm in the early period to 25.93 mm in the latter period, signalling potentially more severe winter storms. A similar incremental trend is observed in autumn, with values rising from 29.06 mm to 30.61 mm.

18.5.22 These trends indicate a pattern of intensifying precipitation events, particularly during the traditional wetter seasons of December to February and September to November. Under the more severe SSP3-7.0 scenario, these seasonal peaks are even more pronounced. For instance, the December to February precipitation increases slightly from 23.83 mm to 25.93 mm, while the September to November period sees an increase from 28.53 mm to a significant 31.14 mm by the last period. These observed increases in precipitation during the colder and transitional seasons could exacerbate flooding risks and necessitate enhanced infrastructural adaptations to manage increased water volumes. While summer months also experience increased precipitation, the rise is not as pronounced as in other seasons.

Table 9 Projected change in the average largest 1-day precipitation

Units: mm	2020-2039				2040-2059				2060-2079			
Scenario	Dec - Feb	Mar-May	Jun-Aug	Sep-Nov	Dec - Feb	Mar-May	Jun-Aug	Sep-Nov	Dec - Feb	Mar-May	Jun-Aug	Sep-Nov
SSP2-4.5	24.16	22.76	26.79	29.06	25.09	23.2	27.39	29.52	25.93	23.2	27.77	30.61
SSP3-7.0	23.83	22.62	26.15	28.53	24.81	22.48	27.72	30.13	25.93	23.11	26.76	31.14

Sea level

18.5.23 Global sea levels have risen by about 0.20m between 1901 and 2018, with the rate of increase accelerating in recent decades. In Ireland, satellite data show that sea levels have risen by approximately 2-3mm per year since the early 1990s (Climate Ireland, 2023). These figures illustrate a notable escalation in the rate of sea level rise, correlating closely with increased greenhouse gas emissions and resultant global warming, which causes both the thermal expansion of the oceans and the melting of ice sheets and glaciers.

18.5.24 Flood risk assessments (FRA) can be found in the Water (Hydrology, Hydrogeology, and Flood Risk) Technical Baseline Report and the OES FRA. The FRA had regard to sea level rise, intense rainfall events and the risk of river and coastal flooding.

Extreme weather

18.5.25 Changing climate patterns are thought to increase the frequency of extreme weather conditions such as droughts, floods, and storms. Warmer weather places pressure on flora and fauna which cannot adapt to a rapidly changing environment. The Major Accidents and Disasters Chapter provides an overview of current climate and extreme weather events experienced in Counties Dublin and Wicklow. The current climate and extreme weather events experienced in the Counties primarily relate to flooding but also drought, high temperatures, storms, and cold spells, particularly in recent years.

18.5.26 The EPA (2019) Irish Climate Futures: Data for Decision Making report states that it is expected that such weather extremes will become more likely and more frequent with future climate change.

Acidification of the sea

18.5.27 Rising atmospheric CO_2 levels have influenced ocean acidification (OA) and climate change, distinguishing OA as a chemical alteration of seawater rather than a direct climatic effect. Since the industrial revolution, the increase in CO_2 has led oceans to absorb more CO_2, disrupting their chemical balance and lowering the pH of the ocean.

18.5.28 Ocean acidification is increasingly recognised as a growing threat to marine ecosystems in Irish waters. The absorption of excess atmospheric CO_2 by the ocean is lowering the pH levels of seawater, a process that has been ongoing since the industrial revolution. According to the Irish Ocean Climate and Ecosystem Status Report 2023 (Marine Institute, 2023), this process is accelerating, with Irish coastal waters experiencing noticeable changes in acidity. Recent studies indicate that ocean acidification is having significant impacts on marine species, particularly those with calcium carbonate shells, such as molluscs and crustaceans, which are vital to marine biodiversity and fisheries. Furthermore, the Marine Institute (2023) highlights that regions such as the west coast of Ireland, which are influenced by nutrient-rich waters, may be particularly vulnerable.

18.5.29 The historical context provided by the Paleocene-Eocene Thermal Maximum (PETM) highlights the severe ecological impacts such shifts can have, underscoring the critical nature of this change and the potential consequences for marine life, particularly calcifying organisms that form the base of the ocean food web.

18.5.30 With the rate of atmospheric CO_2 increasing, and expected to continue rising under various climate scenarios, there is historical climatic evidence to suggest that more CO_2 leads to increased ocean acidification.

18.6 Defining the sensitivity of the baseline

18.6.1 The sensitivity for the receptors for each potential effect, using the criteria outlined in section 18.4, are presented in Table 15 to Table 17.

18.7 Uncertainties and technical difficulties encountered

18.7.1 Assumptions that have been made for the GHG assessment are detailed in the GHG Assessment Report.

18.8 Scope of the assessment

GHG assessment

18.8.1 All GHG emissions arising from Dublin Array will be assessed through the lifecycle assessment (LCA), as per the IEMA Guidance (2022). Direct emissions from activities taking place within the Dublin Array, including the construction, operation, decommissioning, indirect emissions from activities outside of Dublin Array, and embodied carbon within construction materials are all considered as part of the study area for the GHG impact assessment.

18.8.2 The goal and scope of the assessment were framed by key considerations reproduced in Table 10.

Table 10 Scope of GHG assessment

Topic	Decision
Study goal:	To determine the GHG emissions from the lifetime operations of Dublin Array, and to compare them with emissions that would otherwise arise from generating the same electricity.
Scenarios:	Sixty scenarios, considering deployment of three combinations of turbine sizes and numbers, five WTG foundation types, and four OSP foundation types.
Time:	Based in the near present and so using current estimations of material production impacts.
Geography:	Located in the Republic of Ireland, but also cognisant of materials sourced from a global supply base.
Functional unit:	Calculations to initially determine the total emissions across the lifetime of the installation, then factor in the total electricity produced to scale emissions to a carbon intensity of generation, in grams of CO_2/kilowatt hours (gCO_2/kWh).
Impact criteria:	Only global warming potential (climate change) over a 100-year timeframe was considered in this study.
Data sources:	Detailed in Section 3.0 of the GHG Assessment Report – a combination of primary data from the developers and literature data.
Life-cycle stages:	All life cycle stages, from cradle to grave.

Scoped in

18.8.3 The following impacts will be assessed:

- Construction, operation, maintenance, and decommissioning;
  - Impact 1: GHG emissions throughout the lifetime of the project.

Scoped out

18.8.4 A cumulative effects assessment of GHG emissions has been scoped out of the EIA for Dublin Array due to the expected net positive impact on reducing global GHG emissions. Offshore wind farms generate renewable energy, which displaces fossil fuel-based electricity generation, resulting in significant GHG savings over the project's operational lifetime.

18.8.5 Furthermore, cumulative GHG emissions are already addressed at a national and international level through policy frameworks, such as the EU Renewable Energy Directive and Ireland's CAP, which account for the cumulative benefits of renewable energy deployment in meeting climate targets. Assessing cumulative GHG impacts within an EIA is also inherently challenging due to the global and diffuse nature of GHGs, making it difficult to define meaningful boundaries for such an assessment.

Climate change resilience assessment

18.8.6 The CCR assessment assesses the potential impacts of climate change upon Dublin Array. The spatial scope of the assessment includes the offshore and onshore proposed infrastructure. The temporal scope of the assessment covers the construction, operation and maintenance, and decommissioning phases of Dublin Array. For the purposes of the CCR assessment, the construction phase is a 24-month period between 2029-2030, the operation phase is assumed to be 35 years (2030-2065), and the decommissioning phase is also assumed to be 24-months (2066-2067).

18.8.7 The receptors included in the CCR assessment have been grouped into the following categories:

- Offshore built assets and infrastructure;
- Onshore built assets and infrastructure; and
- Construction workers and site users/vessels.

18.8.8 The project components assessed within each of these categories include the following:

- Offshore built assets and infrastructure:
  - Between 39 and 50 WTGs and foundations;
  - Subsea inter array electricity cables;
  - OSPs; and
  - Offshore electricity export cables.
- Onshore built assets and infrastructure:
  - Landfall including the TJB;
  - O&M base;
  - Onshore electrical system this includes underground electricity transmission cables, associated fibre-optic communications cables, and the onshore substation.
- Construction workers and site workers/vessels, as follows:
  - Construction personnel;
  - Workers undertaking installation; and
  - Project vessels.

Scoped in

18.8.9 The following impacts will be assessed:

- Construction
  - Impact 2: Increased safety risk during construction due to high winds/high waves/heat exhaustion;
  - Impact 3: Health and safety risk due to increased possibility of fire e.g., due to overheating of fuel canisters;
  - Impact 4: Increased risk of slips, trips, and falls on board vessels from increased precipitation;
  - Impact 5: Flooding of construction sites along OES where trenching is used for ducts and cables; and
  - Impact 6: Increase in risk of coastal erosion or subsidence at landfall/TJB.
- Operation
  - Impact 7: Increased risk of coastal erosion from sea level rise;
  - Impact 8: Increased risk of flooding/tidal flooding at onshore infrastructure;
  - Impact 9: Land subsidence at landfall due to flooding or drought;
  - Impact 10: Failure of structure from Increased temperatures and frequency of heat waves;
  - Impact 11: Potential for increased temperature of energy storage units to require additional ventilation and cooling;
  - Impact 12: Risk of increases in wind activity affecting power output;
  - Impact 13: Risk of decreases in wind activity affecting power output;
  - Impact 14: Corrosion from increased humidity in the offshore environment;
  - Impact 15: Increased wind speed and wave height causing structural failure of offshore infrastructure;
  - Impact 16: Greater loads on offshore structure from sea level rise and increased wave height;
  - Impact 17: Exacerbation of scouring or structural damage offshore;

  - Impact 18: Greater seabed erosion from increased sea level and wave height;
  - Impact 19: Decrease in pH levels due to ocean acidification, which may exacerbate the effects of corrosion on offshore infrastructure;
  - Impact 20: Increased safety risk due to increases in wind speed and wave height;
  - Impact 21: Increased risk of heat exhaustion from increased temperatures; and
  - Impact 22: Increased risk of slips, trips, and falls from increased precipitation.
- Decommissioning
  - Impact 23: Increased risk of coastal erosion from sea level rise;
  - Impact 24: Increased risk of flooding/tidal flooding at the landfall;
  - Impact 25: Exacerbation of scouring or structural damage offshore;
  - Impact 26: Increased safety risk due to increases in wind speed and wave height;
  - Impact 27: Increased risk of heat exhaustion from increased temperatures; and
  - Impact 28: Increased risk of slips, trips, and falls from increased precipitation.

18.9 Key parameters for assessment

18.9.1 As set out in the Application for Opinion under Section 287B of the Planning and Development Act 2000, flexibility is being sought where details or groups of details may not be confirmed at the time of the Planning Application. In summary, and as subsequently set out in the ABP Opinion on Flexibility (detailed within Volume 2 Chapter 3: EIA Methodology) the flexibility being sought relates to those details or groups of details associated with the following components (in summary - see further detail in see the Project Description Chapter):

- WTG (model – dimensions and number);
- OSP (dimensions);
- Array layout;

- Foundation type (WTG and OSP; types and dimensions and scour protection techniques); and
- Offshore cables (IAC and ECC; length and layout).

18.9.2 To ensure a robust, coherent, and transparent assessment of the proposed Dublin Array project for which development consent is being sought under section 291 of the Planning Act, the Applicant has identified and defined a Maximum Design Option (MDO) and Alternative Design Option(s) (ADO) for each environmental topic/receptor. The MDO and ADO have been assessed in the EIAR to determine the full range and magnitude of effects, providing certainty that any option within the specified parameters will not give rise to environmental effects more significant than that which could occur from the MDO. The extent of significant effects is therefore defined and certain, notwithstanding that not all details of the proposed development are confirmed in the application.

18.9.3 The range of parameters relating to the infrastructure and technology design allow for a range of options in terms of construction methods and practices, which are fully assessed in the EIAR. These options are described in the Project Description Chapter and are detailed in the MDO and ADO tables within each offshore chapter of the EIAR. This ensures that all aspects of the proposed Dublin Array project are appropriately identified, described and comprehensively environmentally assessed.

18.9.4 In addition to the details or groups of details associated with the components listed above (where flexibility is being sought), the confirmed design details and the range of normal construction practises are also assessed within the EIAR (see the Project Description Chapter). Whilst flexibility is not being sought for these elements (for which plans and particulars are not required under the Planning Regulations), the relevant parameters are also incorporated into the MDO and alternative option(s) table (Table 12) to ensure that all elements of the project details are fully considered and assessed.

18.9.5 With respect to project design features where flexibility is not being sought, such as trenchless cable installation methodology at the landfall, the MDO and ADO(s) are the same (as there is no alternative). With respect to the range of normal construction practises that are intrinsic to installation of the development, such as the nature and extent of protection for offshore cables and the design of cable crossings, but which cannot be finally determined until after consent has been secured and detailed design is completed, the parameters relevant to the receptor being assessed are quantified, assigned and assessed as a maximum and alternative, as informed by the potential for impact upon that receptor. In the event of a favourable decision on the application they will be agreed prior to the commencement of the relevant part of the development by way of compliance with a standard 'matters of detail' planning condition (see Volume 2, Chapter 2: Consents, Legislation, Policy and Guidance). Throughout, an explanation and justification is provided for the MDO and alternative(s) within the relevant tables, as it relates the details or groups of details where statutory design flexibility is being sought, and wider construction practises where flexibility is provided by way of planning compliance condition.

18.9.6 Given the sixty potential scenarios (3 layout options, five WTG foundation scenarios and four OSP foundation scenarios) for the GHG assessment, there are also sixty potential scenarios for the climate change results. Only the best-case (lowest emissions) and worst-case (highest emissions) combinations of options are presented for each scenario, which can be defined as the MDO and ADO, respectively. These scenarios are detailed in Table 11.

Table 11 Least impact and greatest impact foundation option combinations for each scenario

Scenario	Layout option A	Layout option B	Layout option C
Best case	WTG option 4	WTG option 4	WTG option 4
	OSP option 3	OSP option 3	OSP option 3
Worst case	WTG option 3	WTG option 3	WTG option 3
	OSP option 4	OSP option 4	OSP option 4

Table 12 Design scenarios assessed in GHG assessment and CCR assessment

Maximum design option	Alternative design options	Justification
GHG Assessment		
Impact 1: GHG emissions throughout the lifetime of the project (including construction, operation and decommissioning)		
Option A: 50 WTGs Jacket & pin-pile and steel, 4 leg structure wind turbine generator foundations, and jacket and grout OSP foundations.	Option B: 45 WTGs Jacket & pin-pile and grout, 4 leg structure wind turbine generator foundations, and monopile and grout OSP foundations.	The GHG assessment considered all 60 scenarios, arising from the three turbine array scenarios, five WTG foundation options, and four OSP foundation options (detailed in the GHG Appendix Report). The MDO represents the worst-case scenario with the highest GHG emissions as per the GHG assessment. Rather than listing all 59 ADOs, the best-case scenario with the lowest GHG emissions is presented in this chapter, ensuring that the full range of potential impacts is transparently assessed.
CCR Assessment		
Impact 2: All effects of potential climate change on the resilience of the project during construction, operation/maintenance, and decommissioning		
Option A: 50 WTGs	Option B: 45 WTGs Option C: 39 WTGs	The MDO (Option A: 50 WTGs) is selected for the CCR assessment to ensure a robust evaluation. While differences between design options are negligible, assessing the highest number of WTG's accounts for the scenario with the greatest number of components potentially exposed to climate impacts during construction, operation/maintenance, and decommissioning. This precautionary approach ensures resilience is thoroughly evaluated under the most extensive design.

18.10 Project Design Features and Other Avoidance and Preventative Measures

18.10.1 As outlined within the EIA Methodology Chapter (Volume 2, Chapter 3) and in accordance with the EPA Guidelines (2022), this EIAR describes the following:

- Project Design Features: These are features of the Dublin Array project that were selected as part of the iterative design process, which are demonstrated to avoid and prevent significant adverse effects on the environment in relation to benthic, subtidal and intertidal ecology. These are presented within Table 13.
- Other Avoidance and Preventative Measures: These are measures that were identified throughout the early development phase of the Dublin Array project, also to avoid and prevent likely significant effects, which go beyond design features. These measures were incorporated in as constituent elements of the project, they are referenced in the Project Description Chapter of this EIAR, and they form part of the project for which development consent is being sought. These measures are distinct from design features and are found within our suite of management plans. These are also presented within Table 13.
- Additional Mitigation: These are measures that were introduced to the Dublin Array project after a likely significant effect was identified during the EIA assessment process. These measures either mitigate against the identified significant adverse effect or reduce the significance of the residual effect on the environment.

18.10.2 All measures are secured within Volume 8, Schedule of Commitments.

Table 13 Project design measures relating to climate change

Project phase and parameter	Project design measures embedded into the project
General	
Site selection	As detailed in Volume 2, Chapter 5: Alternatives Considered, several sites were considered as part of the site selection process. Kish Bank and Bray Bank have been selected as the proposed location of Dublin Array due to the suitable water depths and wind resource at the site, ensuring efficient energy generation and enhancing the project's resilience to climate change.
Cable specification and installation plan (CSIP)	Development of, and adherence to, a CSIP, relating to the offshore ECC, post consent. The CSIP will set out appropriate cable burial depth in accordance with industry good practice, minimising the risk of cable exposure. The CSIP will be conditioned in the deemed Marine Licence. This will minimise the risk of cable exposure, reducing maintenance

Project phase and parameter	Project design measures embedded into the project
	needs and associated emissions, whilst also protecting the cables from climate-related impacts such as seabed erosion.
Cable burial	Effective cable burial will optimise the chance of cables remaining buried whilst seeking to limit the amount of sediment disturbance to that which is necessary, enhancing resilience of cables against climate impacts.
Marine coordination for project vessels	Efficient marine coordination will be implemented to manage project vessels and proximity to wildlife, as per the principles set out in the Navigation and Installation Plan (NIP) and Working in Proximity to Wildlife. This will minimise environmental impact and emissions from vessel operations. Advance warnings help avoid disruptions and potential emissions from rerouting.
Construction	
Health and safety protocols	Real-time weather monitoring and advance warnings for extreme conditions will be implemented. Personal protective equipment and non-slip footwear will be provided to prevent heat exhaustion and slips. Fire safety measures, including fire-resistant materials and suppression systems, will be implemented. Regular health checks will be conducted, and hydration and rest breaks for workers will be ensured. Sites will be managed with effective drainage systems to prevent flooding. Clear communication channels for weather updates and emergency instructions will be maintained. These measures will enhance worker safety and resilience to climate impacts by addressing various health and safety risks associated with climate change.
Operation	
General	Design parameters for project components are designed to accommodate maximum temperature scenarios.
Scour Protection Management Plan	Development of a Scour Protection Plan which will consider the need for scour protection where there is the potential for scour to develop around wind farm infrastructure, including turbine and substation/platform foundations and cables. The plan will be secured via a condition in the deemed Marine Licence.
Decommissioning	
Decommissioning and Restoration Plan	A Decommissioning and Restoration Plan has been included in Volume 7, of the EIAR. The Decommissioning and Restoration Plan includes three rehabilitation schedules, one for each Maritime Area Consent. The decommissioning plans for the offshore infrastructure at Dublin Array will be regularly reviewed and updated to reflect advancements in scientific and technological knowledge, as well as changes in best practices and regulatory requirements. This ensures that the decommissioning process remains effective and environmentally responsible.

18.10.3 Decommissioning practices will incorporate measures similar to the construction phase to minimise GHG emissions and improve climate resilience. Good practice measures would be employed during decommissioning and would be agreed with statutory authorities at the time of decommissioning through a decommissioning plan. The final approach to decommissioning has not yet been confirmed in recognition of the likelihood of changes to best-practice, rules, and legislation between now and the projected decommissioning phase of the project. Therefore, definite mitigation measures for this phase cannot be specified at this stage. However, a decommissioning plan would be required to be submitted prior to decommissioning. This will include mitigation measures designed to encourage lower-carbon and more climate resilient methods.

18.11 Environmental assessment: Construction phase

18.11.1 This section presents the GHG assessment for the entire project lifecycle—construction, operation, and decommissioning—alongside the climate change resilience assessment for the construction phase. The GHG assessment cannot be effectively or meaningfully divided across individual phases due to overlapping sources, shared infrastructure, and the interconnected nature of emissions throughout the project's lifecycle. By considering the full scope of the project, the assessment ensures a comprehensive understanding of its overall contribution to greenhouse gas emissions.

GHG assessment

Impact 1: GHG emissions throughout the lifetime of the project

18.11.2 The Intergovernmental Panel on Climate Change in Renewable Energy Sources and Climate Change Mitigation (2014) state that 50 estimates from 20 studies indicate that emissions associated with the lifecycle of WTGs *'are small compared to the energy generated and emissions avoided over the lifetime of wind power plants [farms]: the GHG [greenhouse gas] emissions intensity of wind energy is estimated to range from 8 to 20g CO2/kWh in most instances'*. The IPCC (2010) reports that, based on lifecycle assessment procedures, the energy payback time for turbines typically ranges between 3.4 and 8.5 months in most cases. More recently, a life cycle assessment in 2022 for a wind turbine installed in Brazil found an energy payback time of about 6 months[2]. Vestas, a leader in sustainable energy currently states on their website (as of January 2025) an energy payback for wind energy of 5 to 8 months[3].

[2] According to https://www.frontiersin.org/journals/sustainability/articles/10.3389/frsus.2022.1060130/full
[3] According to https://www.vestas.com/en/sustainability/environment/energy-payback

18.11.3 The amount of CO_2 that could potentially be avoided on an annual basis due to Dublin Array was estimated based on the expected output of the proposed development. The net displacement value may increase or decrease, as the energy generation mix in Ireland changes under different fuel price scenarios, as demand changes over time, and as more storage, interconnection, and demand side management (smart meters) come online.

18.11.4 For the GHG assessment, the construction phase of Dublin Array was broken down into life cycle stages for quantifying the carbon impacts: raw materials, manufacturing, transport, and installation. Further detail of the activities and materials included, and the resultant impacts can be found in the GHG Assessment Report. The carbon emissions from the construction of Dublin Array are estimated to be between 2.3 and 3.3 million tonnes of CO_2 equivalent. This effect to climate is considered slight, negative and long term.

18.11.5 The impact assessment considered the positive impacts Dublin Array will have on contributing to national targets for the reduction of greenhouse gas emissions. Dublin Array will result in the production of energy from a renewable source which has the potential to avoid over one million tonnes of CO_2 annually that would have been released had the energy been generated by gas. This calculation is based on typical offshore wind capacity factors for the East coast of Ireland (40–50%) and the CO_2 intensity of Combined Cycle Gas Turbine (CCGT) (~371 gCO_2/kWh), the estimated annual energy production and associated CO_2 emissions avoidance for the proposed scenarios align with published industry benchmarks (Energy Ireland, 2023, SSE Renewables, 2020, Wind Energy Ireland, 2023, DUKES, 2023). Gas is the dominant energy source in the Irish power generation mix and is therefore expected to be the energy source that Dublin Array is replacing.

18.11.6 The expected amount of electricity that Dublin Array will generate annually, will range from 3,020 to 3,261 GWh/yr. These values were used for the highest and lowest impact scenarios, respectively. These estimates are based on an assumed load factor of 45%. To assess the potential variation in this assumption, alternative scenarios were developed with different load factors, exploring both optimistic and conservative estimates.

18.11.7 Alternative load factors of 40% (based on a load factor for Irish wind energy stated by SSE Renewables; SSE Renewables, 2020) and 50% (based on a load factor for Irish wind energy stated by Wind Energy Ireland; Wind Energy Ireland, 2023) were selected for analysis. Reducing the assumed load factor from 45% to 40% extends the carbon payback period to 3.4 years for the highest impact scenario, indicating minimal impact on the overall outcome. To explore a more extreme possibility, the annual electricity production was halved to 1,478 GWh/yr. Even with this significant reduction, Dublin Array will still achieve carbon payback after 6.0 years of operation. These reduced load factor and electricity production scenarios were also applied to the lowest impact scenario. Reducing the load factor to 40% increases the payback period to 2.2 years, again showing a limited effect on results. Halving the annual electricity production to 1,597 GWh/yr results in a carbon payback period of 3.9 years. Conversely, evaluating a higher load factor for Dublin Array of 50% for both scenarios shortened the carbon payback period to 2.7 years for the highest impact scenario and 1.8 years for the lowest impact scenario.

18.11.8 As improvements in sustainability and recycling measures are progressed throughout the construction industry it is expected that the embodied carbon calculated as part of this assessment can be taken as a worst case, as with time this figure will improve. In addition, the embodied carbon is calculated on the basis that all emissions occur over one year, a worst-case consideration.

Climate change resilience assessment

18.11.9 It is anticipated that the offshore construction duration could range from 18 months to 30 months. The installation of the OES, excluding surveys and site preparation, is anticipated to take approximately 36 months, with construction of the OES commencing approximately 12 months before the offshore works. The differences between the baseline conditions from 1981-2001 and the projected conditions for 2040 demonstrate that Dublin Array will be subject to climate change impacts over this period, however, the severity of these changes are lesser than those projected for 2040 to 2070. Whilst the construction phase of Dublin Array will be exposed to some climate impacts, in particular increased annual temperatures combined with decreased summer precipitation and increased winter precipitation, the magnitude of the impact will be lesser than in the operational phase. Consequently, the potential effects are less severe than in later phases and will be mitigated through embedded measures such as through the adoption of safe working practices.

18.11.10 The results of the CCR assessment for the construction phase are presented in Table 14. All identified effects were deemed to be of negligible significance for this phase of Dublin Array.

Table 14 CCR of Dublin Array during construction

Potential impact	Climate variable(s)	Receptor	Project design measures	Sensitivity	Magnitude	Significance
Impact 2a: Increased safety risk during construction due to high winds.	Increased wind speed.	Construction workers and site users/vessels.	Safe working practices will be employed for all construction activities.	Low	Negligible	Negligible
Impact 2b: Increased safety risk during construction due to high waves.	Increased wave height.		Safe working practices will be employed for all construction activities.	Low	Negligible	Negligible
Impact 2c: Increased risk of heat exhaustion for construction workers.	Increased temperatures and frequency of heat waves.		Safe working practices will be employed for all construction activities.	Low	Negligible	Negligible
Impact 3: Health and Safety risk due to increased possibility of fire e.g., due to overheating of fuel canisters.	Increased temperatures and frequency of heat waves.		Appropriate measures for safe storage and handling of fuel and other flammable liquids in accordance with applicable regulations will be employed for all construction activities.	Low	Negligible	Negligible
Impact 4: Increased risk of slips, trips, and falls on board vessels.	Increased precipitation, especially in winter months.		Safe working practices will be employed for all construction activities.	Low	Negligible	Negligible
Impact 5: Flooding of construction sites along OES impacting excavation sites where trenching is used for ducts and cables.	Increased precipitation and frequency of heavy rainfall events.	Onshore built assets and infrastructure	Drainage measures with suitable allowance will be designed out the principles to minimise water within the	Low	Negligible	Negligible

Potential impact	Climate variable(s)	Receptor	Project design measures	Sensitivity	Magnitude	Significance
			trench and ensure ongoing drainage of surrounding land.			
Impact 6: Increased coastal erosion could impact construction works on landfall infrastructure.	Sea level rise, wave height and storm surges.		Trenchless installation techniques have been chosen at the landfall, which will run underneath the cliff and avoid any direct interaction with the cliff face. Further details can be found in the Land, Soils and Geology Chapter.	Low	Negligible	Negligible

18.12 Environmental assessment: Operational phase

GHG assessment

18.12.1 During operation of Dublin Array, routine maintenance will be required, including in order to keep it in good working order throughout the lifetime. It is anticipated that Dublin Array will consume a low level of grid electricity throughout operation across its lifetime and require routine replacement components and materials. Assumptions have been made regarding the level of consumption and hence carbon impacts. Further details on transportation movements and assumptions are presented in the GHG Assessment Report.

18.12.2 The impact assessment considered the positive impacts Dublin Array will have on contributing to national targets for the reduction of GHG emissions. Dublin Array will result in the production of energy from a renewable source which has the potential to avoid over a million tonnes of CO_2 annually that would have been released had the energy been generated by gas. This calculation is based on typical offshore wind capacity factors for the East coast of Ireland (40–50%) and the CO_2 intensity of CCGT (~371 gCO_2/kWh), the estimated annual energy production and associated CO_2 emissions avoidance for the proposed scenarios align with published industry benchmarks (Energy Ireland, 2023, SSE Renewables, 2020, Wind Energy Ireland, 2023, DUKES, 2023). Gas is the dominant energy source in the Irish power generation mix and is therefore expected to be the energy source that Dublin Array is replacing.

Climate change resilience assessment

18.12.3 The operational phase is planned to take place over a 35-year period between 2030 and 2065. The projected variables for 2040 and for 2070 are therefore both relevant to this phase. Once operational, Dublin Array will require regular maintenance throughout its lifetime. The effects of climate change over this period may disrupt operations through the potential increase in the likelihood and/or magnitude of extreme weather events.

18.12.4 The results of the CCR assessment for the operation phase are presented in Table 15. All identified effects were deemed to be of negligible to minor significance for this phase of Dublin Array.

Table 15 CCR of Dublin Array during operation

Potential impact	Climate variable(s)	Receptor	Project design measure	Sensitivity	Magnitude	Significance
Impact 7: Coastal erosion of the cliffs at Shanganagh from sea level rise, which could impact the integrity of landfall infrastructure such as the ducts installed using trenchless techniques (e.g. HDDs) and transition joint bays.	Sea level rise, wave height and storm surges.	Onshore built assets and infrastructure	Trenchless techniques will be used to install the connection between the offshore export cable and the TJB to avoid direct interaction with the cliff face and ensure the physical integrity of the cliff remains intact. Comprehensive assessments of these impacts are included in the Land, Soils and Geology Chapter.	Low	Medium	Minor
Impact 8: Increased risk of flooding/tidal flooding at the landfall/TJB.	Sea level rise, wave height, storm surges and increased precipitation.		The landfall/TJB is located in Flood Zone C, indicating a low risk of flooding. The infrastructure is designed to be water compatible, meaning it can withstand water exposure. Coastal flood maps show limited flooding near the Shanganagh River, but no development is planned in these areas. Trenchless directional drilling will be used to avoid exacerbating coastal flood risks, ensuring	Low	Negligible	Negligible

Potential impact	Climate variable(s)	Receptor	Project design measure	Sensitivity	Magnitude	Significance
			the project's resilience to flooding and tidal events. Details of the flood risk assessment are set out in the Water Chapter.			
Impact 9: Risk of land subsidence due to flooding or drought causing damage to onshore infrastructure.	Increased precipitation and increased temperatures.		The landfall, and onshore substation are located within Flood Zone C, low risk of flooding. A small area at the north-western boundary of the O&M Base is within Flood Zone A (although no development is proposed within this area).	Low	Negligible	Negligible
Impact 10: Potential for some structures to fail to operation within original design parameters due to increased heat.	Increased temperatures and frequency of heat waves.	Offshore built assets and infrastructure	The design process considers the impact of climate change on maximum temperature capacity and ensures that appropriate parameters are embedded into the design. It is also noted that times of peak energy production are likely to be correlated with periods of lower temperatures.	Low	Negligible	Negligible
Impact 11: Increased temperature of energy storage units requiring ventilation and cooling.	Increased temperatures.		The project design will incorporate equipment with temperature resilience suitable for future climatic	Low	Negligible	Negligible

Potential impact	Climate variable(s)	Receptor	Project design measure	Sensitivity	Magnitude	Significance
			conditions, ensuring safe and efficient operation. Further details can be found in the Project Description Chapter.			
Impact 12: Disruption to energy production due to high wind speed above the cut-out wind speed	Increased wind speed.		Wind turbine power curves and rotor diameter can be varied to suit different wind regimes. Project design has not yet been finalised so that final wind turbine choice can consider predicted changes in windspeeds and take advantage of expected technology developments.	Low	Negligible	Negligible
Impact 13: Disruption to energy production due to low wind speed below the cut-in wind speed.	Decreased wind speed.		Wind turbine power curves and rotor diameter can be varied to suit different wind regimes. Project design has not yet been finalised so that final wind turbine choice can consider decreases in future wind speeds and take advantage of expected technology developments.	Low	Negligible	Negligible
Impact 14: Increased humidity combined with	Increased humidity.		The WTGs and Foundations will have corrosion	Low	Negligible	Negligible

Potential impact	Climate variable(s)	Receptor	Project design measure	Sensitivity	Magnitude	Significance
saltwater in the offshore environment could accelerate corrosion, formation of condensation, and mould/microbial contamination, damaging the WTGs.			protection and cathodic protection systems to control and limit corrosion. In addition, WTGs typically have internally dehumidification systems.			
Impact 15: Fatigue damage from loading may result in structural failure due to the propagation of small cracks over the design life of an WTG or Foundation, which could grow to a critical size, threatening the integrity of the structure.	Increased wind speed and wave height.		Extreme and operational environmental parameters applied in design will consider changes due to climate change. Structures will be subject to routine inspections. Overall average wind speeds are predicted to decrease so while higher extremes may need considered in fatigue the impact is likely to be low.	Low	Negligible	Negligible
Impact 16: Greater environmental loads due to the increased heights at which tidal and wave loads act on the structures.	Sea level rise and increased wave height.		Predicted sea level rise across the lifetime of Dublin Array is accounted for in the design process.	Low	Negligible	Negligible
Impact 17: Sea level rise altering hydrodynamics of ocean environment leading to exacerbation of scouring.	Sea level rise.		Scour around foundations to be mitigated by the use of scour protection measures where assessed as required during design. Routine	Low	Low	Minor

Potential impact	Climate variable(s)	Receptor	Project design measure	Sensitivity	Magnitude	Significance
			inspections will be conducted, and repair/replenishment of scour protection has been considered.			
Impact 18: Increased sea level and wave height can lead to greater seabed erosion, exposing offshore cables to physical damage and increasing the likelihood of faults.	Sea level rise and increased wave height.		The design process considers the impact of climate change on changes in the marine environment and ensures that appropriate parameters are in the design.	Low	Negligible	Negligible
Impact 19: Decrease pH levels indicate an increase in ocean acidification, which may exacerbate the effects of corrosion on offshore project components such as: WTGs, Floating Foundations, Mooring and Anchoring and Offshore Export and Inter-Array cables.	Decreased pH levels		Corrosion protection systems such as cathodic protection, sacrificial protection, or Impressed Current cathodic protection (ICCP) coatings are embedded into the design of the project components.	Low	Negligible	Negligible
Impact 20a: Increased safety risk during operation and maintenance due to high winds.	Increased wind speed.	Construction workers and site users/vessels	Safe working practices will be employed for all operation and maintenance activities.	Low	Negligible	Negligible

Potential impact	Climate variable(s)	Receptor	Project design measure	Sensitivity	Magnitude	Significance
Impact 20b: Increased safety risk in relation to operation and maintenance procedures due to high waves.	Increased wave height.		Safe working practices will be employed for all operation and maintenance activities.	Low	Negligible	Negligible
Impact 21: Increased risk of heat exhaustion for workforce involved in operation and maintenance.	Increased temperatures and frequency of heat waves.		Safe working practices will be employed for all operation and maintenance activities.	Low	Negligible	Negligible
Impact 22: Increased risk of slips, trips, and falls on board vessels.	Increased precipitation, especially in winter months.		Safe working practices will be employed for all operation and maintenance activities.	Low	Negligible	Negligible

18.13 Environmental assessment: Decommissioning phase

GHG assessment

18.13.1 Dublin Array decommissioning activities have the potential to generate carbon emissions, primarily from activities such as the dismantling and removal of turbines, offshore platforms, and associated infrastructure, as well as transportation and waste management processes. If components are refurbished or replaced, emissions may arise from the energy and resources required for these activities. The complete methodology applied for the GHG assessment can be found in the GHG Assessment Report, which includes an evaluation of the decommissioning phase, considering the transportation and management of materials at the end of their life.

18.13.2 The intensity and duration of emissions during decommissioning are expected to be lower than those associated with the construction phase. This is because decommissioning primarily involves the removal and transportation of existing materials rather than the production and installation of new materials. The GHG Assessment Report concludes that the primary burden at the decommissioning stage is the freight impacts, as materials are transported to recycling or disposal facilities. Consequently, the overall impact is anticipated to result in slight, negative, long-term effects.

18.13.3 These negative effects during decommissioning will be offset by the significant carbon savings achieved during the operational phase, by the renewable energy displacing fossil fuel-based electricity generation, avoiding substantial GHG emissions. Furthermore, opportunities to reuse or recycle components, such as steel from WTG's, will help to further minimise the carbon footprint of decommissioning activities, aligning with principles of the circular economy.

Climate change resilience assessment

18.13.4 The decommissioning phase will likely take place over a two-year period. For the purposes of the CCR assessment, this is assumed to be between 2066 and 2067. As with the operational phase, the projected variables for 2070 indicate a potential increase in the likelihood and/or magnitude of extreme weather events. It is possible therefore that the effects of climate change may cause some disruption to the decommissioning stage of Dublin Array.

18.13.5 The results of the CCR assessment for the decommissioning phase are presented in Table 16. The identified effects were deemed to be of negligible to minor significance for this phase.

Table 16 CCR of Dublin Array during decommissioning

Potential impact	Climate variable(s)	Receptor	Project design measure	Sensitivity	Magnitude	Significance
Impact 23: Coastal erosion from sea level rise could impact the integrity of landfall infrastructure such as the ducts installed using trenchless techniques (e.g. HDDs) and transition joint bays, potentially disrupting decommissioning works.	Sea level rise, wave height and storm surges.	Onshore built assets and infrastructure	Trenchless techniques will be used to install the connection between the offshore export cable and the TJB to avoid direct interaction with the cliff face and ensure the physical integrity of the cliff remains intact. Comprehensive assessments of these impacts are included in the Land, Soils and Geology Chapter.	Low	Medium	Minor
Impact 24: Flooding of landfall infrastructure and onshore export cables during decommissioning works.	Sea level rise and increased precipitation.		Decommissioning will be undertaken in accordance with best practice guidelines at the time and will include appropriate drainage measures where necessary.	Medium	Low	Minor
Impact 25: Exacerbation of scouring on offshore foundations may weaken stability of foundations impacting ease and safety of removal.	Increased wave height and tidal variability.	Offshore built assets and infrastructure	Piled foundations are expected to be cut approximately 2 m below the seabed and the upper section removed. Scour around foundations to be mitigated by the use of scour protection measures, where assessed as required during design. Routine inspections will be conducted, and	Low	Low	Minor

Potential impact	Climate variable(s)	Receptor	Project design measure	Sensitivity	Magnitude	Significance
			repair/replenishment of scour protection has been considered in the design. Decommissioning will be undertaken in accordance with best practice guidelines at the time and will take into consideration updated climate projections when considering appropriate scour decommissioning options.			
Impact 26a: Increased safety risk during decommissioning due to high winds.	Increased wind speed.		Safe working practices will be employed for all decommissioning activities.	Low	Negligible	Negligible
Impact 26b: Increased safety risk in relation to decommissioning procedures due to high waves.	Increased wave height.		Safe working practices will be employed for all decommissioning activities.	Low	Negligible	Negligible
Impact 27: Increased risk of heat exhaustion for workforce, including regular site users and construction workers involved in decommissioning.	Increased temperatures and frequency of heat waves.	Construction workers and site users	Safe working practices will be employed for all decommissioning activities.	Low	Negligible	Negligible

Potential impact	Climate variable(s)	Receptor	Project design measure	Sensitivity	Magnitude	Significance
Impact 28: Increased risk of slips, trips, and falls on board vessels.	Increased precipitation, especially in winter months.		Safe working practices will be employed for all decommissioning activities.	Low	Negligible	Negligible

18.14 Environmental assessment: Cumulative effects

GHG assessment

18.14.1 As outlined in section, cumulative effects in relation to GHG emissions have been scoped out of the assessment.

Climate change resilience assessment

18.14.2 It is recognised that, when considered in conjunction with neighbouring renewable energy projects, such as Codling offshore wind farm, Dublin Array will contribute to a combined mitigatory effect regarding the impacts of climate change. The cumulative contribution of these projects to carbon reduction commitments via their input of renewable energy into the grid will help to mitigate the impacts of climate change by lowering the levels of GHGs emitted through energy production. It is, however, not possible to directly link any resulting reductions in GHG emissions to the specific climate change impacts experienced by Dublin Array itself due to the global nature of climate change. Global emissions and the subsequent impacts of climate change are influenced by activities worldwide meaning that changes in climate impacts cannot be attributed to location-specific emission reductions. Similarly, emissions can be held in the atmosphere for extensive periods of time meaning that the temporal relationship between climate impacts and specific emission reductions is difficult to define. Consequently, cumulative effects have not been assessed as part of the CCR or ICCI assessment.

18.15 Interactions of the environmental factors

GHG assessment and climate change resilience assessment

18.15.1 Interrelated effects refer to the potential interaction between multiple impacts on one receptor. If a particular receptor is affected by multiple impacts arising from the same project in different ways, this may result in a more significant effect than when an impact is considered in isolation. In the context of climate change vulnerability and resilience, the projected impacts of climate change may interact with an effect already identified by another topic, resulting in a combined impact on a receptor with the potential to exacerbate the significance of the effect. These interacting impacts are referred to as in-combination climate impact (ICCI) effects.

18.15.2 The methodology for assessing ICCI effects follows the IEMA EIA guidance on Climate Change Resilience and Adaptation (IEMA, 2020).

18.15.3 Initial research for the assessment included a review of the EIA outcomes outlined in the other technical topic areas included elsewhere in the EIAR to confirm the likely environmental effects identified for each topic. The projections on future baseline conditions presented in section 18.5 were then used to inform an expert judgement on whether the significance of the identified effect would be greater or lesser due to projected changes to the climate when compared with existing baseline conditions.

18.15.4 Climate change related effects identified within the following chapters were considered to be negligible and therefore not significant in EIA terms, and have therefore not been considered within the in-combination impact assessment:

- Nature Conservation Chapter;
- Shipping and Navigation Chapter;
- Marine Infrastructure and Other Users Chapter;
- Aviation and Radar Chapter;
- Cultural Heritage Settings Assessment Chapter;
- Noise and Vibration Chapter;
- Socio-economic, Tourism, Recreation and Land Use Chapter;
- Major Accidents and Disasters Chapter;
- Human Health Chapter; and
- Air Quality Chapter.

18.15.5 The following chapters were included in the ICCI assessment due to their particular relevance to climate change and its potential direct impact on the identified issues:

- Marine Geology, Oceanography, and Physical Processes Chapter;
- Marine Water and Sediment Quality Chapter;
- Benthic Subtidal and Intertidal Ecology Chapter;
- Fish and Shellfish Ecology Chapter;
- Marine Mammals Chapter;
- Offshore Ornithology Chapter;
- Bats in the Offshore Environment Chapter;
- Commercial Fisheries Chapter;

- Marine Archaeology Chapter; and
- SLVIA Chapter.

18.15.6 As explained in section 18.10, project design features and other avoidance and preventative measures are considered when assigning the significance of an effect. The relevant measures for each topic area are outlined in the correlating topic chapter.

18.15.7 The outcomes of the ICCI assessment are presented in Table 17. The level of significance identified for all effects was deemed to be unchanged. This is in part due to many identified effects relating to the construction phase. The projections of climatic variables for 2040 indicate that climate change effects projected for the period of 2027-2030 when construction is planned to take place are not expected to be severe. Therefore, the conclusion is that climate change is not likely to exacerbate the environmental effects identified below.

Table 17 ICCI assessment of Dublin Array across its lifetime

EIA topic	Receptor(s)	Climate variable(s)	Potential impact	Change in significance
Marine Geology, Oceanography and Physical Processes Chapter.	Coast Annex I offshore sandbanks. Seabed areas contained within nationally or internationally important sites.	Sea level rise, storm surges, and wave height.	Changes in sand bank morphology, combined with coastal defences, may result in loss of intertidal habitats.	No changes limited changes to physical processes indicated, therefore no higher level of significance associated with effects on habitat availability.
Marine Water and Sediment Quality Chapter.	Water and sediment quality. Bathing waters.	Increased temperatures. Increased precipitation. Increased wind speeds.	Increase of contaminant concentrations in the water column. Affecting freshwater inputs to the marine environment. Affecting water clarity through changes in suspended particulate matter	No change as limited changes to physical processes indicated, therefore no higher level of significance associated with water clarity. Changes to freshwater inputs and contaminant concentrations are expected to be minimal due to onshore management of channels and the managed landscape.
Benthic Subtidal and Intertidal Ecology Chapter.	Sub-tidal and intertidal receptors. Ecological receptors e.g., sediment type. Designated site features e.g., sandbanks.	Increased temperatures. Sea level rise, storm surges and wave height.	Increased temperatures combined with decreases in pH levels may result in loss of habitat and place negative pressure on native species. Changes to sea levels and wave climate may increase pressures on intertidal habitats and native species through long term changes to habitat morphology.	No change as habitat cycles are shorter than long-term climate change effects.
Fish and Shellfish Ecology Chapter.	Valued ecological fish and shellfish.	Increased temperatures.	Increased temperatures may result in changes to population	No change as limited changes to physical processes and benthic

EIA topic	Receptor(s)	Climate variable(s)	Potential impact	Change in significance
	Designated site features (e.g., native oyster).	Sea level rise, storm surges and wave height.	distribution of substrate dependent species unable to adapt their distribution (e.g., herring and sand eel). Decreases in pH levels may impact population levels of calcifying species (e.g., shellfish). Sea level rise may impact habitat availability for some intertidal species and intertidal habitats. Potential impact on species who rely on brackish water for survival.	ecology indicated, therefore no higher level of significance associated with effects on habitat availability and intertidal fish and shellfish receptors. Increased temperatures may increase the vulnerability of fish and shellfish stocks; however, the expectation is that most species temperature ranges and shifts in food availability therefore there is no change in significance.
Marine Mammals Chapter.	Harbour porpoise. Grey seal. Harbour seal.	Increased temperatures. Sea level rise, storm surges and wave height.	Temperature increases may lead to geographic range shifts resulting in increased predation and competition risks and impacting prey availability. Changes in sea levels, storminess and wave height may limit haul-out sites for seals and pups.	No change as species range shifts over 10 to 25 years so it is not anticipated that there would be any change in marine mammal distribution during construction or operation and maintenance.
Offshore and Intertidal Ornithology Chapter.	Terrestrial sea birds. Marine sea birds.	Increased temperatures. Increased wind speed.	Affecting hatching success, chick growth and chick survival. Affecting the ability of adult birds to forage successfully	No change, Dublin Array is not expected to exacerbate impacts to marine food webs, therefore, no higher level of significance associated with successful foraging. Terrestrial climate change impacts to breeding success are likely to be relatively minor, with no higher level of significance expected.

EIA topic	Receptor(s)	Climate variable(s)	Potential impact	Change in significance
Bats in the Offshore Environment Chapter.	Bats species found within the study area.	Increased temperatures and heatwaves.	Affecting hibernation cycles, survival rates and range changes.	No change as species' range shifts are expected to mitigate the impacts of climate change in the long-term.
Commercial Fisheries Chapter.	Fish and shellfish stocks.	Increased temperatures. Storm surges.	Temperature changes could affect the abundance of fish and shellfish stocks in the commercial fisheries study area. Increased storminess could impact fishing activity in the study area e.g., by changing seasonal fishing patterns.	No change as habitat cycles and seasonal fishing patterns are shorter than long-term climate change effects
Marine Archaeology Chapter.	Marine heritage receptors e.g., shipwrecks, historic seascape characterisation, palaeolandscapes.	Sea level rise. Temperature increase. Storm surges and wave height.	Deeper water resulting from rising sea levels could result in collapse of receptors e.g., shipwrecks. Changes in sea temperatures combined with decreases in PH levels could increase rate of degradation of receptors through chemical and biological factors. Storminess and changes in wave climate could exacerbate seabed movement and increase rate of receptor degradation.	No change, any medium- and long-term climate impacts to offshore marine heritage receptors are unlikely to be realised during the lifetime of the project.
SLVIA Chapter	Seascape, landscape and visual receptors.	Increase in winter precipitation and decrease in summer precipitation. Increased temperatures and heat wave frequency.	Frequency of visibility of the Dublin Array at distance offshore may decrease during periods with increased precipitation and/or storm intensity. The effects of Dublin Array are assessed in	No change as projected climate impacts are considered unlikely to exacerbate or reduce the visual effects of the Dublin Array to any notable degree.

EIA topic	Receptor(s)	Climate variable(s)	Potential impact	Change in significance
		Sea level rise and heavy rainfall events.	optimum visibility conditions to ensure the worst-case is assessed. Flooding could impact the character of the coast and seascape.	

18.16 Transboundary statement

18.16.1 Dublin Array will have a net positive transboundary impact by contributing to the reduction of global GHG emissions. The renewable energy generated by Dublin Array will displace fossil fuel-based electricity generation, aligning with international commitments to combat climate change. The resulting GHG savings will contribute to global efforts to mitigate climate risks that extend across national borders. This reflects the interconnected nature of climate change and highlights the project's alignment with international climate policies and decarbonisation goals.

18.17 Summary of effects

GHG assessment

18.17.1 Dublin Array is anticipated to generate electricity with a carbon intensity of 32.0g/kWh for the maximum design scenario and 20.8g/kWh for the minimum design scenario, compared to the current marginal mix in Ireland of gas derived electricity with a carbon intensity of 371g/kWh. Overall, for both MDO and alternative scenarios, Dublin Array is deemed to be of beneficial significance regarding reduction of emissions compared to the baseline scenarios of gas CCGT by producing energy from a renewable source which has the potential to avoid over one million tonnes of CO_2 annually that would have been released had the energy been generated by gas.

18.17.2 The Dublin Array MDO Scenario would result in net emission reductions compared to the project baseline scenarios of 35 $MTCO_2e$ (Gas CCGT). Dublin Array ADO Scenario would result in net emission reductions compared to the project baseline scenarios of 39 $MTCO_2e$ (Gas CCGT). Dublin Array will provide a renewable source of electricity which will beneficially contribute to Ireland's goal of achieving net zero carbon emissions by 2050. Consequently, the effects of Dublin Array are deemed to be of beneficial significance regarding the reduction of GHG emissions, when compared to the above-described baseline scenarios, in accordance with the significance matrix in Table 3. This is considered to be significant in EIA terms.

Climate change resilience assessment

18.17.3 The assessment provided in this chapter has considered the resilience of Dublin Array to climate change and the exacerbating effect of climate change on other environmental receptors.

18.17.4 The approach taken was based upon the IEMA EIA Guide to Climate Change Resilience and Adaptation (IEMA, 2020), and the requirements of the Infrastructure Planning Environmental Impact Assessment Regulations (2017) (Department of Communities and Local Government, 2017).

18.17.5 A summary of the assessment outcomes is provided in Table 18. As concluded in the table, when considering the mitigation outlined the assessed significance of the identified effects varies from minor adverse to negligible and have not been considered in the ICCI assessment.

18.17.6 Furthermore, the outcomes of the ICCI assessment, as summarised in section 18.14, conclude that climate change is not likely to affect the conclusions made by other chapters contained within this EIAR.

Table 18 Summary of effects for climate change

Description of impact	Effect	Additional mitigation measures	Residual effect
Construction, operation, and decommissioning			
Impact 1: GHG emissions throughout the lifetime of the project	Beneficial	N/A	N/A
Construction			
Impact 2: Increased safety risk during construction due to high winds/high waves/heat exhaustion	Negligible	Not applicable – no additional measure identified	No significant adverse residual effects
Impact 3: Health and safety risk due to increased possibility of fire e.g., due to overheating of fuel canisters	Negligible	Not applicable – no additional measure identified	No significant adverse residual effects
Impact 4: Increased risk of slips, trips, and falls on board vessels from increased precipitation	Negligible	Not applicable – no additional measure identified	No significant adverse residual effects
Impact 5: Flooding of construction sites at landfall/TJB where trenching is used for ducts and cables	Negligible	Not applicable – no additional measure identified	No significant adverse residual effects
Impact 6: Increase in risk of coastal erosion or subsidence at landfall/TJB	Negligible	Not applicable – no additional measure identified	No significant adverse residual effects
Operation			
Impact 7: Increased risk of coastal erosion from sea level rise	Minor	Not applicable – no additional measure identified	No significant adverse residual effects
Impact 8: Increased risk of flooding/tidal flooding at the landfall	Minor	Not applicable – no additional measure identified	No significant adverse residual effects
Impact 9: Land subsidence at landfall due to flooding or drought	Minor	Not applicable – no additional measure identified	No significant adverse residual effects

Description of impact	Effect	Additional mitigation measures	Residual effect
Impact 10: Failure of structure from Increased temperatures and frequency of heat waves	Minor	Not applicable – no additional measure identified	No significant adverse residual effects
Impact 11: Potential for increased temperature of energy storage units to require additional ventilation and cooling	Minor	Not applicable – no additional measure identified	No significant adverse residual effects
Impact 12: Risk of increases in wind activity affecting power output	Negligible	Not applicable – no additional measure identified	No significant adverse residual effects
Impact 13: Risk of decreases in wind activity affecting power output	Minor	Not applicable – no additional measure identified	No significant adverse residual effects
Impact 14: Corrosion from increased humidity in the offshore environment	Minor	Not applicable – no additional measure identified	No significant adverse residual effects
Impact 15: Increased wind speed and wave height causing structural failure of offshore infrastructure	Negligible	Not applicable – no additional measure identified	No significant adverse residual effects
Impact 16: Greater loads on offshore structure from sea level rise and increased wave height	Negligible	Not applicable – no additional measure identified	No significant adverse residual effects
Impact 17: Exacerbation of scouring or structural damage offshore	Minor	Not applicable – no additional measure identified	No significant adverse residual effects
Impact 18: Greater seabed erosion from increased sea level and wave height	Minor	Not applicable – no additional measure identified	No significant adverse residual effects
Impact 19: Decrease in pH levels due to ocean acidification, which may exacerbate the effects of corrosion on offshore infrastructure	Negligible	Not applicable – no additional measure identified	No significant adverse residual effects
Impact 20: Increased safety risk due to increases in wind speed and wave height	Negligible	Not applicable – no additional measure identified	No significant adverse residual effects
Impact 21: Increased risk of heat exhaustion from increased temperatures	Minor	Not applicable – no additional measure identified	No significant adverse residual effects

Description of impact	Effect	Additional mitigation measures	Residual effect
Impact 22: Increased risk of slips, trips, and falls from increased precipitation	Negligible	Not applicable – no additional measure identified	No significant adverse residual effects
Decommissioning			
Impact 23: Increased risk of coastal erosion from sea level rise	Minor	Not applicable – no additional measure identified	No significant adverse residual effects
Impact 24: Increased risk of flooding/tidal flooding at the landfall	Minor	Not applicable – no additional measure identified	No significant adverse residual effects
Impact 25: Exacerbation of scouring or structural damage offshore	Minor	Not applicable – no additional measure identified	No significant adverse residual effects
Impact 26: Increased safety risk due to increases in wind speed and wave height	Negligible	Not applicable – no additional measure identified	No significant adverse residual effects
Impact 27: Increased risk of heat exhaustion from increased temperatures	Minor	Not applicable – no additional measure identified	No significant adverse residual effects
Impact 28: Increased risk of slips, trips, and falls from increased precipitation	Negligible	Not applicable – no additional measure identified	No significant adverse residual effects

18.18 Conclusion

18.18.1 The carbon emissions generated during the construction and decommissioning phases of the project will be rapidly offset by the substantial GHG savings achieved during the operational phase. It is estimated that these emissions will be neutralised within just 2 to 3 years of operation, highlighting the efficiency and low carbon footprint of offshore wind energy. Beyond this initial payback period, the project will deliver decades of renewable energy generation, displacing fossil fuel-based electricity and contributing significantly to national and international climate goals. Dublin Array will result in the production of energy from a renewable source which has the potential to avoid over one million tonnes of CO_2 annually that would have been released had the energy been generated by gas.

18.18.2 This reinforces the urgent need for offshore wind as a cornerstone of the transition to a low-carbon economy. Offshore wind farms not only provide a reliable and scalable source of clean energy but also play a critical role in reducing global carbon emissions, enhancing energy security, and mitigating the impacts of climate change. The Dublin Array project exemplifies how renewable energy infrastructure can drive meaningful, long-term, and positive contributions to addressing the climate crisis, ensuring a sustainable energy future for generations to come.

18.19 References

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Appendix A Legislation and policy context

Policy/legislation	Key provisions	How are the key provisions addressed
Legislation		
Directive (EU) 2023/2413 of the European Parliament and of the Council 18 October 2023 amending Directive (EU) 2018/2001, Regulation (EU) 2018/1999 and Directive 98/70/EC as regards the promotion of energy from renewable sources, and repealing Council Directive (EU) 2015/652.	The 2023 amendment to the Renewable Energy Directive strengthens measures to maximise renewable energy development, implements sector-specific targets, promotes electrification, facilitates permitting procedures, and reinforces sustainability criteria for bioenergy. It establishes an overall policy for the production and promotion of energy from renewable sources in the EU. It sets an overall renewable energy target of at least 42.5% binding at EU level by 2030 – but aims for 45%. A number of the provisions within the Directive were due to be transposed into Irish law in July 2024 and all of its remaining components are due to be transposed by May 2025.	Dublin Array aligns with the key provisions of the Renewable Energy Directive by contributing to the increased deployment of renewable energy sources, supporting the achievement of sector-specific targets, and facilitating the transition to a low-carbon energy system in line with EU climate objectives.
Directive 2014/52/EU of the European Parliament and of The Council of 16 April 2014 amending Directive 2011/92/EU on the assessment of the effects of certain public and private projects on the environment. The EIA Directive.	Article 3 states that the Environmental Impact Assessment shall identify, describe, and assess the direct and indirect significant effects of a project on the following factors: c) air and climate Annex IV states that the description of the project should include an estimate by type and quantity of expected residues and emissions. In addition, a description of the factors likely to be significantly affected by the project such as air and climate (for	This chapter presents the findings of the EIA concerning the potential impacts of Dublin Array on climate, and the projects resilience to climate during construction, operation and maintenance, and decommissioning.

Policy/legislation	Key provisions	How are the key provisions addressed
	example greenhouse gas emissions, impacts relevant to adaptation).	
Statutory		
National Energy and Climate Plan 2021-2030	Ireland's National Energy and Climate Plan 2021-2030 prioritizes renewable energy, energy efficiency, and climate action to accelerate the transition to a low-carbon economy.	Dublin Array aligns with the Plan by contributing to the increased share of renewable energy sources, enhancing energy security, and reducing greenhouse gas emissions. It supports the plan's objectives of promoting renewable energy deployment and transitioning to a low-carbon economy by harnessing wind energy to generate clean electricity. Additionally, offshore wind farms help diversify Ireland's energy mix, reduce reliance on fossil fuels, and advance towards achieving the Plan's targets for renewable energy generation and climate action.
Climate Action Plan 2024	The third annual update to Ireland's Climate Action Plan 2019 follows on from Climate Action Plan 2023 by refining and updating the measures and actions required to deliver Ireland's carbon budgets and sectoral emissions ceilings. It provides a roadmap for taking decisive action to halve Ireland's emissions by 2030 and reach net zero by no later than 2050, as committed to in the Climate Action and Low Carbon Development Act 2015, as amended. Specifically, CAP24 sets targets for renewable energy of: (i) achieving 9 GW of onshore wind, 8 GW of solar power, and at least 5 GW from offshore wind projects by 2030; and (ii) achieving an 80% share of renewable electricity by 2030.	Offshore wind farms directly support Ireland's Climate Action Plan 2024 by advancing renewable energy goals and reducing greenhouse gas emissions. They are a key component of Ireland's transition to a low-carbon economy, providing clean, sustainable energy and contributing to energy security.

Policy/legislation	Key provisions	How are the key provisions addressed
Climate Action and Low Carbon Development Act 2015, as amended	The Climate Action and Low Carbon Development Act 2015, as amended: ▪ Provides a statutory basis a 'national climate objective', which commits to pursue and achieve no later than 2050, the transition to a climate resilient, biodiversity-rich, environmentally sustainable, and climate-neutral economy. ▪ The carbon budgeting process is now law, requiring government to adopt a series of economy-wide five-year carbon budgets, including sectoral targets for each relevant sector, on a rolling 15-year basis, starting in 2021. ▪ A National Long Term Climate Action Strategy will be prepared every five years. ▪ Provides that the first two five-year carbon budgets proposed by the Climate Change Advisory Council should equate to a total reduction of 51% emissions over the period to 2030, in line with the Programme for Government commitment. ▪ Introduces a requirement for each local authority to prepare a CAP, which will include both mitigation and adaptation measures and be updated every five years in alignment with the CAP. ▪ s.15(1) of the Act requires that a relevant body 'shall, insofar as practicable, perform its functions in a manner consistent with - (a) the most recent approved CAP, (b) the most	Dublin Array directly supports Ireland's Climate Action and Low Carbon Development Act, 2015 (as amended) by providing clean, renewable energy and contributing to the nation's ambitious climate targets. This specifically advances the particular requirements of section 15(1) of the Act.

Policy/legislation	Key provisions	How are the key provisions addressed
	recent approved national long term climate action strategy, (c) the most recent approved national adaptation framework and approved sectoral adaptation plans, (d) the furtherance of the national climate objective, and (e) the objective of mitigating greenhouse gas emissions and adapting to the effects of climate change in the State.	
National Marine Planning Framework (NMPF) 2021	Climate Change Policy 1: 'Proposals should demonstrate how they: ▪ avoid contribution to adverse changes to physical features of the coast; ▪ enhance, restore, or recreate habitats that provide a flood defence or carbon sequestration ecosystem services where possible. Where potential significant adverse impacts upon habitats that provide a flood defence or carbon sequestration ecosystem services are identified, these must be in order of preference and in accordance with legal requirements: a) avoided, b) minimised, c) mitigated, d) if it is not possible to mitigate significant adverse impacts, the reasons for proceeding must be set out. This policy should be included as part of statutory environmental assessments where such assessments are required.	The scope of this chapter covers all offshore aspects of the Dublin Array project extending up to MHWS. As per the conclusions of the CCR assessment, no significant adverse effects on the physical features of the coast, including those between MHWS and MLWS have been identified. In addition, rainfall data which accounts for predicted changes in the climate has been considered within the Water Chapter which assesses the potential impacts associated with the landfall and TJB which are located where the offshore export cables will meet the coastline. Where deemed necessary, mitigation measures have been suggested so that significant adverse residual effects to flood risk and erosion are prevented. ICCI effects have been assessed in this Chapter. ICCI effects indicate the extent to which climate change could exacerbate the effects of Dublin Array on other environmental receptors. This includes ecological receptors, such as habitats that provide flood defence or carbon sequestration ecosystem services. As per the conclusions of the ICCI assessment, climate change is not expected to exacerbate any of the effects identified by

Policy/legislation	Key provisions	How are the key provisions addressed
	Climate Change Policy 2: For the lifetime of the proposal, the following climate change matters must be demonstrated: ▪ estimation of generation of greenhouse gas emissions, both direct and indirect; ▪ measures to support reductions in greenhouse gas emissions where possible; ▪ impact of climate change effects upon the proposal from factors including but not limited to sea level rise, ocean acidification, changing weather patterns; ▪ measures incorporated to enable adaptation climate change effects; ▪ likely impact upon climate change adaptation measures adopted in the coastal area relevant to the proposal and/or adaptation measures adopted by adjacent activities; ▪ where impact upon climate change adaptation measures in the coastal area relevant to the proposal and/or adaptation measures adopted by adjacent activities is identified, these ▪ impacts must be in order of preference and in accordance with legal requirements: a) avoided, b) minimised, c) mitigated,	offshore ecology assessment chapters to any significant extent. Specific details of mitigation measures that will be implemented to prevent adverse impacts can be found in the Benthic Subtidal and Intertidal Ecology. The GHG Assessment concludes that the proposed development will support reductions in greenhouse gas emissions and therefore the project will directly support Ireland's 2030 targets for decarbonisation. This assessment accounts for the estimated greenhouse gas emissions, both direct and indirect, resulting from Dublin Array as well as the annual carbon savings that will be achieved through the clean energy delivered to the grid by the project. Further details on the GHG Assessment can be found in the GHG Assessment Report. This Chapter demonstrates that Dublin Array has considered, and is resilient to, the effects of climate change for the lifetime of the development. This assessment was based on best available information at the time of writing, including data collected from the World Bank Knowledge Portal, the UK Met Office and the UK Government Office of Science on projected changes to the following climate variables: temperature, rainfall, sea level rise, and sea pH levels. As indicated by the conclusions of the CCR assessment, all effects on the resilience of Dublin Array have been assessed to be of negligible or minor adverse significance.

Policy/legislation	Key provisions	How are the key provisions addressed
	d) if it is not possible to mitigate significant adverse impacts, the reasons for proceeding must be set out.	
Planning Policy and Development Control		
Dún Laoghaire-Rathdown County Council Development Plan 2022-2028	'Policy Objective CA1: National Climate Action Policy is a Policy Objective to support the implementation of International and National objectives on climate change including the 'Climate Action Plan 2021 Securing Our Future', the 'National Adaptation Framework' 2018, the 'National Energy and Climate Plan 2021-2030', and take account of the 'Climate Action and Low Carbon Development Act 2015, as amended', and subsequent updates, other relevant policy, guidelines and legislation, that support the climate action policies included in the County Development Plan.' 'Policy Objective CA2: Regional Climate Action states it is a Policy Objective to work closely with the Eastern Midland Regional Authority (EMRA) the Dublin Metropolitan Climate Action Regional Office (Dublin CARO), City of Dublin Energy Management Agency (Codema) and the Sustainable Energy Authority of Ireland (SEAI) to achieve the climate action policies and objectives set out in the Eastern and Midland Region Spatial and Economic Strategy (consistent with RPO 3.1, 36, 7.4, 7.30, 7.31, 7.32, 7.33, 7.35, 7.38, 7.40, 7.42, 7.43, 7.7 of the RSES).'	Dublin Array aligns with these policies by contributing to national, regional, and local climate action goals. It supports renewable energy targets outlined in CAPs and legislation, reduces carbon emissions, and promotes climate resilience.

Policy/legislation	Key provisions	How are the key provisions addressed
	'Policy Objective CA4: Dún Laoghaire-Rathdown County Council Climate Change Action Plan 2019-2024 (DLR CCAP) states it is a Policy Objective to implement and take account of the Dún Laoghaire-Rathdown County Council Climate Change Action Plan 2019 - 2024 (DLR CCAP), to take account of the 'Climate Action and Low Carbon Development Act 2015, as amended', and subsequent updates of both and to transition to a climate resilient low carbon County. (Consistent with SO8 of the NPF, RPO 7.32, 7.33 of the RSES).' 'Policy Objective CA10: Renewable Energy: It is a Policy Objective to support County, Regional, National and International initiatives and pilot schemes to encourage the development and use of renewable energy sources, including the SEAI Sustainable Energy Community initiatives, as a means of transitioning to a low carbon climate resilient County in line with national renewable energy targets.' 'Policy Objective CA11: Onshore and Offshore Wind Energy and Wave Energy: It is a Policy Objective to support in conjunction with other relevant agencies, wind energy initiatives, both onshore and offshore, wave energy, onshore grid connections and reinforcements to facilitate offshore renewable energy development when these are undertaken in an environmentally acceptable manner.'	
Dublin City Development Plan 2022-2028	Policy CA1 – National Climate Action Policy: To support the implementation of national objectives on	Dublin Array aligns with Policy CA1 by supporting national climate objectives like the Climate Action Plan

Policy/legislation	Key provisions	How are the key provisions addressed
	climate change including the 'Climate Action Plan 2021: Securing Our Future' (including any subsequent updates to or replacement thereof), the 'National Adaptation Framework' 2018 and the 'National Energy and Climate Plan for Ireland 2021-2030' and other relevant policy and legislation. Policy CA2 – Mitigation and Adaptation: To prioritise and implement measures to address climate change by way of both effective mitigation and adaptation responses in accordance with available guidance and best practice.	2021 and the National Energy and Climate Plan for Ireland 2021-2030. Additionally, it adheres to Policy CA2 by prioritising both mitigation and adaptation responses to climate change, contributing to emissions reduction and enhancing climate resilience.
Guidelines and technical standards		
Assessing Greenhouse Gas Emissions and Evaluating Their Significance' 2nd edition (IEMA, 2022)	The requirement to address climate change has resulted from the 2014 amendment to the EIA Directive. This document provides guidance when addressing GHG emissions assessment and mitigation within an EIA.	This chapter provides a baseline characterisation and assessment of climate change, including an assessment and evaluation of the significance of greenhouse gas emissions from the proposed development.
Climate Change Resilience and Adaption (IEMA, 2020)	This guidance provides a framework for the effective consideration of climate change resilience and adaptation within the EIA process.	This methodologies for the CCR assessment, detailed in section 18.4 are in line with this guidance.
Climate Change Performance Index (CCPI)	CCPI is an independent monitoring tool which tracks countries climate protection performance. It assesses individual countries based on climate policies, energy usage per capita, renewable energy implementation and GHG and ranks their performance in each category and overall. Ireland has ranked as the worst EU performer in the CCPI 2019.	The CCPI ranking has been considered and referenced within Section 18.6.

Policy/legislation	Key provisions	How are the key provisions addressed
Climate Action Network Europe Off Target Report 2018 (June 2018)	The June 2018 'Off Target Report' published by the CAN Europe which ranks EU countries ambition and progress in fighting climate change listed Ireland as the second worst performing EU member state in tackling climate change. It also states that Ireland is set to miss its 2020 climate (20% reduction in greenhouse gases) and renewable (40% increase in overall energy from renewable electricity sources) energy targets. Additionally, it was noted that Ireland is also off course for its 2030 emissions target.	The report findings have been considered within the climate change chapter.

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